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FEASIBILITY STUDY
FOR
DEFENSE REUTILIZATION AND MARKETING OFFICE
(SITE 6)

NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Contaminants of Concern
CTDEP	State of Connecticut Department of Environmental Protection
CTE	Central Tendency Exposure
CTO	Contract task order
CWA	Clean Water Act
DAF	Dilution-Attenuation Factor
DRMO	Defense Reutilization and Marketing Office
FFS	Focused Feasibility Study
FS	Feasibility Study
GCL	Geosynthetic Clay Liner
GRA	General Response Actions
HBL	Health Based Limit
HI	Hazard Index
ICR	Incremental Cancer Risks
IR	Installation Restoration
IRA	Interim Removal Action
MCL	Maximum Contaminant Levels
NPL	National Priorities List
NSB-NLON	Navy Submarine Base New London
O&M	Operation and Maintenance
OBDA	Overbank Disposal Area
OBDANE	Overbank Disposal Area, Northeast
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PRG	Preliminary Remedial Goal
RAO	Remedial Action Objectives
RI	Remedial Investigation
RME	Reasonable Maximum Exposure

ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SCS	United States Department of Agriculture Soil Conservation Service
SCWA	Southeastern Connecticut Water Authority
SSL	Soil Screening Levels
SWPC	Surface Water Protection Criteria
TBC	To be considered
TCLP	Toxicity Characteristic Leaching Procedure
TSD	Treatment, Storage, Disposal
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WPCA	Ledyard Water Pollution Control Authority

EXECUTIVE SUMMARY

PURPOSE AND OBJECTIVE OF REPORT

This Feasibility Study (FS) has been prepared for the Site 6 - Defense Reutilization and Marketing Office (DRMO) located at the Navy Submarine Base - New London (NSB-NLON), Connecticut. This report has been prepared by Brown & Root Environmental (B&R Environmental) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-90-D-1298, Contract Task Order (CTO) 267 for the U.S. Navy's Installation Restoration (IR) Program. This FS evaluates remedial alternatives for contaminated soil and groundwater at the DRMO.

SITE DESCRIPTION AND HISTORY

The DRMO is located adjacent to the Thames River in the northwestern section of NSB-NLON. From 1950 to 1969 the DRMO was used as a landfill and waste burning area. In 1995, as part of a Time Critical Removal Action, approximately 4,700 tons of contaminated soil were removed from the DRMO to be disposed of off site and an asphalt and geosynthetic clay (GCL) liner was placed over most of the site. Currently, the DRMO is used as a storage and collection facility for items to be sold during auctions and sales held periodically during the year.

SITE INVESTIGATIONS

Several investigations have been conducted at NSB-NLON to date. The relevant investigations at the DRMO include the Remedial Investigations (Phase I and II), the sampling conducted in 1993 as part of a Draft Focused Feasibility Study, and confirmation sampling conducted in 1995 as part of Time-Critical Removal Action.

NATURE AND EXTENT OF CONTAMINATION

Surface and subsurface soil, groundwater, and surface water were the most widely sampled media. Only one surface water sample was collected in the area of the DRMO. In addition, two pavement samples were collected from the scrap yard. Relatively high concentrations of multiple organic and inorganic chemicals were detected in the soil matrix at the DRMO. In spite of this fact, it does not appear that substantial impact on the groundwater has occurred to date and no COCs were retained for groundwater. In addition to the various organic chemicals detected in the soil, relatively high concentrations of lead still remain in the soil after the Time-Critical Removal Action was conducted.

RISK ASSESSMENT

A baseline human health risk assessment was conducted in the Phase II RI (B&R Environmental, March 1997) assuming that potential receptors (i.e., older child trespasser, construction worker, potential future residents, and full-time employees) might be exposed to the contaminated media at the site.

Although such a future land use scenario is extremely unlikely, the possibility of the DRMO site being used for residential purposes was considered for the determination of human health risks. This was done because the DRMO site constitutes riverfront real estate and that, since traditionally this kind of property has been highly desirable for residential development, such a future land use scenario cannot be completely ruled out.

Only under a reasonable maximum exposure scenario, wherein the receptors are assumed to be exposed to the maximum concentrations of contaminants, did the estimated cumulative incremental cancer risk for the future resident exceed the U.S. EPA's target risk range of 1E-6 to 1E-4. Most of the risk is attributable to ingestion of soil containing PAHs, PCBs, dioxins, arsenic, and beryllium, as well as dermal contact with PCBs and the inhalation of fugitive dust containing chromium. For all receptors considered, the cumulative non-carcinogenic risks (hazard indices) under a reasonable maximum exposure scenario exceeded the acceptable upper limit of 1.0. Under the central tendency exposure scenario wherein the receptors are assumed to be exposed to average concentrations of contaminants, non-carcinogenic hazard indices did not exceed the acceptable upper limit of 1.0 for any receptor. Most human health risk stems from potential ingestion of and dermal contact with soils contaminated with PCBs. Most other human health risk is attributable to exposure to antimony, cadmium, and to a lesser extent chromium, present in the DRMO soil. No significant human health risk was associated with exposure to groundwater.

Assessment of risk for potential ecological receptors (i.e., terrestrial vegetation, soil invertebrates, short-tailed shrew, and red-tailed hawk) that could potentially be exposed to the contaminated surface soil at the DRMO site indicated an unacceptable risk. The summation of the chemical specific hazard quotients for several inorganic compounds, 4,4'-DDT and 4,4'-DDD exceeded the acceptable Hazard Indices. However, the DRMO does not provide a suitable ecological habitat (paving, buildings, cap, etc.) and actual risks to ecological receptors are likely to be much less than those calculated for the area.

REMEDIAL ACTION OBJECTIVES AND ESTIMATED VOLUMES OF CONTAMINATED MEDIA

Based on the result of the risk assessment, the remedial action objectives for the site were derived for the protection of potential human and ecological receptors to soil contamination. Based on the risk assessment and surface water protection, groundwater has not been impacted at unacceptable levels by site contaminants. The following were identified as remedial action objectives:

- Prevent exposure (unacceptable risk) to receptors under either a current industrial or future, possible although unlikely, residential land use scenario either through institutional controls and/or removal/treatment/disposal.

- Prevent unacceptable risk to ecological receptors in the Thames River from potential migration of DRMO contaminants.

Soil preliminary remedial goals (PRGs) were determined for the DRMO based on the following criteria:

- Protection of human health
- Protection of ecological receptors
- Protection of surface water

Table ES-1 summarizes the preliminary remediation goals (PRGs) calculated for each of these criteria.

The estimated areas of soils containing contaminants exceeding the preliminary remediation goals listed in Table ES-1 are 11,230 square feet under the current industrial land use scenario and 107,780 square feet under the future residential land use scenario. The depth of detected soil contamination exceeding these goals is estimated to be within 6 to 8 feet from the surface under the current industrial land use scenario and between 3 and 10 feet from the surface under the future residential land use scenario. Total volumes of soil exceeding PRGs are estimated at approximately 3,150 cubic yards for the industrial land use scenario and 13,600 cubic yards for the residential land use scenario.

GENERAL RESPONSE ACTIONS

General response actions, or those generic remedial approaches that would be used alone or in combination with others as a response to the contamination at the site are as follows:

- No Action: This is a baseline approach that is used for comparing other approaches.

TABLE ES-1

DRMO FS
SUMMARY OF SOIL PRGs
NSB-NLON, GROTON, CONNECTICUT

MEDIA: SOIL COCs	LAND USE (1)			ARAR (2)
	Current Industrial Scenario	Future Residential Scenario		
	Human Health Risk PRG (mg/kg)	Human Health Risk PRG (mg/kg)	Ecological Risk PRG (mg/kg)	Alternate Pollutant Mobility to be Protective of the Surface Water (mg/kg)
Benzoic acid				8.4*
Benzo(a)anthracene		2*		27
Benzo(a)pyrene		0.2*		28
Benzo(b)fluoranthene		2*		75
Dibenzo(a,h)anthracene		0.2*		
Indeno(1,2,3-cd)pyrene		2		
Hexachlorobiphenyl		0.35*		0.38
Aroclors (1254+1260)	6*	0.35*		0.38
Dioxins		0.00059*		
4,4'-DDT			5*	
4,4'-DDD			5	0.08*
Arsenic		0.96*		
Aluminum			50*	
Antimony			5*	
Beryllium		0.35		
Barium				160*
Boron			0.5*	
Cadmium	84*	67	3*	88
Chromium		11	0.4*	209
Cobalt			20*	
Copper			50*	
Lead			50*	
Mercury			0.128*	
Silver			2*	6.12
Thallium			1*	
Vanadium			2*	
Zinc			50*	13200

TABLE ES-1

DRMO FS
SUMMARY OF SOIL PRGs
NSB-NLON, GROTON, CONNECTICUT

NOTES:

1 Risk-based PRGs for chemicals contributing at least 1E-06 to a cumulative cancer risk of greater than 1E-04 or a major portion of a noncancer hazard index of greater than 1.0.

2 Calculated value using Federal or State water quality standards (see Table 2-5).

* Lowest value selected as appropriate PRG for the land use.

- Institutional Controls: These are administrative actions that would control the future use of the site and monitor future effects.

- Containment: These are technologies to minimize access to contaminated media by providing physical barriers to potential receptors or ways to reduce contaminant migration in the environment.

- Removal: These are technologies to remove (i.e., excavate or dredge) the contaminated media from the site, followed by treatment or disposal.

- Treatment: These are in-situ or ex-situ technologies to remove the contaminants or render them harmless by physical, chemical, biological or thermal treatment of the contaminated media.

- Disposal: These are methods to dispose of the contaminated media after excavation or treatment residues (contaminated byproducts) in an environmentally safe manner.

SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

All possible technologies and process options that are relevant to the above listed general response actions were screened for effectiveness, implementability, and cost. Those technologies that were determined to be ineffective or difficult to implement were eliminated from further consideration.

All of the technologies and process options that were retained for soil are summarized below:

General Response Action	Remedial Technology	Process Options
No Action	None	None
Institutional Controls	Access/Use Restrictions	Active: Physical Barriers
		Passive: Land Use Restrictions
	Monitoring	Groundwater/Surface Water Monitoring
Containment	Surface Water Controls	Revegetation/Diversion/Collection
	Capping	Repair/Restoration of Existing Cap
Removal	Excavation	Excavation/Dredging
Ex-Situ Treatment	Physical/Chemical	Chemical Fixation-Solidification
	Thermal	Thermal Desorption
		Incineration
Disposal	Offsite Disposal	RCRA Hazardous Waste TSD Facility
		Solid Waste Disposal Facility

With regard to treatment of soil, the specific process option selected is based on the type of contamination present. It is anticipated that separate process options would be required for the treatment of inorganic and organic contaminants. Although thermal desorption and incineration would both be effective for the removal of the organic contaminants present in the DRMO soil, thermal desorption could achieve this at a significantly lower cost than incineration. Therefore, thermal desorption was selected as the representative process for thermal treatment in lieu of incineration. Chemical fixation-solidification was selected to remediate inorganic contaminant through immobilization.

DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives were assembled using technologies and process option that were selected to meet the remedial action objectives. The following remedial alternatives were assembled:

- **Alternative 1: No Action**. The existing cap would stay in place but would no longer be maintained. Retained as a baseline for comparison with other alternatives.

- **Alternative 2: Institutional Controls and Monitoring**. Institutional controls would include maintenance of the existing cap and implementation of site access limitations and land use restrictions to eliminate or reduce pathways of exposure to contaminants. Monitoring would include long-term sampling and analysis of groundwater and, if necessary, of surface water and river sediment to determine if contaminants are migrating from the soil. Monitoring would also include the performance of 5-year site reviews for a period of 30 years.

- **Alternative 3: "Hot Spots" Excavation, Offsite Disposal, Institutional Controls, and Monitoring**. This alternative would involve excavating soil contaminated above industrial land use preliminary remediation goals, repair and restoration of the existing cap, and offsite disposal of the excavated soil at a RCRA hazardous waste TSD facility. Prior to offsite disposal, free water would be removed from wet excavated soil by onsite dewatering and the drainage water would be treated prior to discharge to the Thames River. Institutional controls Prior to and monitoring would be identical to those for Alternative 2.

- **Alternative 4: Excavation, Onsite Treatment (thermal desorption & fixation-solidification), and Offsite Disposal**. This alternative would consist of excavating all soil contaminated above residential land use, ecological, and surface water protection preliminary remediation goals. The excavated soil would be treated on site using a combination of thermal desorption and chemical fixation-solidification.

Thermal desorption would remove and destroy organic COCs from excavated soil and, as required, chemical fixation-solidification would then immobilize inorganic COCs in the thermally treated soil. Prior to thermal desorption, free water would be removed from wet excavated soil by onsite dewatering and the drainage water would be treated prior to discharge to the Thames River. Following treatment, the soil would be transported off site for disposal at a solid waste disposal facility.

DETAILED ANALYSIS OF ALTERNATIVES

The remedial alternatives were analyzed in detail using seven of the nine criteria provided in the National Contingency Plan (finalized in Federal Register, Volume 55, Number 46, March 8, 1990) and the Comprehensive Environmental Response, Compensation and Liability Act guidance from the Office of Solid Waste and Emergency Response, Directive 9355.3-01, October 1988. The seven criteria are as follows:

- Overall Protection of Human Health and the Environment
- Compliance with Applicable and Relevant and Appropriate Requirements and To Be Considered guidance
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility or Volume through Treatment
- Short-term Effectiveness
- Implementability
- Cost

Two other criteria, State and Community Acceptance were not evaluated in this report. They will be evaluated after regulatory and public comments are available.

COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives were compared to each other using the same criteria that were used for detailed analysis. The following is a summary of the comparison:

- **Overall Protection of Human Health and Environment**. Alternative 1 would provide very limited protection of human health and the environment. Although the existing cap would continue to reduce risk from direct exposure of human and ecological receptors to contaminated soil, this cap would not be maintained and exposure could occur as it deteriorates. Also no monitoring would be performed to detect potential migration of contaminants from soil which could impact ecological receptors in the Thames River. Alternative 2 would be protective of human health and the environment through maintenance of the existing cap, limitation of site access, land use restrictions, and monitoring. Maintenance of the existing cap and limitation of site access would prevent unacceptable human health and ecological risk from exposure to contaminated soil under the current industrial land use scenario. Land use restrictions would prevent residential development which could result in unacceptable risk to human and ecological receptors from direct exposure to contaminated soil. Monitoring would detect potential migration of contaminants from soil which could impact ecological receptors in the Thames River. Alternative 3 would provide better protection of human health and the environment as it would include the same protective components as Alternative 2 plus excavation and offsite disposal of soil "hot spots" of contaminated soil which would eliminate the potential source of unacceptable human health risk under the current industrial land use scenario and remove the worse source(s) of potential migration of contaminants from soil which could impact ecological receptors in the Thames River. Alternative 4 would provide the best protection of human health and the environment. Excavation, onsite treatment, and offsite disposal of all soil contaminated above residential land use, ecological, and surface water protection preliminary remediation goals would eliminate unacceptable risk to human and ecological receptors from exposure to soil under all scenarios and remove all sources of potential migration of contaminants from soil which could impact ecological receptors in the Thames River

- **Compliance with Applicable and Relevant and Appropriate Requirements and To Be Considered guidance**. Alternative 1 would not comply with chemical-specific and location-specific ARARs and TBCs. There are no action-specific ARARs and TBCs for Alternative 1. Alternatives 2, 3, and 4 would comply with all chemical-specific, location-specific, and action-specific ARARs and TBCs

- **Long-term Effectiveness and Permanence**. Alternative 1 would have limited effectiveness because the existing cap would minimize the risk from exposure to contaminated soil but no permanence because that cap would not be maintained and no monitoring would be performed. Alternatives 2 would be long-term effective and permanent. Maintenance of the existing cap would effectively prevent unacceptable risk to workers and trespassers from direct exposure to soil, site access limitation would effectively minimize the number of trespassers, land use restrictions would effectively prevent residential development which could result in unacceptable human health and ecological risks, and monitoring would be effective to verify the continued absence of any contaminant migration from the soil which could adversely impact ecological receptors in the Thames River. Alternative 3 would provide somewhat better long-term effectiveness and permanence since, in addition to the same institutional controls and monitoring components as Alternative 2, the main source of potential human health risk under the current industrial scenario would also be permanently eliminated with the excavation and offsite disposal of soil "hot spots". Such removal would also effectively lower the risk of contaminant migration from the soil which could adversely impact ecological receptors in the Thames River. Alternative 4 would provide the best long-term effectiveness and permanence because it would effectively prevent unacceptable human health and ecological risk under all scenarios, including possible future residential land use, through excavation, onsite treatment, and offsite disposal of all soil contaminated above residential land use, ecological, and surface water protection preliminary remediation goals.

- **Reduction of Toxicity, Mobility, or Volume through Treatment**. Alternatives 1 and 2 would not offer any reduction of contaminant toxicity, mobility, or volume through treatment. Some reduction in contaminant toxicity and volume might occur for both alternatives through natural attenuation processes but the extent of this reduction would only be evaluated by the monitoring performed as part of Alternative 2. Alternative 2 would also provide a slight reduction in contaminant mobility since maintenance of the existing cap would minimize surface infiltration through contaminated soil in the unsaturated zone. Alternative 3 would offer a minimal, but fully-irreversible, reduction in contaminant toxicity, mobility, or volume through onsite treatment of the drainage water from wet soil dewatering operations. However, Alternative 3 would also achieve considerable reduction in contaminant toxicity, mobility, or volume by non-treatment means through excavation and offsite disposal of "hot spots" of contaminated soil. Alternative 4 would achieve an essentially complete and fully-irreversible reduction in the toxicity, mobility, and volume of organic contaminants through onsite thermal desorption. Alternative 4 would also achieve an essentially complete and irreversible reduction in the mobility of inorganic contaminants through onsite chemical fixation-solidification. However, this later treatment process would likely result in a 10 to 15 percent increase in the volume of treated soil.

- **Short-term Effectiveness**. Alternative 1 would have no short-term effectiveness concerns since no remedial action would take place. Alternative 1 would never achieve the remedial action objectives. Alternative 2 would have minor short-term effectiveness concerns resulting from potential exposure of site worker to contaminated soil during maintenance of the existing cap and fence and during the installation of new monitoring wells and the maintenance and sampling of new and existing monitoring wells. Alternative 2 would have no short-term effectiveness concerns resulting from adverse impact to the surrounding community and environment. Alternative 2 would immediately achieve the remedial action objectives but continued achievement of the remedial action objective for protection of the ecological receptors in the Thames River would have to be regularly verified through monitoring. Alternatives 3 and 4 would have significant short-term effectiveness concerns resulting from potential exposure of site worker to contaminated soil and groundwater and fugitive dust emissions during onsite excavation and dewatering activities. Alternative 4 would have an added short-term effectiveness concern because of the potential for exposure of site workers to contaminated soil and offgas emissions during onsite treatment activities. Alternatives 3 and 4 would also have some short-term effectiveness concerns due to potential adverse impact to the surrounding community and the environment resulting from fugitive dust and offgas emissions and spillage of contaminated material during transportation. All of the above-mentioned potential for exposure to site workers would be effectively minimized through wearing of appropriate personal protection equipment, implementation of engineering controls (e.g., dust suppression, offgas treatment), and compliance with applicable OSHA regulations and site-specific health and safety procedures. All of the above-mentioned potential adverse impact to the surrounding community and environment would be adequately minimized through the implementation of engineered controls (e.g., dust suppression, offgas treatment, sedimentation and erosion controls, and spill prevention programs). Alternatives 3 and 4 would meet the remedial action objectives within 5 and 7 months, respectively. For Alternative 3, continued achievement of the remedial action objective for protection of the ecological receptors in the Thames River would have to be regularly verified through monitoring.

- **Implementability**. Alternative 1 would be easiest to implement since there would not be anything to implement. The institutional controls and monitoring components of Alternative 2 would be simple to implement as long as the DRMO remains under the Navy's control but would require incorporation of special provisions in property transfer document if the site was ever to pass to private ownership. Alternative 3 would be harder to implement than Alternative 2 because, in addition to institutional controls and monitoring, it would include excavation and offsite disposal of contaminated soil "hot spots". Excavation would be difficult to implement because extensive shoring would be required for any excavation deeper than 3 feet bgs and accumulation of groundwater in these deeper excavated could not be practically prevented because of the high permeability of the soil and the proximity of the Thames River. However, excavation could still be performed with the use of readily available construction equipment. Offsite disposal would be easily implementable since a number of RCRA hazardous waste disposal facilities would be capable of receiving the excavated soil. Alternative 4 would be most difficult to implement because, although no institutional controls and monitoring would be needed, it would be subject to the same difficulties regarding excavation as Alternative 3 and, in addition, it would require onsite treatment of the excavated soil. While many qualified chemical fixation-solidification contractors would be available, the number of thermal desorption contractors with PCB removal experience would be limited. Administratively; Alternatives 2 and 3 would require the implementation of deed restrictions; Alternatives 3 would have to comply with RCRA regulations for the offsite disposal of excavated soil; the onsite operations of Alternatives 3 and 4 would need to meet the substantive requirements of a RCRA hazardous waste treatment, storage, and disposal facility; Alternatives 3 and 4 would also require coordination with State agencies to determine acceptable surface water discharge criteria for the treated drainage water; and Alternative 4 would require additional coordination with State agencies to determine acceptable treatment criteria for the thermal desorption offgas.

- **Cost**. The capital, operation and maintenance, and net present worth of the alternatives were estimated to be as follows:

Alternative	Capital ($)	Total O&M ($/30 years)	NPW ($/30 years)
1	0	0	0
2	90,814	617,580	708,394
3	4,363,156	617,580	4,980,736
4	16,128,927	0	16,128,927

The total operating and maintenance costs shown for Alternatives 2 and 3 are for groundwater monitoring only and include a $20,000 lump sum amount at the end of the third year of monitoring for final site reviews and report preparation. The 30-year net present worth costs for Alternatives 2 and 3 also include the performance of 5-year reviews for 30 years.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF REPORT

This Feasibility Study (FS) report has been prepared by Brown & Root Environmental (B&R Environmental), under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-90-D-1298, Contract Task Order (CTO) 267 for the U.S. Navy's Installation Restoration (IR) Program. This FS has been prepared to provide remedial action alternatives for the Defense Reutilization and Marketing Office (DRMO) located at the Navy Submarine Base - New London (NSB-NLON), Connecticut. The scope of the report is limited to the contaminated soil and groundwater and their effects on the Thames River adjacent to the DRMO.

1.2 BASE BACKGROUND

This section presents general background information. This information consists of a summary of the facility description, land uses, topography, climate, surface water hydrology, ecology and site investigations.

1.2.1 Base Description

NSB-NLON is located in southeastern Connecticut in the towns of Ledyard and Groton. Figure 1-1 depicts the vicinity of the facility. It encompasses approximately 576 acres on the east bank of the Thames River, approximately 6 miles north of Long Island Sound. The site is bounded to the east by Connecticut Route 12, to the south by Crystal Lake Road, and to the west by the Thames River. The northern border is a low ridge that trends approximately east-southeast from the Thames River to Baldwin Hill.

NSB-NLON currently provides base command for naval submarine activities in the Atlantic Ocean. It also provides housing for Navy personnel and their families and supports submarine training facilities, military offices, medical facilities, and facilities for submarine maintenance, repair, and overhaul.

Land use adjacent to the base is residential and commercial. Residential development along Military Highway, Sleepy Hollow, Long Cove Road and Pinelock Drive borders the site to the north and extends north into the Gales Ferry section of Ledyard. Property along Route 12 to the east of the base consists of widely-spaced private homes and open, wooded land. Development is mixed commercial and residential farther south on Route 12. It includes a church, automobile sales and repair facilities, convenience stores, restaurants, and a gas station. Private residences, an automobile service station, and a dry cleaners are

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LOCATION MAP
NSB - NEW LONDON
GROTON, CONNECTICUT

2000 0 2000 4000 Feet

FIGURE 1-1

Brown & Root Environmental

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located along the south side of Crystal Lake Road. Housing for Navy personnel exists farther south of Crystal Lake Road.

1.2.2 Base History

In 1867, the State of Connecticut donated a 112-acre parcel of land on the east bank of the Thames River to the Navy. The Navy did not use the property until 1868 when it officially designated the property a Navy Yard. The site was used to moor small craft and obsolete warships and served as a coaling station for the Atlantic fleet. The Department of the Navy designated the site a Submarine Base in 1916. During World War I, facilities at the base were extensively expanded; 6 piers and 81 buildings were added. In 1917, a submarine school was established, and in 1918 the Submarine Medical Center was founded.

NSB-NLON underwent another period of growth during World War II. Between 1935 and 1945 the Navy built in excess of 180 buildings and acquired land adjacent to NSB-NLON. The base expanded from 112 acres to 497 acres. The growth of NSB-NLON continued after World War II. In 1946 the Medical Research Laboratory was established.

In 1968 the Submarine School was changed from the status of an activity to a command and became the largest tenant on the base. The Naval Submarine Support Facility was established in 1974, and the Naval Undersea Medical Institute was established the following year. Presently, NSB-NLON consists of over 300 buildings on 576 acres of land.

On August 30, 1990 NSB-NLON was placed on the National Priorities List (NPL) by the United States Environmental Protection Agency (U.S. EPA) pursuant to CERCLA and the Superfund Amendments and Reauthorization Act (SARA) of 1986. The NPL is a list of uncontrolled or abandoned hazardous waste sites identified by U.S. EPA requiring priority remedial actions.

1.2.3 Base Topography and Surface Features

Four bedrock highs form the topographic upland areas at the NSB-NLON and in the surrounding area. To the east of the facility, Baldwin Hill reaches an elevation of 245 feet above mean sea level (msl). In the northern, central, and southern portions of the facility, the bedrock highs reach elevations that also exceed 200 feet above msl. These bedrock highs have a northwest-southeast trend, which is consistent with the regional strike and other bedrock features in the region (USGS, 1967). The western edge of the facility borders the Thames River.

At NSB-NLON, the bedrock highs slope downward to two small, west-trending valleys. Bedrock outcrops are prevalent along steep topographic slopes. In addition to the large bedrock highs there are several small sub-ridges, which are visible as bedrock outcrops at the facility. Two primary sub-ridges include one east of the Defense Reutilization and Marketing Office (DRMO) and one northeast of the Goss Cove Landfill.

The two valleys between the bedrock highs are characterized as wetlands and poorly-drained stream valleys. The valleys slope gently to the Thames River. In the northern valley, the ground elevation ranges from approximately 80 feet in the eastern portion to near sea-level along the Thames River. The eastern (upper) portion of this valley contains the Area A Wetland, which drains through an earthen dike into the Area A Downstream/OBDA. The ground surface drops steeply across the dike to thirty to forty feet below the elevation of the wetland. Historically, the ground surface decreased more uniformly toward the Thames River (USGS, 1960). The steep drop in the ground elevation was caused by construction of the dike and subsequent filling of the valley with dredge spoils from the Thames River.

In the southern valley, the ground elevation slopes mildly from approximately 50 feet in the eastern portion to near sea-level along the Thames River. Historically, there was a topographic depression at the former Crystal Lake between Tang and Crystal Lake Road. The topographic depression has been filled. Filling has also occurred along the Thames River, and the historical shoreline has been extended.

Currently NSB-NLON consists of over 300 buildings. The density of buildings is high along the central bedrock high, in the southern valley, and along the Thames River. In the northern valley, there are streams, a wetland, and a golf course. The northern bedrock high is not highly developed, except along the southern face at the Area A Weapons Center and the Torpedo Shops. The top and northern faces of the northern ridge are wooded, undeveloped areas.

1.2.4 Climate and Meteorology

Southeastern Connecticut is in the northern temperate zone. The climate is influenced by cold and dry continental-polar air during the winter and warm, humid maritime air during the summer. During the winter, this region is located near the Polar Front boundary, which separates regions of cold, dry continental-polar air and warm, moist tropical air. The area experiences extensive winter storm activity and variable daily temperatures. During the summer, the Polar Front boundary is located further north, and the region experiences warm weather.

The prevailing winds are southwesterly from the continent and bring most of the weather into the region. Land-sea breezes are also present in the region. Occasional storms moving northward along the mid-Atlantic coast provide strong northeasterly winds and storms, commonly known as "coastals" or "northeasters." Storms are extensive with heavy rainfall and are occasionally of hurricane intensity. Dense fog is frequently advected onshore from the Atlantic Ocean from the spring through the fall (NOAA, March 1988).

The average annual temperature at New London, Connecticut, is approximately 50°F. Average monthly temperatures vary from 58-72°F in July and August to 23-30°F in January and February. The average wind speed is approximately 10 miles per hour. Precipitation ranges from 32 to 65 inches of water per year and averages approximately 44 inches per year as measured at New London over an 81-year period. The greatest amount of precipitation occurs in the months of March and August and the least in June and September. Evaporation averages approximately 23 inches per year (Naval Facilities Engineering Command, 1988).

1.2.5 Base Surface Water Hydrology and Quality

This section summarizes available information regarding surface water hydrology and surface water quality in the vicinity of NSB-NLON. The primary focus of this section is the Thames River, which is the major receiving surface water body proximate to the facility.

1.2.5.1 Base Surface Water Hydrology

NSB-NLON is located on the east bank of the Thames River within the Thames River Watershed. 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 in the City of Norwich Harbor, at the confluence of the Shetucket and Yantic Rivers, and discharges into Long Island Sound approximately six miles south of NSB-NLON. The Thames River estuary extends north from Long Island Sound to Norwich (16 miles). 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 mean sea level between Long Island Sound and the Subase and about 25 feet farther upstream. At NSB-NLON, the width of the channel is approximately 600 to 900 feet. Outside of the channel, depths are relatively shallow (2 to 10 feet). Upstream of NSB-NLON there are shallow coves that empty into the river. Most of the coves are at least partially cut off from the river by a rail bed.

The two rivers that join to form the Thames River are the Shetucket and Yantic Rivers. The Yantic River has a drainage basin of 88 square miles. Average, minimum, and maximum flows in the Yantic have been reported at 170, 3.5, and 13,400 cubic feet per second (ft^3/s), respectively. The Shetucket, 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. According to an engineering study (LMS Engineers, 1992), other sources of inflow to the Thames River are 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, as well as combined sewer overflows in Norwich, industrial discharges, and several small streams.

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. The river is tidally influenced with a mean tidal range at the New London State Pier of 2.6 feet (LMS Engineers, 1992). A freshwater flushing time of 0.5 to 2 days from Norwich to Long Island Sound has been estimated (Welsh and Stewart, 1984). In comparison, a bottom water flushing time of greater than 19 days was estimated. The average freshwater flow discharging to Long Island Sound from the Thames River has been estimated as 222 million cubic feet per day (Soderberg and Bruno, 1971). However, stream flow in the Thames River is small in comparison to intertidal volume and exchange (Bohlen and Tramontano, 1977). 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.

As previously discussed, 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. Salinity measurements taken in the Thames River adjacent to NSB-NLON in May of 1995 for the Supplemental Ecological Investigation confirmed the constant 30 parts per thousand salinity level. The salinity of the water at the surface of the river is more variable, with the salinity ranging from 28 parts per thousand at the mouth of the river to 2 parts per thousand at the upstream end of the estuary at Norwich.

Surface water from NSB-NLON drains west toward the Thames River via streams and storm sewers. The offsite portion of these watersheds includes a sparsely developed residential area located to the east along Route 12 and an area with limited commercial development located north of the intersection of Crystal Lake Road and Route 12.

Significant onsite drainage features include several streams (perennial and intermittent), ponds, Rock Lake, North Lake, and a large wetland (Area A Wetland). The majority of these surface water features are located in the north central section of NSB-NLON. Six streams, three ponds, and North Lake are included in the Area A Downstream/OBDA Site. These water courses drain to the Thames River through discharge points located at the DRMO and the Lower Subase north of Pier 33. The water courses in the southern portion of NSB-NLON drain to the Thames River through discharge points located at the Goss Cove Landfill.

1.2.5.2 Surface Water Quality and Designation

The State of Connecticut Department of Environmental Protection (CTDEP) has classified the Thames River quality as SC/SB. This classification designates the water for marine fish, shellfish, and wildlife habitat, certain aquaculture operations, recreational uses, industrial and other legitimate use, and indicates that the waters presently are not meeting water quality criteria or not supporting one or more designated uses as a result of pollution (CTDEP, 1992).

The quality of the surface water in the Thames River has been measured by the USGS upstream of NSB-NLON at Mohegan, Connecticut (USGS, 1993). Many depth-specific water quality parameters have been measured by the USGS including pH, dissolved oxygen, hardness as $CaCO_3$, and dissolved metals (e.g., iron, manganese, and lead).

Parameters such as pH, dissolved oxygen and total hardness varied depending on the time of year when the sample was collected and the depth from which it was collected. The pH of shallow surface water (1 foot) ranged from 6.3 (November 16, 1990) to 8.5 (July 9, 1991), while the pH of deep surface water (20 feet) ranged from 6.5 (November 16, 1990) to 7.9 (May 8, 1991). Dissolved oxygen in shallow surface water of the Thames River ranged from 13.2 milligrams per liter (mg/L) (January 10, 1991) to 8.7 mg/L (September 9, 1991) and for deep surface water, it ranged from 8.8 mg/L (January 10, 1991) to 1.7 mg/L (July 9, 1991). The total hardness of shallow surface water ranged from 340 mg/L (May 8, 1991) to 1,000 mg/L (July 9, 1991), while the total hardness of deep surface water ranged from 5,000 mg/L (November 16, 1990) to 2,300 mg/L (January 10, 1991).

Concentrations of dissolved metals in the surface water of the Thames River remained relatively constant over the sampling period (i.e., November 16, 1990; January 10, 1991; May 8, 1991; and July 9, 1991), but varied with depth. The average concentration of dissolved iron in shallow surface water was 84 micrograms per liter (µg/L) and in deep surface water was 25 µg/L. Average dissolved manganese concentrations ranged from 28 µg/L (shallow surface water) to 61 µg/L (deep surface water). The average concentration of dissolved lead in shallow surface water was 7.1 µg/L. This average is skewed due to a single high detection (27 µg/L) measured on July 9, 1991. In deep surface water, lead was not detected above method detection limits; therefore, an average was not calculated.

1.2.6 General Soil Characteristics

The United States Department of Agriculture Soil Conservation Service (SCS) has mapped the soils of NSB-NLON (SCS, 1983). According to the SCS report, soils at NSB-NLON have a moderate to moderately high permeability. Available water capacity is moderate to low. The soils are well drained and runoff is rapid. The pH of the soils indicate that they are strongly to moderately acidic, and the erosion hazard is severe.

Native soils across the facility consist of a dark, fine, sandy loam (Hollis and Charlton soils). Stones, boulders, and bedrock outcrops are prevalent on hills and ridges (the Hollis-Charlton-Rock Complex). The Hinkley Loam has been identified in the far northwestern portion of the facility. The soil is associated with stream terraces and outwash plains and consists of a dark, gravely/sandy loam. Native materials along the Thames River were most likely of this type.

Altered soils at NSB-NLON have been classified as either Urdothents-Urban land or Urban land. The Urdothents-Urban land is defined as excessively to moderately drained soils that have been disturbed by cutting and filling. This soil type has been mapped in the northern portion of NSB-NLON in the Area A Downstream/OBDA and along the Thames River. Urban land is defined as areas where more than 85 percent of the surface is covered by streets, parking lots, and buildings. Urban land has been mapped in the southern portion of NSB-NLON and along the Thames River.

1.2.7 Base Geology

NSB-NLON is situated in the Eastern Uplands region of Connecticut. The area has irregular hills of exposed bedrock and poorly drained, uneven valleys. The bedrock consists of metamorphosed rocks of sedimentary and igneous origin. The bedrock has been faulted and folded. A major east-west trending fault (The Honey Hill Fault) is located approximately 6 miles north of NSB-NLON. The fault does not intersect the facility.

According to the bedrock map (USGS, 1967), the NSB-NLON facility is underlain by the bedrock of five different formations: Alaskite Gneiss, Granitic Gneiss, Mamacoke Formation, Plainfield Formation, and Westerly Granite. The Alaskite Gneiss and Granitic Gneiss are orange-pink to light gray, medium-grained granitic gneisses. The Mamacoke Formation is a light to dark gray, medium-grained biotite-quartz-feldspar gneiss. The Plainfield Formation is a dark green hornblende-biotite-quartz-plagioclase gneiss. The Westerly Granite consists of gray, fine- to medium-grained equigranular granite.

Most of the surficial deposits in the area are unconsolidated glacial materials that were deposited during the Pleistocene Age. There are two types of glacial deposits at the facility, stratified drift and glacial till. Stratified drift consists of sorted silt, sand, and gravel that were deposited by meltwater streams. Stratified drift is located on terraces of the Thames River and is mapped along the western portion of the facility (USGS, 1960). Glacial till consists of a dense, heterogeneous mixture of clay, silt, sand, and rock fragments as large as boulders. Glacial till is exposed on most of the bedrock highs and most likely underlies outwash materials in the valleys. The thickness varies considerably but averages less than 10 feet.

The remainder of the surficial deposits are the product of post-glacial river/floodplain processes and manmade modifications. Quaternary alluvium that consists of sand, silt, and gravel has been mapped in the area of the Area A Wetland (USGS, 1960). Artificial and natural fill are prevalent at the sites under investigation.

1.2.7.1 Bedrock Surface and Structure

The eastern edge of the facility is bordered by a bedrock high known as Baldwin Hill. The bedrock along this hill slopes toward the facility. There are three bedrock highs along the northern, central, and southern portions of the facility. At higher elevations (i.e., greater than 120 feet) these hills mimic the topographic surface.

In the two nearly east-west trending valleys between the bedrock highs, the bedrock surface continues to decrease along slopes similar to the hills whereas the topographic surface flattens. In the northern valley, the bedrock surface decreases to a general elevation of 30 feet below surface. The overburden thickness is typically 20 to 30 feet; however, it is thicker in the eastern portion of the valley in the vicinity of the Area A Wetland. There are three oblong-shaped bedrock highs that protrude within the valley. On these hills, the depth to bedrock is less than 10 feet. The southern valley is broader, and the bedrock elevation decreases to below mean sea level, and the overburden thickens to greater than 50 feet.

Along the Thames River, the bedrock surface decreases to elevations of 66 and 82 feet below msl. These elevations are below the bottom of the Thames River, which has an approximate depth of 40 feet.

Of the five different types of bedrock, only the biotite-quartz-feldspar gneiss of the Mamacoke Formation and the Granitic Gneiss were identified during drilling, as documented in the boring logs for site-specific investigations. The Mamacoke Formation was identified at the CBU Drum Storage Area, Area A Landfill, Area A Downstream Watercourses, Rubble Fill Area at Bunker A86, OBDA, Torpedo Shops, OBDANE, Spent Acid Storage and Disposal Area, and Goss Cove Landfill. The Granitic Gneiss was identified at the Area A Weapons Center. Both formations were identified within the Area A Wetland and the DRMO. The bedrock surface was not encountered at the Lower Subase.

1.2.8 Base Hydrogeology

This section provides a summary of hydrogeologic conditions at NSB-NLON. This section includes brief discussions of groundwater quality and designations, aquifer characteristics, and groundwater flow.

1.2.8.1 Groundwater Quality

For the State of Connecticut, the USGS National Water Summary (USGS, 1986) reports that "...groundwater beneath more than 90 percent of the land in the state is considered to be suitable for drinking without treatment...". Saltwater intrusion impacts groundwater in coastal areas. Other points of interest are that groundwater is hard to very hard in 70 percent of the wells in the state's carbonate rock aquifer, 40 percent of the wells in the state's sedimentary rock aquifer, and 15 percent of the wells in the stratified drift and crystalline bedrock aquifers. NSB-NLON can be characterized as being located in the stratified drift and crystalline bedrock aquifers of the state. The report also states that "large concentrations of iron (as large as 40,000 µg/L) and manganese (as large as 14,000 µg/L) are a common natural groundwater-quality problem in Connecticut."

There are several well water users in the vicinity of NSB-NLON. These include the Groton Water Department, the Southeastern Connecticut Water Authority (SCWA), the town of Ledyard, and residences adjacent to the base. The Groton Water Department supplies potable water to NSB-NLON. The primary source of the Groton water supply is reservoirs which are supplemented with wells. The water supplies are located within the Poquonock River Watershed, located east of NSB-NLON, which is not within the NSB-NLON watershed.

1.2.8.2 CTDEP Groundwater Classifications

The groundwater beneath the northern portion of NSB-NLON is classified by CTDEP as GA. The GA classification signifies groundwaters presumed suitable for direct human consumption without the need for treatment. Sites included on the north portion of NSB-NLON include the DRMO, Area A Landfill, Area A

Wetland, Area A Weapons Center, CBU Drum Storage Area, Rubble Fill Area at Bunker A86, Torpedo Shops, OBDA, Area A Downstream Watercourses, and OBDANE.

The Navy applied on August 12, 1996 to the State of Connecticut for reclassification of the groundwater at NSB-NLON. The Navy will attempt to have all groundwater at NSB-NLON reclassified as GB, which is the designation for lower quality (i.e., industrial) uses. The CTDEP stated in a letter dated October 21, 1996, that the application appears to meet the criteria pending the results of a public hearing. A public hearing was conducted on December 13, 1996 and, as a result, on March 5, 1997, CTDEP reclassified groundwater as GB for most areas of NSB-NLON, including the DRMO site.

1.2.8.3 Local Background Groundwater Quality

SCWA uses groundwater to provide potable water to residents in areas north, east, and northwest of NSB-NLON. Water quality data collected in 1991 and 1994 from 16 SCWA divisions were obtained from the water authority. Barium, sodium, chloride, fluoride, sulfate, nitrates and nitrites, were detected in the groundwater. Iron and manganese were not included in the analysis.

The Town of Ledyard also uses groundwater to provide potable water to its residents. The Ledyard Water Pollution Control Authority (WPCA) monitors groundwater constituents. Concentrations of iron and manganese measured in Well #1 in the Highland Well Field were obtained by NSB-NLON from the WPCA. This well is approximately 6 miles northeast of NSB-NLON. The data obtained included 7 sampling rounds, all from July and August of 1995. The concentrations of iron ranged from 2,170 µg/L to 2,780 µg/L. The concentrations of manganese ranged from 1,100 µg/L to 1,400 µg/L. The analytical results did not indicate whether they were total or dissolved concentrations.

Homes on Route 12 near the northeast portion of the site have private drinking water wells, as do homes north of NSB-NLON on Sleepy Hollow Road, Long Cove Road, and Military Highway. The quality of the groundwater in these areas was measured by Atlantic and is summarized in the Off-site Residential Well Water Data Evaluation Report (Atlantic, July 1994). Manganese concentrations measured in these residential wells ranged from less than 0.7 to 2,130 µg/L, while iron concentrations ranged from less than 4.8 to 21,800 µg/L. Two trailer parks near the site have wells classified as public water supply wells. The Colonel Ledyard Mobile Home Park, located on Sleepy Hollow Road adjacent to the North Gate, has a well that supplies between 15 and 20 families. The Grandview Trailer Park, located at the intersection of Long Cove Road and Route 12, has two water supply wells. There are several irrigation wells on site at the golf course which have not been used for several years.

Based on review of the analytical data for monitoring wells located throughout the NSB-NLON facility, it was determined that soils and bedrock throughout the area may contain high concentrations of some naturally-occurring chemicals. Manganese and iron were two of the elements that were detected at high concentrations.

Manganese concentrations in offsite residential wells located upgradient of NSB-NLON were as high as 2,130 µg/L. These levels are typical of most wells on the base. Maximum concentrations of manganese in groundwater at several sites at NSB-NLON exceed the offsite concentrations by less than one order of magnitude.

Data indicate that total and dissolved concentrations of manganese in groundwater are similar, indicating that the manganese is generally dissolved in the groundwater. In general, maximum concentrations of manganese were detected in the Area A Wetland, the Area A Downstream/OBDA near Streams 1 and 5, and the Torpedo Shops. Many other areas of NSB-NLON had limited or no data available, and conclusions could not be drawn about the concentration of manganese in groundwater for those areas. The maximum concentrations of iron detected in the shallow overburden and bedrock groundwater were 141,000 µg/L (Goss Cove Landfill) and 108,000 µg/L (Area A Wetland), respectively. Areas of NSB-NLON that had high concentrations of manganese also had high concentrations of iron. These areas included the Area A Wetland, Area A Downstream/OBDA, and the Torpedo Shops. The occurrence of manganese and iron in the groundwater may be due to natural sources; i.e., local geologic units or dredge spoils from the Thames River. A Groundwater/Leachate Modeling Study (B&R Environmental, October 1996) showed that the anticipated concentrations of metals in the groundwater/leachate from the Area A landfill (a previously suspected source of these contaminants) would be lower than the Federal Ambient Water Quality Criteria and the Connecticut's Surface Water Protection Criteria.

The pH of the shallow and deep groundwater ranged from approximately 5 to 9. Higher pHs (greater than 9) were only detected in the shallow overburden groundwater (Lower Base and Area A Downstream/OBDA), while lower pHs (less than 5) were detected in both the shallow and deep groundwater (Spent Acid Storage and Disposal Area and Area A Downstream/OBDA). The pH of the shallow and deep groundwater in the Area A Landfill and Area A Wetland ranged from 6 to 8. The pH of 8 was measured in a deep well along the upgradient edge of the NSB-NLON. The pH of the groundwater decreases in a downgradient direction towards the dike of the Area A Wetland. This decrease in pH may be a result of the anaerobic conditions present in the Area A Wetland. The pH of the deep groundwater in the area upgradient of the Torpedo Shops and Area A Weapons Center was around 8. The pH of groundwater around the Rubble Fill Area at Bunker A86 which is upgradient of the Area A Landfill and Area A Wetland is approximately 6.

1.2.8.4 Aquifer Characteristics

Values of hydraulic conductivity in the overburden ranged from 0.07 to 20.3 feet/day (2.47E-5 to 7.16E-3 cm/sec). The highest value is from a well screened in loose sand and gravel near the Thames River. Intermediate values between 1 and 5 feet/day are for wells screened in the shallow fill and terrace deposits consisting primarily of dense, coarse sand with some gravel and silt. The lowest values of hydraulic conductivity, which are less than 1 foot/day, are from wells screened in very dense, silty sand in the shallow overburden and dense, poorly sorted sand in the deeper overburden. The results indicate that the overburden materials are generally moderately permeable. Due to the limited database and the fact that some wells are screened across multiple lithologies within the overburden, detailed evaluations of the hydraulic characteristics of differing types of overburden materials cannot be made.

The general direction of groundwater flow at NSB-NLON is from Baldwin Hill across the facility to the west (toward the Thames River). However, the water table surface locally mimics the bedrock (and topographic) surface. High hydraulic potentials develop within the three bedrock highs in the northern, central, and southern areas of the facility. Precipitation infiltrates into the overburden and bedrock and flows radially from the areas of high bedrock (and topographic) elevation toward areas of low bedrock (and topographic) elevation. More specifically, groundwater flows toward the two valleys and ultimately toward the Thames River or directly from the western edges of the three hills toward the Thames River.

The vertical component of groundwater flow is predominantly downward in upland areas of NSB-NLON. However, at the base of the hills, the bedrock surface flattens and the overburden thickens. In these areas, upward gradients may occur, resulting in shallow bedrock groundwater discharge into the overburden. Near the Thames River, upward gradients exist, as is typical for groundwater in major stream valleys. Whether an upward or downward gradient develops depends on factors such as the bedrock configuration, depth of the overburden, permeability, distance to the river, and the tides.

The Phase II Remedial Investigation (RI) report (B&R Environmental, March 1997) presented the following conclusions regarding tidal influences of groundwater discharge from NSB-NLON: (1) During low tide, the hydraulic gradient of the water table at NSB-NLON is towards the Thames River and will result in the highest discharge rate of groundwater to the river; (2) During high tide, the hydraulic gradient of the groundwater at NSB-NLON along the Thames River is reversed and flow occurs from the river to the site, temporarily halting the discharge of shallow groundwater from the base to the river; (3) The reversal in hydraulic gradient resulting from tidal influences occurs only near the river, generally within 300 feet, and does not seem to significantly alter groundwater flow in other areas of NSB-NLON.

Furthermore, based on the evaluation of the monthly water-level data, the following conclusions may be reached regarding seasonal influences on groundwater discharge from NSB-NLON:

- During periods of limited recharge (i.e., summer and early fall), the hydraulic gradients along the bedrock highs (where there is limited overburden thickness) decrease and the groundwater discharge from these areas decreases. Conversely, during periods of significant recharge (late fall and spring), the hydraulic gradients in these areas and groundwater discharge increases.

- Hydraulic gradients in the portions of the site where there is significant overburden (i.e., the valleys and floodplain) remain relatively constant (with the exception of tidal-related variations) throughout the year as does the groundwater discharge.

1.2.9 Demography and Land Use

This section provides general information regarding demographics. This information has been compiled from the Phase I RI report (Atlantic, August 1992). Several communities are located within 1 mile of NSB-NLON. According to the U.S. Bureau of the Census, three neighborhoods in the Town of Groton lie adjacent to or within NSB-NLON. The neighborhood boundaries are described as follows:

- North West - The community is located adjacent to NSB-NLON on the east side of Route 12 from the Groton - Ledyard town line to Walker Hill Road on the south. The neighborhood extends west to the Ledyard Reservoir.

- Pleasant Valley - The Pleasant Valley Neighborhood borders the south boundary of NSB-NLON. On the east it is bounded by Connecticut Route 12 and on the west by the Thames River. The southern boundary of Pleasant Valley is Grove Street and Walker Hill Road.

- Naval Submarine Base - New London - NSB-NLON is considered a neighborhood in Groton although portions of it are located in Ledyard. The Gales Ferry section of Ledyard is also located adjacent to NSB-NLON to the north.

According to the 1990 census report, the following is the population distribution:

- Groton: population/median age of 45,144/25.5 yr (county subdivision) and 9,837/28.9 yr (city)
- NSB-NLON: population: 10,738 active military and 1,007 active civilian
- Ledyard (county subdivision): population/median age of 14,913/31.8 yr

1.2.10 General Ecology

The New London/Groton area lies in the Central Hardwoods zone that covers a large portion of the northeastern United States. Virgin forests in this area have been replaced by second or third growth stands as a result of development. Many wetland areas have been filled to support development. Although the Thames River has been dredged and its banks have been stabilized, the course of the river is unchanged, and the river still supports a variety of indigenous species of flora and fauna.

1.2.10.1 Terrestrial Habitats

The following description of the NSB-NLON terrestrial habitats was derived primarily from the Initial Assessment Study of Naval Submarine Base, New London, Connecticut, (NEESA, March 1983).

Both upland and wetland vegetation are found at NSB-NLON. The climate favors hardwoods over softwoods, although coniferous trees may be prevalent in areas of poor soil where competition from hardwood species is less intense.

Typical of most municipal areas in Connecticut, oak/beech/red maple forests dominate the upland vegetation in this area. These hardwoods, or deciduous trees, comprise most of the total vegetative cover, with oak being the dominant species. The softwoods, or evergreens, account for less than 10 percent of the forest types. White pine, cedar, and hemlock are the major trees in this category. Excluding ornamental plantings, evergreens usually occur in nature in concentrated clusters or stands. Both the Pine Swamp and the Great Cedar Swamp in Ledyard are excellent examples of this condition. However, a deciduous tree (red maple) usually dominates along with the evergreens in wet areas.

Although mature hardwoods and softwoods exist in the area, nearly 70 percent of the total woodland is occupied by immature trees as a result of the extensive logging and clearing that took place in the last century and into the present one. Some common understory plants of wooded areas are dogwood, cherry, tupelo, sassafras and other tree saplings, catbriar, and grape vine. Poison ivy is also common. Bittersweet, barberry, goldenrod, green briar, catbriar, sumac, hawthorne, grasses, and wildflowers flourish in open areas and old pasture land.

The land within and surrounding NSB-NLON provides habitat for various terrestrial fauna. Common mammals include the eastern grey squirrel, raccoon, white-tailed deer, opossum, eastern cottontail, and woodchuck. Although these species are typically found in hardwood forests and old field habitats, they overlap into the other areas. Common amphibians found in this part of eastern Connecticut include the American toad, bullfrog, leopard frog, dusky salamander, and red-backed salamander. Reptiles common to the area include the water snake, garter snake, hognose snake, painted turtle, and spotted turtle.

The avian fauna of the NSB-NLON consists of a variety of species that may be permanently residential, migratory, or seasonal. Winter birds often found around home feeders include the tufted titmouse, nuthatch, and cardinal. Summer birds of residential areas are the blue jay, robin, chickadee, and house sparrow. Summer birds common to more natural and open areas are the mourning dove, common crow, eastern kingbird, and sparrow hawk. Over 20 species of birds can be found breeding in the upland forests and fields. The most commonly found breeding species are the bobwhite quail, yellow shafted flicker, towhee, and brown thrasher.

1.2.10.2 Aquatic Habitats

Both freshwater and estuarine aquatic habitats exist at NSB-NLON. Freshwater streams, ponds, lakes, and wetlands exist at NSB-NLON. The Thames River, a tidal estuary, borders NSB-NLON on the west. The following sections describe the aquatic habitats in each type of water body.

Two lakes, North Lake and Rock Lake, are maintained at NSB-NLON for recreational and aesthetic purposes. North Lake is an artificial (man-made) lake, while Rock Lake is a natural lake. The other freshwater systems naturally occurring within NSB-NLON are in Area A, and they are restricted to shallow waters associated with the wetlands and the ephemeral streams that drain them.

Offbase, the main nearby estuarine body is the Thames River. Several studies on the plankton (using chlorophylla as surrogate), marine algae, benthic invertebrates, shellfish, finfish, and birds have been conducted; the results of which are summarized in the Phase II RI report (B&R Environmental, March 1997).

1.2.10.3 Endangered Species

Six Federal or State Endangered, Threatened or Special Concerns species have been sighted in the NSB-NLON area (CTDEP, 1994). The state threatened species are the Atlantic Sturgeon, Golden

Alexanders, and Seaside Crowfoot. The state special concern species are the Creeping Bush-clover, Crooked-stem Aster, and *Carex crawfordii*.

Most of NSB-NLON, including the DRMO site, does not provide critical habitat for these endangered species. However, the Thames River, which borders the DRMO site, is a potential habitat for these species, especially the state threatened Atlantic Sturgeon.

1.3 DRMO BACKGROUND

This section provides a site-specific summary of the information available on the DRMO. Section 1.3.1 provides a brief description of the site; Section 1.3.2 discusses its physical features; and Section 1.3.3 discusses the previous investigations conducted.

1.3.1 DRMO Description

The DRMO is located adjacent to the Thames River in the northwestern section of NSB-NLON (Figure 1-2). Currently, the DRMO is used as a storage and collection facility for items such as computers, file cabinets, and other office equipment to be sold during auctions and sales held periodically during the year.

From 1950 to 1969 the DRMO was used as a landfill and waste burning area. Non-salvageable waste items including construction materials and combustible scrap were burned along the Thames River shoreline, and the residue was pushed to the shoreline and partially covered.

At various times, metal and wood products have been stored over most of the site.

Building 491, located in the northern, unpaved portion of the site was used to store miscellaneous items including batteries. Metal scrap bailing operations are performed adjacent to Building 491 on a gravel surface. Building 491 formerly housed a battery acid handling facility.

Buildings 355 and Building 479 are located in the southern, paved, portion of the site and are primarily used for storage. A large scrap yard is located north of Building 479.

Submarine batteries were previously stored in the southeast portion of the site adjacent to the railroad tracks. No evidence of leaks were observed.

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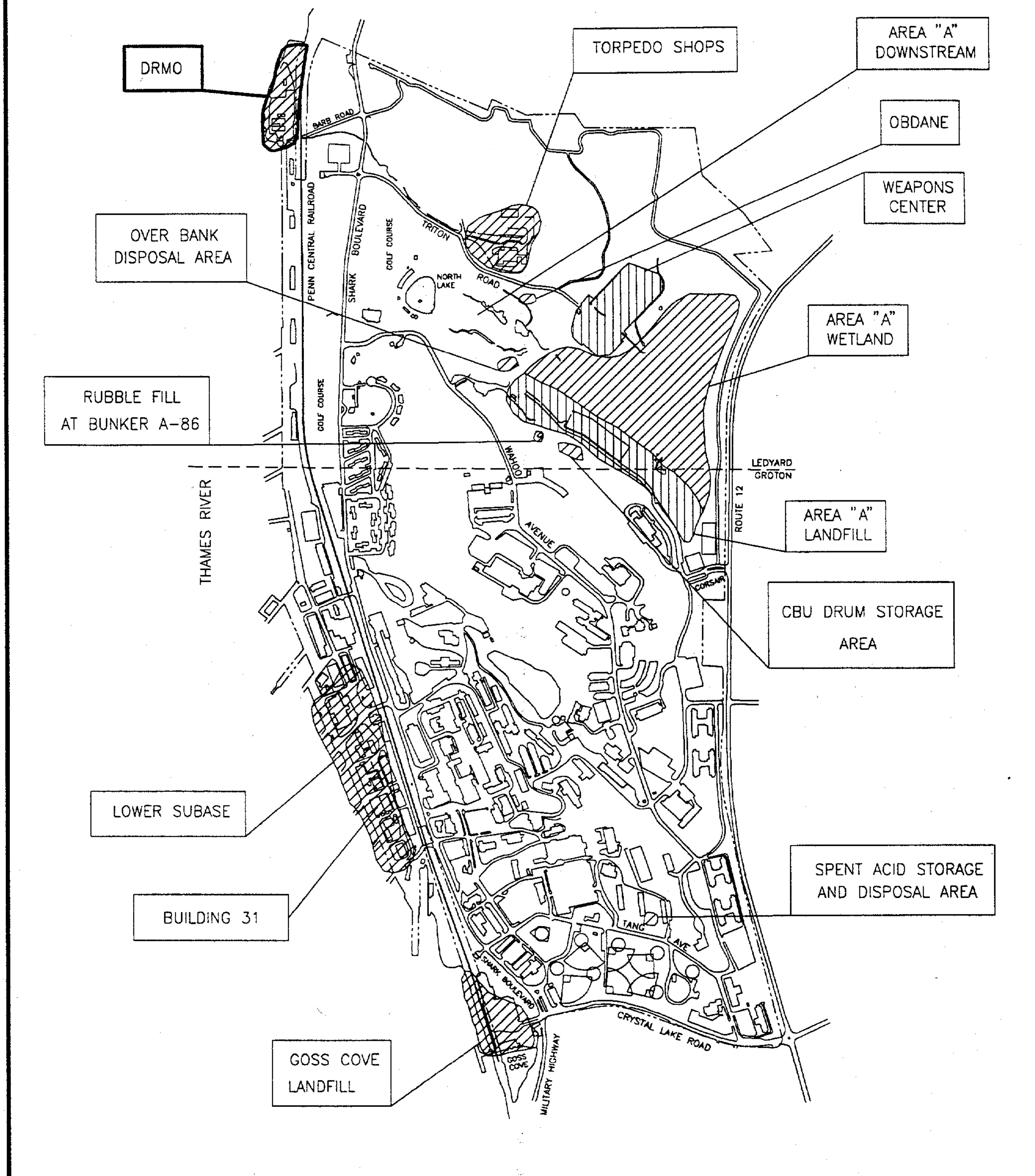

SITE MAP
NSB NLON
GROTON, CONNECTICUT

SOURCE: Naval Submarine Base Existing Conditions April 1985 Loureiro Engineering Associates

FIGURE 1-2
SITE LOCATION MAP

1.3.2 DRMO Characteristics

This section presents a summary of site characteristics for the DRMO based on information generated during the Phase I and Phase II RIs. This section discusses topography, surface water, soils, geology, and ecology features present at the DRMO.

1.3.2.1 Topography and Surface Features

The DRMO topography is illustrated in Figure 1-3. An exposed, bedrock highpoint, located to the east of the DRMO, slopes steeply to the west towards the site. The ground surface within the DRMO site boundaries gently slopes westward from an elevation of 8 feet msl along the eastern boundary of the site to 4 feet msl at the Thames River. The land is relatively flat, low lying and prone to flooding by the Thames River.

A cap was installed during a Time-Critical Removal Action (see Section 1.3.3.4) and this area, as well as the remaining portion of the DRMO, was upgraded via placement of an asphalt layer. Buildings 479, 355 and 491 are located within the paved area.

1.3.2.2 Surface Water Features

All surface runoff from the site flows to the Thames River which is located along the western edge of the DRMO. Two storm sewer systems located along the southern boundary of the site transfer runoff from the eastern side of the Providence and Worcester Railroad to the Thames River (Atlantic, August 1992).

1.3.2.3 Soil Characteristics

The SCS Soils Map (SCS, 1983) classifies the soil at the DRMO as Udorthents-Urban land complex. This classification is defined as being excessively drained to moderately drained soil that has been disturbed by cutting and filling.

To the north of the site, the soil is classified as the Hinkley Loam. This soil is found on stream terraces and outwash plains and consists of a dark, gravely sand loam. Native materials at the DRMO were most likely of this type.

Northwest and upslope of the site, along the exposed bedrock highpoint, the soil is classified as Hollis-Charlton-Rock complex. This classification is defined as being stones and boulders intermingled with a dark, fine, sandy loam. Bedrock outcrops are prevalent.

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NOTES:

1. UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE.
2. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN, (ATLANTIC, MAY 1993).
3. SURFACE SOIL SAMPLES 6SS1C-1, 6SS1C-2, AND 6SS1C-3 WERE COMPOSITED TO FORM 6SS1C.
4. SURFACE SOIL SAMPLES 6SS2C-1, 6SS2C-2, AND 6SS2C-3 WERE COMPOSITED TO FORM 6SS2C.
5. POTENTIOMETRIC SURFACE FOR WATER LEVELS MEASURED ON AUGUST 23-24, 1994.
6. MEAN HIGH WATER ELEVATION BASED ON FFS BY ATLANTIC, MARCH 1994.

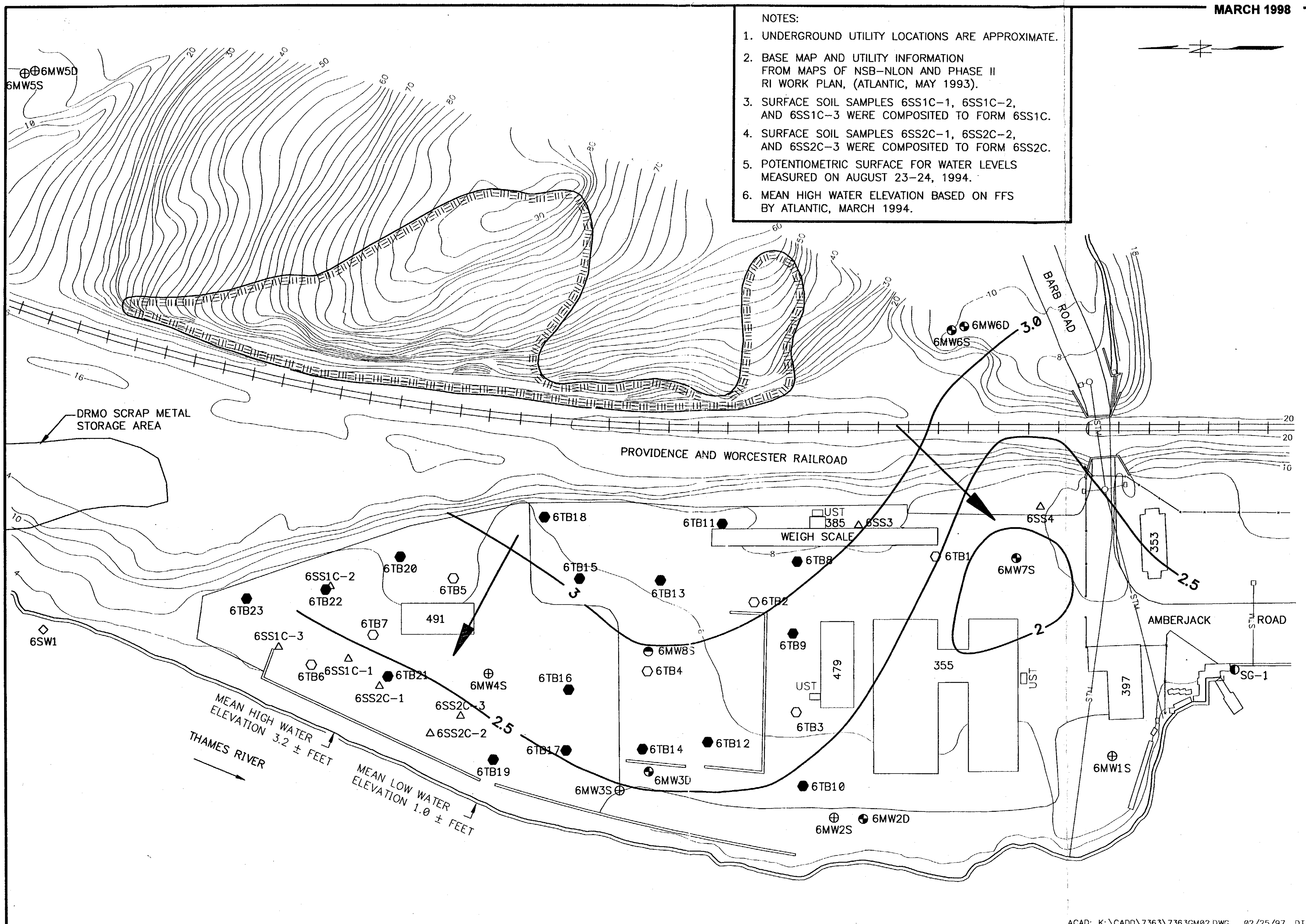


FIGURE 1-3
FORMER SAMPLING LOCATIONS
NSB - NEW LONDON
GROTON, CONNECTICUT

Brown & Root Environmental

LEGEND

- 10 — EXISTING CONTOUR
- 123 BUILDING No.
- WATERCOURSE
- STM STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK
- GROUNDWATER FLOW DIRECTION
- 6MW2S PHASE I MONITORING WELL
- 6MW2D PHASE II MONITORING WELL
- 6TB3 PHASE I TEST BORING
- 6TB9 FFS TEST BORING
- 6MW8S FFS MONITORING WELL
- 6SS1C-2 PHASE I SURFACE SOIL SAMPLE
- 6SW1 PHASE II SURFACE WATER SAMPLE
- SG-1 PHASE II STAFF GAUGE
- 2.5 POTENTIOMETRIC SURFACE CONTOUR

SCALE IN FEET: 0 60 120

1.3.2.4 Geology

Geologic conditions underlying the DRMO consist of a westward-thickening wedge of overburden materials (fill and natural deposits) overlying fractured metamorphic bedrock. The upper layer of fill material is between 2 and 20 feet thick. The fill consists primarily of sand and gravel but also contains metal and wood. The fill is thickest along the Thames River (6MW2D, 6TB10, 6TB12, 6TB16, 6TB17, and 6TB19) and thinnest at 6TB13 and 6TB15. There was no evidence of fill at 6MW7S (southeast corner of site) or the 6MW6 and 6MW5 well clusters (offsite).

In most cases, the fill is underlain by clayey silt, which thickens from 2 feet along the eastern portion of the DRMO to a maximum observed thickness of 46 feet along the Thames River. The silt layer is underlain by sand and gravel, except at 6MW2D where the silt lies directly on bedrock. Upslope of the DRMO at the 6MW5 and 6MW6 well clusters, the clayey silt is missing, and 20 feet of sand and gravel rest on bedrock. The coarse-grained natural overburden materials are generally mapped as terrace deposits along the Thames River (USGS, 1960). These terrace deposits are stratified drift of former glacial meltwater streams. At the DRMO, the coarse-grained terrace deposits are overlain by the clayey silt, which are finer-grained river bottom sediments.

Bedrock in the northern portion of the DRMO has been mapped as the Granite Gneiss. Bedrock in the southern portion of the DRMO has been mapped as the Mamacoke Formation (USGS, 1967). These mapped formations were detected during drilling: the Granite Gneiss was encountered at 6MW5D and the Mamacoke Formation was encountered at 6MW6D. The Westerly Granite has been mapped along the eastern portion of the site, but it was not detected during drilling (Phase I RI). The bedrock at the DRMO slopes westward toward the Thames River. The slope of the bedrock surface across the DRMO is approximately 25 percent.

1.3.2.5 Hydrogeology

Groundwater is present within the overburden and bedrock underlying the DRMO. The water table is generally encountered within the fill materials at the site (between 2.5 and 10.5 feet below ground surface), with the underlying clayey silt and terrace deposits under saturated conditions. Based on the expected relative permeability of these three units (the coarse-grained fill and terrace deposits are expected to be significantly more permeable than the intervening clayey silt layer), the three deposits are considered to be separate hydrostratigraphic units. The clayey silt may function as an aquitard relative to the overlying and underlying coarser grained units.

Groundwater flow is generally from east to west, following topographic and bedrock surface slope to the Thames River. The Thames River is tidally influenced with a mean tidal range at NSB-NLON of 2.2 feet, which creates reversals in groundwater flow directions and causes water levels to fluctuate. Based on a tidal study conducted as part of an Action Memorandum for Building 31 at the Lower Base (Halliburton NUS, May 1993), it was established that tidal influence created groundwater level fluctuations of up to 1.19 feet in monitoring wells located approximately 100 feet from the river. Accordingly, due to the proximity of the site to the river, and the demonstrated influence of tides on groundwater levels near the river, it is expected that tidal fluctuations of the river locally affect groundwater levels, at least in the western portion of the DRMO.

During low tide, the hydraulic gradient of the groundwater table at NSB-NLON is towards the Thames River and will result in the highest discharge rate of groundwater to the river. During high tide, the hydraulic gradient of the groundwater is reversed and flow occurs from the river to the site, temporarily halting the discharge of groundwater from the base to the river (B&R Environmental, March 1997).

No clear patterns for vertical groundwater flow are evident from the water level data. At well cluster 6MW2S/2D, an upward flow gradient was observed between the fill and terrace deposits during two of the three comprehensive water level measuring rounds. At cluster 6MW3S/3D, a downward gradient was observed between the fill and terrace deposits during two of the three measurement rounds. At cluster 6MW5S/5D, an upward gradient was observed between the bedrock and terrace deposits during two of three measurement rounds, while at cluster 6MW6S/6D, a downward gradient between the fill and bedrock was observed during all three water level rounds. Vertical gradients are expected to fluctuate significantly near the river, due to tidal fluctuations and the resulting impacts on groundwater levels. Shallow overburden groundwater levels are expected to vary in response to the tides, more than deeper groundwater, due to a more direct hydraulic connection between the shallow overburden and river in comparison to deeper groundwater flow zones.

Since the underlying clayey silt layer likely acts to minimize groundwater impacts from the DRMO to the deep river bottom and alluvial deposits, the groundwater flux from the DRMO to the river was calculated from the fill only. The average hydraulic conductivity of the fill materials was calculated by taking the geometric mean of DRMO-specific hydraulic conductivities (both Phase I RI and Phase II RI) for two wells completed within the fill materials. Hydraulic conductivities from Phase I RI well 6MW2S (70 ft/day) and from Phase II RI well 6MW7S (1.9 ft/day), were used for this calculation. The average hydraulic conductivity calculated for the fill material is 11.5 feet/day. Using Darcy's equation, the associated hydraulic discharge rate was calculated to be 1,666 cubic feet/day The actual discharge rate is likely to be substantially lower than this calculated rate, as tidal effects were not considered. During periods of high tide, groundwater discharge to the river is expected to be halted as gradients reverse and the river recharges the groundwater.

1.3.2.6 Ecological Habitat

The DRMO site is located in the northwestern section of NSB-NLON, adjacent to the Thames River. In the past, the southern half of the DRMO was covered with asphalt, most of which was deteriorated, while the northern portion was unpaved and had a gravel surface. The site was subsequently remediated in 1995, and a cap was placed over a majority of the central and northern portions of the site (OHM, September 1995). Bituminous concrete pavement was then placed over the entire area of the composite cap. This section of the NSB-NLON is very well-developed and is characterized by high human activity. Because of these conditions, the DRMO provides poor habitat for wildlife and, as previously mentioned does not constitute a critical habitat for any endangered species.

1.3.3 DRMO Investigations

The following sections summarize the previous investigative activities performed at the DRMO.

1.3.3.1 Phase I Remedial Investigation

The Phase I RI at this site included test borings and monitoring well installation, as well as soil, surface water, and groundwater sampling. Twelve shallow subsurface (less than 2 feet deep) soil samples plus one field duplicate and 12 subsurface (greater than 2 feet deep) soil samples plus one field duplicate were collected from seven test borings and five monitoring well borings. Four surface soil samples (two composite and two grab samples) plus one field duplicate were collected and analyzed. Six groundwater samples plus one field duplicate were collected from five shallow wells and one deep well. Additionally, one surface water sample was collected from the Thames River at the north end of this site (B&R Environmental, March 1997). The soil samples were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), Semi Volatile Organic Compounds (SVOCs), pesticides and Poly Chlorinated Byphenyls (PCBs); Target Analyte List (TAL) metals; and Toxicity Characteristics Leaching Procedure (TCLP) metals. The groundwater and surface water samples were analyzed for TCL VOCs, SVOCs, pesticides and PCBs; TAL metals; and radiological analyses. Sample locations are shown on Figure 1-3.

1.3.3.2 Draft Focused Feasibility Study Field Investigation

A field investigation in support of the Draft Focused Feasibility Study (FFS) was performed at the DRMO site in October 1993 to better define the extent of soil contamination. Split-spoon samples were collected from 17 borings. Refer to Figure 1-3 for sample locations. One or more samples were collected from each boring based on visual evidence of contamination, field-measured organic vapor readings, and field-measured lead contamination (using X-Ray Fluorescence). Twelve surface (less than 2 feet deep) soil samples and twelve subsurface (greater than 2 feet deep) soil samples were collected. One surface and two subsurface field duplicates were also collected. The samples were analyzed for TCL VOCs, SVOCs, pesticides and PCBs; TAL metals; dioxins; and TCLP VOCs, SVOCs, pesticides, PCBs and metals. One of the borings was completed as a monitoring well (B&R Environmental, March 1997).

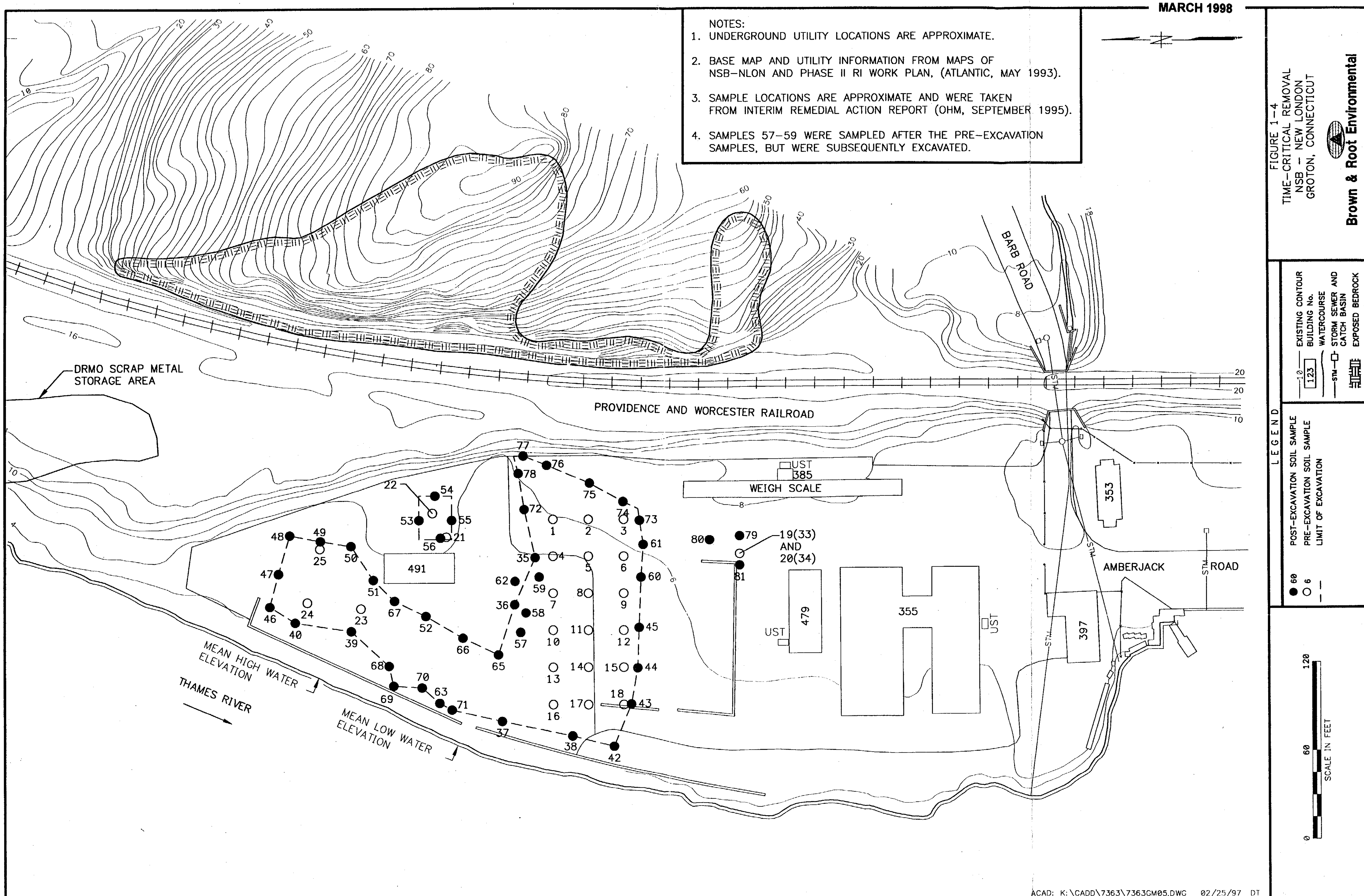
1.3.3.3 Phase II Remedial Investigation

Five new groundwater monitoring wells (two shallow and three deep) were installed and sampled during the Phase II RI. Additionally, four previously installed shallow wells were sampled. Two rounds of groundwater sampling were completed and ten samples (including one field duplicate sample) were collected during each sampling round. Three subsurface soil samples were collected during the installation of three of the new wells. The soil samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs and TAL metals and the groundwater samples were analyzed for TCL VOCs, TCL SVOCs, and TAL metals (B&R Environmental, March 1997). Sample locations are shown on Figure 1-3.

1.3.3.4 Time-Critical Removal Action

OHM Remediation Services completed a Time-Critical Removal Action at the DRMO in January 1995 (OHM, September 1995). In the removal action, soils containing concentrations of lead, PAHs, and PCBs in excess of the preliminary remediation goals (PRGs) were excavated and removed from the northern half of the DRMO (Figure 1-4). Excavation extended to a maximum depth of approximately 3 feet below the ground surface or to the water table. The PRGs used for soil screening of lead, PCBs, and carcinogenic PAHs were 500 mg/kg, 10 mg/kg, and 100 mg/kg, respectively. Approximately 4,700 tons of soil were excavated and transported to a RCRA landfill located in Grand View, Idaho. Residual contamination above the PRGs remained in the soil after excavation was completed due to the excavation being limited to 3 feet by the shallow water table and exceedances of the allotted time for the project (B&R Environmental, March 1997).

Additionally, a steel-walled, spent-acid-storage tank was excavated, cut into manageable pieces, and disposed offsite with the contaminated soil.


NOTES:
1. UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE.
2. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN, (ATLANTIC, MAY 1993).
3. SAMPLE LOCATIONS ARE APPROXIMATE AND WERE TAKEN FROM INTERIM REMEDIAL ACTION REPORT (OHM, SEPTEMBER 1995).
4. SAMPLES 57-59 WERE SAMPLED AFTER THE PRE-EXCAVATION SAMPLES, BUT WERE SUBSEQUENTLY EXCAVATED.
DRMO SCRAP METAL STORAGE AREA
PROVIDENCE AND WORCESTER RAILROAD
BARB ROAD
AMBERJACK ROAD
WEIGH SCALE
UST
385
491
479
355
397
353
19(33) AND 20(34)
MEAN HIGH WATER ELEVATION
MEAN LOW WATER ELEVATION
THAMES RIVER
FIGURE 1-4
TIME-CRITICAL REMOVAL
NSB – NEW LONDON
GROTON, CONNECTICUT
Brown & Root Environmental
LEGEND
EXISTING CONTOUR
BUILDING No.
WATERCOURSE
STORM SEWER AND CATCH BASIN
EXPOSED BEDROCK
POST-EXCAVATION SOIL SAMPLE
PRE-EXCAVATION SOIL SAMPLE
LIMIT OF EXCAVATION
SCALE IN FEET
0
60
120
ACAD: K:\CADD\7363\7363GM05.DWG 02/25/97 DT
01338032

The excavated area was backfilled with clean borrow material from an offsite location. A cap consisting of a woven geotextile liner, a geosynthetic clay liner, and a nonwoven geotextile liner was installed. Approximately 12 inches of crushed stone and 3 inches of asphalt were placed over the clay/geotextile cover. This cap does not meet RCRA Title C requirements. The remaining (paved) portion of the DRMO was also upgraded via placement of an asphalt layer.

1.4 SUMMARY OF REMEDIAL INVESTIGATION RESULTS

This section provides a site-specific summary of the information available from the RI on the DRMO. Section 1.4.1 discusses the nature and extent of contamination; Section 1.4.2 presents a summary of the human health risk assessment; Section 1.4.3 presents a summary of the ecological risk assessment; and Section 1.4.4 presents conclusions based on the information presented in Sections 1.4.1 through 1.4.3.

1.4.1 <u>Nature and Extent</u>

This section contains a discussion of the nature and extent of soil and groundwater contamination at the DRMO site. Samples were collected at the DRMO during both Phases I and II RIs, as well as during the FFS and the Time-Critical Removal Action.

1.4.1.1 DRMO Soil

The soil analytical data are summarized in Table 1-1. Since soils excavated during the Time-Critical Removal Action are no longer present at the site, they are not included in Table 1-1 and are also excluded from the following discussion of the nature and extent of contamination at the site. The sample locations are shown on Figures 1-3 and 1-4.

Several VOCs, including carbon disulfide, vinyl chloride, monocyclic aromatics, ketones, and several halogenated aliphatics, were detected in the surface and subsurface soils at this site. Most VOCs were detected infrequently (in from one to seven of 73 total samples) and at relatively low concentrations (less than 20 μg/kg); however, there were some samples collected which contained elevated levels of VOCs. The subsurface sample from boring 6TB4 in the central portion of the site (6 to 8 feet deep) contained the following halogenated aliphatics, 1,1,2,2-tetrachloroethane (6,400 μg/kg), 1,1,2-trichloroethane (590 μg/kg), 1,2-dichloroethane (1,900 μg/kg), 1,2-dichloroethene (16,000 μg/kg), tetrachloroethene (210 μg/kg), trichloroethene (7,100 μg/kg), and vinyl chloride (1,300 μg/kg). These compounds and their degradation products are typically used in degreasing operations. Their occurrence at such concentrations was limited to the sample collected from 6TB4. Xylenes (340 μg/kg) and acetone (350 μg/kg) were also detected in sample

TABLE 1-1

DRMO FS
SUMMARY OF SOIL ANALTYICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
1,1,2,2-Tetrachloroethane	1/56	1.78	DRMO-35	1/17	6400	6TB4
1,1,2-Trichloroethane	0/56	-	ND (3)	1/17	590	6TB4
1,1-Dichloroethane	3/56	1.38-6.25	DRMO-35	0/17	-	ND
1,1-Dichloroethene	0/56	-	ND	1/17	13	6TB4
1,2-Dichloroethane	2/56	1.25-6.68	DRMO-40	2/17	79-1900	6TB4
1,2-Dichloroethene (total)	0/14	-	ND	2/17	2-16000	6TB4
2-Butanone	7/56	2.35-14.4	DRMO-40	0/17	-	ND
2-Hexanone	1/56	3.03	DRMO-42	0/17	-	ND
4-Methyl-2-pentanone	1/56	1.21	DRMO-42	1/17	5100	6TB17
Acetone	30/56	1.87-1630	DRMO-72	2/17	78-350	6TB4
Benzene	2/56	1.13-6.41	DRMO-40	1/17	7	6TB4
Carbon disulfide	4/56	1-5.37	DRMO-60	3/17	2-48	6TB4
Chloroethane	1/56	1.55	DRMO-35	0/17	-	ND
Chloroform	0/56	-	ND	1/17	14	6TB4
Ethylbenzene	3/56	1.22-9.07	DRMO-45	1/17	44	6TB4
Methylene chloride	39/56	2-427	DRMO-75	2/17	17-41	6TB16
Styrene	4/56	1.28-2.59	DRMO-35	0/17	-	ND
Tetrachloroethene	12/56	1-14.7	DRMO-74	4/17	5-210	6TB4
Toluene	15/56	1-12.2	DRMO-36	3/17	1-43	6TB4
Trichloroethene	26/56	1-93.1	DRMO-44	6/17	1-7100	6TB4
Vinyl chloride	1/56	1.66	DRMO-35	1/17	1300	6TB4
Xylenes, total	10/56	0.992-29.7	DRMO-45	2/17	340-5400	6TB17
SEMIVOLATILE ORGANICS (ug/kg)						
1,2,4-Trichlorobenzene	2/56	4820-4940	DRMO-63	0/16	-	ND
1,3-Dichlorobenzene	1/56	1060	DRMO-35	0/16	-	ND

TABLE 1-1

DRMO FS
SUMMARY OF SOIL ANALTYICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 5

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
2-Methylnaphthalene	8/56	48.7-8360	DRMO-67	4/16	42-44000	6TB17
4-Methylphenol	1/56	209	DRMO-54	1/16	790	6TB4
Acenaphthene	6/56	286-13700	DRMO-45	3/16	49-52000	6TB17
Acenaphthylene	11/56	39-5600	DRMO-45	1/16	89	6MW2
Anthracene	30/56	39-29300	DRMO-45	5/16	37-41000	6TB17
Benzo(a)anthracene	36/56	100-43700	DRMO-45	9/16	72-50000	6TB17
Benzo(a)pyrene	31/56	188-40600	DRMO-45	6/16	74-31000	6TB17
Benzo(b)fluoranthene	36/56	150-78600	DRMO-45	10/16	24-39000	6TB17
Benzo(g,h,i)perylene	22/56	62.4-11000	DRMO-43	4/15	370-9400	6TB17
Benzo(k)fluoranthene	28/56	47-19400	DRMO-43	7/15	20-25000	6TB17
Benzoic acid	2/9	9300-12000	6SS3	2/10	32-220	6MW7S
Bis(2-ethylhexyl)phthalate	37/56	179-12500	DRMO-45	2/16	120-7700	6MW4
Butyl benzyl phthalate	1/56	423	DRMO-52	0/16	-	ND
Carbazole	9/47	46-14200	DRMO-45	1/8	26000	6TB17
Chrysene	37/56	93-47100	DRMO-45	11/16	100-43000	6TB17
Dibenzo(a,h)anthracene	1/56	1160	DRMO-37	1/15	130	6MW2
Dibenzofuran	6/56	82-14300	DRMO-45	1/16	46000	6TB17
Fluoranthene	42/56	66-95100	DRMO-45	11/16	36-100000	6TB17
Fluorene	9/56	214-19200	DRMO-45	3/16	66-70000	6TB17
Indeno(1,2,3-cd)pyrene	22/56	60.3-9290	DRMO-43	4/15	26-9800	6TB17
Naphthalene	6/56	228-23700	DRMO-45	2/16	6500-87000	6TB17
Phenanthrene	34/56	55-96900	DRMO-45	9/16	79-160000	6TB17
Pyrene	44/56	140-174000	DRMO-45	12/16	47-89000	6TB17
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	3/56	9.3-227	DRMO-74	0/17	-	ND
4,4'-DDE	3/56	10.5-35.9	DRMO-74	1/17	4.1	6TB9

TABLE 1-1

DRMO FS
SUMMARY OF SOIL ANALTYICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 5

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
4,4'-DDT	7/56	1.42-63.4	DRMO-74	0/17	-	ND
Aroclor-1254	36/56	75-22400	DRMO-72	3/17	72-440	6TB20
Aroclor-1260	33/56	120-29100	DRMO-35	6/17	110-12000	6TB2
Delta-BHC	1/56	5.09	DRMO-77	0/17	-	ND
Dieldrin	1/56	4.68	DRMO-77	0/17	-	ND
Endosulfan II	2/56	2.24-25.4	DRMO-74	0/17	-	ND
Endosulfan sulfate	2/56	28.9-37.9	DRMO-60	0/17	-	ND
Endrin	2/56	10.6-12.5	DRMO-77	1/17	4.4	6MW2D
Endrin aldehyde	4/47	2.56-6.86	DRMO-74	2/9	5.6-5.8	6TB9
Endrin ketone	3/56	3.21-31.9	DRMO-77	0/17	-	ND
Gamma-Chlordane	2/56	2.77-20.4	DRMO-74	1/17	2.5	6TB20
Heptachlor epoxide	5/56	0.96-20.7	DRMO-74	0/17	-	ND
DIOXINS (ug/kg)						
1,2,3,4,6,7,8-HpCDD	-	-	NA (4)	1/1	0.67	6TB20
OCDD	-	-	NA	1/1	3.07	6TB20
INORGANICS (mg/kg)						
Aluminum	56/56	2430-18900	DRMO-46	17/17	4880-12100	6TB16
Antimony	35/45	0.0249-134	DRMO-63	3/7	4.1-7	6MW3D
Arsenic	55/56	0.31-16.4	DRMO-75	17/17	1.1-7.5	6MW1
Barium	56/56	17.9-934	DRMO-40	17/17	28-212	6TB17
Beryllium	56/56	0.119-24.9	DRMO-36	14/17	0.22-16.8	6TB17
Boron	1/5	2.9	6TB11	4/9	15.6-96.2	6TB17
Cadmium	54/56	0.175-126	DRMO-40	12/17	0.45-6.4	6MW4
Calcium	56/56	500-16300	DRMO-48	17/17	981-21400	6TB17
Chromium	56/56	4.42-1210	DRMO-63	15/17	6.2-139	6MW4
Cobalt	54/56	1.69-179	DRMO-48	16/17	3.5-130	6TB17

TABLE 1-1

DRMO FS
SUMMARY OF SOIL ANALTYICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
PAGE 4 OF 5

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Copper	56/56	6.37-8730	DRMO-49	17/17	10.6-4980	6TB17
Cyanide	27/56	0.0254-7.68	DRMO-69	1/14	0.15	6TB20
Iron	56/56	3590-103000	DRMO-48	17/17	6480-65800	6TB17
Lead	56/56	2.9-5980	DRMO-77	17/17	2.3-2140	6TB17
Magnesium	56/56	1080-7190	6SS3	17/17	1820-6670	6TB16
Manganese	56/56	56.7-1260	DRMO-40	17/17	126-673	6TB17
Mercury	55/56	0.0033-20.7	DRMO-46	9/15	0.12-0.78	6TB20
Nickel	56/56	3.43-1250	DRMO-48	17/17	6.5-374	6TB17
Potassium	56/56	608-6520	6SS3	17/17	1050-6280	6MW7S
Selenium	17/56	0.112-0.773	DRMO-40	2/17	1-5.3	6TB17
Silver	33/56	0.021-24.3	DRMO-63	0/17	-	ND
Sodium	53/56	41.2-4220	DRMO-78	16/17	117-5860	6TB4
Thallium	15/56	0.0145-0.64	6TB23	0/17	-	ND
Vanadium	56/56	6.26-368	DRMO-52	17/17	9-63.8	6MW4
Zinc	56/56	12.5-28300	6TB2	17/17	25.6-14900	6TB17
TCLP (mg/L)						
Barium (100.0/10) (5)	10/10	0.18-1.4	6MW4	9/9	0.073-1.3	6MW4
Cadmium (1.0/0.05)	6/10	0.011-0.25	6MW4	3/9	0.019-0.087	6MW4
Chromium (5.0/0.5)	6/10	0.008-0.11	6TB2	4/9	0.0077-0.11	6MW5S
Lead (5.0/0.15)	6/10	0.11-6.2	6SS3	3/9	0.2-0.87	6MW4
Mercury (0.2/0.02)	1/10	0.0077	6MW2	0/9	-	ND
Selenium (1.0/0.5)	1/10	0.1	6MW5S	1/9	0.1	6MW1
Silver (5.0/0.36)	5/10	0.0082-0.012	6TB1	2/9	0.01-0.029	6MW5S
1,2-Dichloroethane (0.5/na) (6	0/1	-	ND	1/1	0.028	6TB20

TABLE 1-1

DRMO FS
SUMMARY OF SOIL ANALTYICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
PAGE 5 OF 5

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLANEOUS PARAMETERS						
Ash (%)	-	-	NA	2/2	81.4-85.8	6TB16
Cation ex. capacity (meq/100g	-	-	NA	2/2	9.3-21	6TB16
pH	-	-	NA	2/2	7.69-7.76	6TB20
Specific gravity (g/cm3)	-	-	NA	2/2	2.1-2.2	6TB20
Total organic carbon (mg/kg)	-	-	NA	3/3	600-8400	6TB20

NOTES:

1 Includes samples 6MW1 (0-2), 6MW2 (0-2), 6TB8 (0-2) (field duplicate of 6MW2 (0-2)), 6MW4 (0-2), 6MW5S (0-2), 6SS3, 6 duplicate of 6SS3). 6SS4, 6TB1 (0-2), 6TB2 (0-2), 6TB3 (0-2), 6TB8 (0-1), 6TB11 (-02), 6TB12 (0-2), 6TB20 (0-1), 6TB23 (0-1), 16144-32, 16144-35 through -55 (16144-41 is a field duplicate of 16144-40), 16144-56, 16144-DUP (field duplicate of 16144-60, through -82) 17144-64 is a field duplicate of 16144-63, 16144-82 is a field duplicate of 16144-74). Maximum concentrations are use for the evaluation of field duplicates and are counted as one sample. Excavated samples are not included in the summary. Surface soil samples were collected during the Phase I RI (September to November 1990), the FFS (October 1993), and the Time Critical Removal Action (November to December 1994).

2 Includes samples 6MW1 (4-6), 6MW6 (4-6) (field duplicate of 6MW1 (4-6)), 6MW2 (2-4), 6MW2D-0406, 6MW3D-0406, 6M 6MW5S (8-10), 6MW7S-0709, 6TB1 (2-4), 6TB2 (2-4), 6TB3 (6-8), 6TB4 (6-8), 6TB8 (4-6), 6TB9 (2-4), 6TB10 (4-6), 6TB16 (16-18), 6TB16 (8-10), 6TB17 (10-12), 6TB37 (10-12) (field duplicate of 6TB17 (10-12)), and 6TB20 (4-6). Maximum concentrations are used for evaluation of field duplicates and are counted as one sample. Excavated samples are not included in the summary. Subsurface soil samples were collected during te Phase I RI (September to October 1990), FFS (Olctober 1993), and Phase

3 Not Detected.

4 Not Analyzed.

5 Values in parentheses represent Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Clean-Up Standard Pollutant Mobility Criteria for GB waters.

6 NA - Not Applicable.

6TB4, and xylenes (5,400 µg/kg) and 4-methyl-2-pentanone (5,100 µg/kg) were detected in sample 6TB17 (10 to 12 feet deep), located near the Thames River.

Several SVOCs, including 4-methylphenol, benzoic acid, carbazole, chlorinated benzenes, phthalates, and Polycyclic Aromatic Hydrocarbons (PAHs) were detected in DRMO soils. PAHs were the most prevalent class of chemicals observed in the soil at this site. Soil samples collected throughout the site contained PAHs. PAHs detected most frequently (e.g., pyrene, fluoranthene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene) are relatively insoluble. Soluble PAHs (e.g., naphthalene, 2-methylnaphthalene, dibenzofuran, acenaphthalene) were also detected but were much less prevalent. The presence of PAHs may be attributable to the emplacement of contaminated material during filling activities that occurred prior to construction of the DRMO, or it could be related to releases of oily materials. The higher concentrations generally occurred in the soils surrounding the area excavated during the Time-Critical Removal Action discussed in Section 1.3.3.4. Maximum concentrations of most PAHs in surface soils were found in the sample collected during the Time-Critical Removal Action from location 45, collected along the excavation sidewalls approximately 100 feet north of Building 479 in the central portion of the site. Maximum concentrations of most PAHs in subsurface soils were found in a soil sample from boring 6TB17, located approximately 60 feet further north and 50 feet east of the Thames River.

Several pesticides and PCBs (Aroclor-1254 and Aroclor-1260) were also detected in soil samples collected at the DRMO site. Pesticides/PCBs were detected more frequently and at higher concentrations in surface soils than in subsurface soils. For example, 4,4'-DDE, endrin, endrin aldehyde, and gamma-chlordane were the only pesticides detected in subsurface soils; they were each detected in from one to three of 17 subsurface samples at concentrations less than 6 mg/kg. The two Aroclors were detected in subsurface soils (C_{max} = 12,000 µg/kg Aroclor-1260) and surface soils (C_{max} = 29,100 µg/kg Aroclor-1260) at higher concentrations than the pesticides in surface soils.

A majority of the maximum concentrations of pesticides in the surface soil samples were found in samples from locations 74 and 77, collected during the Time-Critical Removal Action near the eastern border in the central portion of the site. Although several pesticides were detected in the surface soils, concentrations of pesticides were low relative to PCB concentrations. With the exception of 4,4'-DDD (227 µg/kg) in the IRA sample from location 74, all pesticide concentrations were less than 65 µg/kg. Concentrations of Aroclor-1254 and Aroclor-1260, however, ranged up to 22,400 µg/kg and 29,100 µg/kg, respectively, in the surface soil samples. Concentrations of PCBs were generally highest in the soils surrounding the excavation area.

The subsurface sample collected from boring 6TB20 at a depth of 4 to 6 feet was the only sample analyzed for dioxins which was not excavated during the Time-Critical Removal Action. OCDD (3.07 μg/kg) and 1,2,3,4,6,7,8-HpCDD (0.67 μg/kg) were detected in this sample.

Concentrations of metals were generally higher in surface soils than in subsurface soils. Maximum concentrations of all metals detected in surface and subsurface samples exceeded NSB-NLON background with the exceptions of boron (in surface soils) and aluminum (in subsurface soils). Maximum concentrations of copper, lead, sodium, and zinc in both surface and subsurface soils, and of mercury and nickel in surface soils only, exceeded NSB-NLON background levels by more than two orders of magnitude. Maximum concentrations of metals in surface soils were found in various soil samples collected in the northern half of the DRMO site. A majority of the maximum concentrations of metals in subsurface samples were found in the sample collected at a depth of 10 to 12 feet from boring 6TB17, located approximately 50 feet east of the Thames River shoreline and 40 feet north of the originally paved portion of the site. Cyanide was also detected at concentrations less than 8 mg/kg in 27 of 56 surface soil samples and one subsurface soil sample (6TB20).

Barium, cadmium, chromium, lead, mercury, selenium, and silver were detected in the TCLP analytical results of surface soil samples. With the exception of mercury, these same metals were detected in TCLP analytical results of subsurface soil samples. The volatile organic compound 1,2-dichloroethane was also detected in the TCLP analysis of the subsurface soil sample from boring 6TB20. Maximum concentrations of all TCLP metals except silver in surface and subsurface samples exceeded Connecticut remediation standards for pollutant mobility for GA/GAA waters. The maximum concentration of lead in surface soils exceeded the associated Federal Toxicity Characteristic regulatory level (Table 1-1). All other inorganic concentrations are below Federal Toxicity Characteristic regulatory levels.

1.4.1.2 DRMO Pavement

Two pavement samples were collected in the scrap yard of the DRMO. Aroclor-1248, Aroclor-1254, and Aroclor-1260 were detected in both samples at concentrations ranging from 171 μg/kg to 388 μg/kg. Maximum concentrations of all three Aroclors were found in the pavement sample from boring 19. Lead was also detected in both samples at concentrations of 10.6 mg/kg and 25.0 mg/kg from borings 19 and 20, respectively.

1.4.1.3 DRMO Groundwater

The analytical results for groundwater samples collected during the Phase I RI and Rounds 1 and 2 of the Phase II RI are summarized in Tables 1-2 through 1-4.

Limited organic contamination was noted in these samples. Trichloroethene, 1,1-dichloroethane, and 1,2-dichloroethene (total) were detected in from one to three shallow Phase I RI samples at concentrations of 8 μg/L or less. Maximum concentrations were all found in the sample from well 6MW4S, located in the center of the scrap yard. These same chemicals were detected, each in one shallow well sample, at concentrations of 3 μg/L or less during Round 1 of the Phase II RI. Carbon disulfide (3 μg/L) and 1,2-dichloroethene (total) (2 μg/L) were also each detected in one deep well sample during Round 1. During Round 2 of the Phase II RI, 1,2-dichloroethene (total), trichloroethene, and/or vinyl chloride were detected in the samples from two shallow wells (6GW3S and 6GW8S) at concentrations of 8 μg/L or less. Trichloroethene (2 μg/L) was detected in deep well sample 6GW6D.

Benzoic acid (21 μg/L) and bis(2-ethylhexyl)phthalate (10 μg/L) (detected in the sample from well 6MW5D, located north east (upgradient) of the DRMO site) were the only SVOCs detected during the Phase I RI. Several phthalate esters, benzoic acid, and 1,4-dichlorobenzene were detected in groundwater samples during Round 1 of the Phase II RI; each was detected in only one sample at a concentration of 5 μg/L or less. Two PAHs were also detected, each at 1 μg/L, in the sample from deep well 6MW2D, located near the northwest corner of Building 355. Bis(2-ethylhexyl)phthalate and phenol (0.7 μg/L and 3 μg/L, respectively, in sample 6GW6D) were the only semivolatiles detected in Round 2 Phase II RI samples. No pesticides or PCBs were detected in any of the groundwater samples collected from the DRMO.

Maximum concentrations of most metals detected during the Phase I RI were found in the sample from shallow well 6MW4S, located in the center of the scrap yard. Since this well was later abandoned, no further data were available for well 6MW4S. Maximum concentrations of a majority of metals detected during the Phase II RI were found in samples from wells 6MW2S and 6MW2D, located near the northeast corner of Building 355. Concentrations of metals were generally higher in deep wells than in shallow wells. Notable concentrations of arsenic (C_{max} = 21 μg/L in 6GW2D), lead (C_{max} = 52.7 μg/L in 6GW2S), and manganese (C_{max} = 1,440 μg/L in 6GW2D) were detected in groundwater samples.

Based on the levels of uncertainty reported with results (i.e., uncertainty levels are greater than results) for gross alpha in all samples for which gross alpha was analyzed, and for gross beta in samples 6MW2S and 6MW3S, gross alpha and gross beta were considered as not detected in these samples. With this in mind, gross beta was detected in shallow well samples at concentrations ranging from 6.3 pCi/L to 180 pCi/L and in

TABLE 1-2

DRMO FS
SUMMARY OF PHASE I GROUNDWATER ANALYTICAL RESULTS (UNFILTERED)
NSB-NLON, GROTON, CONNECTICUT

Analyte	Shallow Wells [1]			Deep Wells [2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)						
1,1-Dichloroethane	1/5	2	6MW4S	0/1	-	ND [3]
1,2-Dichloroethene (total)	3/5	1-2	6MW4S	0/1	-	ND
Trichloroethene	3/5	1-8	6MW4S	0/1	-	ND
SEMIVOLATILE ORGANICS (ug/L)						
Benzoic acid	0/5	-	ND	1/1	21	6MW5D
Bis(2-ethylhexyl)phthalate	0/5	-	ND	1/1	10	6MW5D
INORGANICS (ug/L)						
Arsenic	3/5	3.35-18.6	6MW4S	0/1	-	ND
Barium	4/5	27.9-86.2	6MW4S	1/1	33.9	6MW5D
Cadmium	3/5	2.1-4	6MW4S	0/1	-	ND
Calcium	5/5	6970-170000	6MW4S	1/1	10600	6MW5D
Copper	5/5	8-355	6MW4S	1/1	9.4	6MW5D
Iron	5/5	102-4880	6MW5S	0/1	-	ND
Lead	1/5	3.4	6MW5S	0/1	-	ND
Magnesium	5/5	1270-396000	6MW4S	1/1	1000	6MW5D
Manganese	5/5	20.1-1000	6MW5S	1/1	84.5	6MW5D
Mercury	0/5	-	ND	1/1	0.3	6MW5D
Nickel	2/5	11.7-23.2	6MW4S	0/1	-	ND
Potassium	5/5	3230-123000	6MW4S	1/1	3460	6MW5D
Selenium	4/5	9.9-23.5	6MW4S	0/1	-	ND
Sodium	5/5	7470-3350000	6MW4S	1/1	14600	6MW5D
Zinc	5/5	11.25-356	6MW4S	1/1	13.8	6MW5D

NOTES:

1 Includes samples 6MW1S, 6MW2S, 6MW3S, 6MW6S (field duplicate of 6MW3S), 6MW4S, and 6MW5S. Duplicate sample results are averaged and counted as one sample.

2 Includes sample 6MW5D.

3 ND - Not Detected

TABLE 1-3

DRMO FS
SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentratio Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentratio Range	Location of Maximum Detection
VOLATILE ORGANICS												
1,1-Dichloroethane	1/6	3	6MW8S	-	-	NA (3)	0/3	-	ND (4)	-	-	NA
1,2-Dichloroethene (total)	1/6	1	6MW3S	-	-	NA	1/3	2	6MW3D	-	-	NA
Carbon disulfide	0/6	-	ND	-	-	NA	1/3	3	6MW2D	-	-	NA
Trichloroethene	1/6	2	6MW3S	-	-	NA	0/3	-	ND	-	-	NA
SEMIVOLATILE ORGANICS												
1,4-Dichlorobenzene	1/5	0.5	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Benzo(g,h,i)perylene	0/5	-	ND	-	-	NA	1/3	1	6MW2D	-	-	NA
Benzoic acid	1/5	1	6MW3S	-	-	NA	0/3	-	ND	-	-	NA
Bis(2-ethylhexyl)phthalate	1/5	4	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Di-n-butyl phthalate	1/5	1	6MW3S	-	-	NA	0/3	-	ND	-	-	NA
Di-n-octyl phthalate	0/5	-	ND	-	-	NA	1/3	5	6MW3D	-	-	NA
Diethyl phthalate	1/5	2.5	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Dimethyl phthalate	1/5	0.9	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Indeno(1,2,3-cd)pyrene	0/5	-	ND	-	-	NA	1/3	1	6MW2D	-	-	NA
INORGANICS												
Aluminum	3/5	27.05-2090	6MW2S	0/5	-	ND	2/3	1140-19300	6MW2D	0/3	-	ND
Arsenic	2/5	2-4.3	6MW2S	1/5	4.2	6MW2S	1/3	15.6	6MW2D	0/3	-	ND
Barium	5/5	10.3-75.4	6MW6S	4/5	11.5-73.3	6MW6S	3/3	29.1-288	6MW3D	2/3	156-270	6MW3D
Boron	4/5	474.5-1580	6MW2S	4/5	483.5-1560	6MW2S	3/3	101-2370	6MW2D	3/3	89.8-2420	6MW2D
Cadmium	1/5	2.6	6MW6S	0/5	-	ND	0/3	-	ND	0/3	-	ND
Calcium	5/5	24700-140000	6MW2S	5/5	23900-140000	6MW2S	3/3	23400-274000	6MW3D	3/3	22600-275000	6MW3D
Chromium	1/5	6.3	6MW2S	0/5	-	ND	1/3	47.6	6MW2D	1/3	3.2	6MW2D
Cobalt	0/5	-	ND	0/5	-	ND	2/3	4.6-14.3	6MW2D	0/3	-	ND
Copper	3/5	4.1-50.4	6MW2S	3/3	2-3.4	6MW1S	1/2	63.1	6MW2D	2/2	3.2-18	6MW3D
Iron	5/5	129-3170	6MW2S	2/5	144-536	6MW3S	3/3	6880-39400	6MW2D	3/3	2670-3990	6MW3D
Lead	3/5	1.6-52.7	6MW2S	0/5	-	ND	2/3	45.6-50.9	6MW2D	1/3	2.4	6MW3D
Magnesium	5/5	6890-411000	6MW2S	5/5	5630-411000	6MW2S	3/3	11000-729000	6MW3D	3/3	10900-726000	6MW3D
Manganese	4/5	14.3-602	6MW7S	4/5	5.5-606	6MW7S	3/3	852-1340	6MW2D	3/3	693-1060	6MW3D
Mercury	1/5	0.21	6MW2S	1/5	0.2	6MW1S	0/3	-	ND	0/3	-	ND
Nickel	0/5	-	ND	1/5	10.4	6MW3S	2/3	19.8-32.9	6MW2D	2/3	10.8-12.9	6MW6D
Potassium	5/5	4440-187000	6MW2S	5/5	4000-184000	6MW2S	3/3	7450-364000	6MW2D	3/3	6890-373000	6MW2D
Sodium	5/5	54100-3800000	6MW2S	5/5	5700-387000	6MW2S	3/3	87900-6490000	6MW3D	3/3	7400-750000	6MW3D

TABLE 1-3

DRMO FS
SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Shallow Wells [1]						Deep Wells [2]					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentratio Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentratio Range	Location of Maximum Detection
Vanadium	2/5	28-42.4	6MW2S	2/5	12.6-19.5	6MW3S	1/2	64.2	6MW2D	0/1	-	ND
Zinc	2/5	4.8-81.9	6MW2S	1/5	3.7	6MW1S	1/3	113	6MW2D	1/3	22.2	6MW3D
MISCELLANEOUS PARAMETERS												
BOD (mg/L) [5]	1/1	46.8	6MW3S	-	-	NA	-	-	NA	-	-	NA
COD (mg/L) [6]	1/1	198	6MW3S	-	-	NA	-	-	NA	-	-	NA
Hardness as $CaCO_3$ (mg/	3/3	84-1600	6MW3S	-	-	NA	3/3	112-4800	6MW3D	-	-	NA
Total organic carbon (mg/	1/1	3.3	6MW3S	-	-	NA	-	-	NA	-	-	NA
Total phosphorus (mg/L)	1/1	0.73	6MW3S	-	-	NA	-	-	NA	-	-	NA
TSS (mg/L) [7]	1/1	8	6MW3S	-	-	NA	-	-	NA	-	-	NA
Oil & grease (mg/L)	1/1	700	6MW3S	-	-	NA	-	-	NA	-	-	NA

NOTES:

1 Includes samples 6GW1S, 6GW2S, 6GW3S, 6GW6S, 6GW7S, 6GW7S-D (field duplicate of 6GW7S), and 6GW8S. Duplicate sample results are averaged and counted as one sample.
2 Includes samples 6GW2D, 6GW3D, and 6GW6D.
3 Not Analyzed.
4 Not Detected.
5 BOD - Biochemical Oxygen Demand.
6 COD - Chemical Oxygen Demand.
7 TSS - Total Suspended Solids.

TABLE 1-4

DRMO FS
SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Shallow Wells [1]						Deep Wells [2]					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
1,2-Dichloroethene (total)	2/6	2-8	6MW8S	-	-	NA [3]	0/3	-	ND	-	-	NA
Trichloroethene	2/6	4-6	6MW3S	-	-	NA	1/3	2	6MW6D	-	-	NA
Vinyl chloride	1/6	5	6MW8S	-	-	NA	0/3	-	ND	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
Bis(2-Ethylhexyl)phthalate	0/5	-	ND	-	-	NA	1/3	0.7	6MW6D	-	-	NA
Phenol	0/5	-	ND	-	-	NA	1/3	3	6MW6D	-	-	NA
INORGANICS (ug/L)												
Aluminum	0/5	-	ND	1/5	327	6MW2S	2/3	88.85-806	6MW2D	0/3	-	ND
Antimony	0/3	-	ND	1/5	5.7	6MW3S	0/2	-	ND	0/3	-	ND
Arsenic	3/5	10-20	6MW1S	1/5	14	6MW2S	2/3	2.65-21	6MW2D	1/3	12	6MW2D
Barium	1/5	94.4	6MW7S	3/5	25.5-116	6MW7S	3/3	28.6-242	6MW3D	3/3	13.35-297	6MW3D
Beryllium	0/5	-	ND	0/5	-	ND	1/3	1	6MW3D	0/3	-	ND
Boron	4/5	1280-1880	6MW2S	4/5	1360-1940	6MW2S	3/3	87.4-2340	6MW2D	3/3	85.5-2410	6MW3D
Calcium	5/5	19300-176000	6MW2S	5/5	19200-178000	6MW2S	3/3	15150-268000	6MW3D	3/3	13400-326000	6MW3D
Cobalt	0/5	-	ND	1/5	3	6MW7S	1/3	11.6	6MW6D	1/3	3.5	6MW3D
Copper	3/5	4.7-6.8	6MW2S	2/5	4.8-31.9	6MW7S	1/3	9.7	6MW2D	2/3	5.2-21.2	6MW3D
Iron	5/5	8.7-235	6MW7S	4/5	5.7-361	6MW7S	3/3	5690-44550	6MW6D	3/3	67.55-14100	6MW3D
Magnesium	5/5	4610-538000	6MW2S	5/5	4370-602000	6MW1S	3/3	8490-949000	6MW3D	3/3	8110-966000	6MW3D
Manganese	3/5	23-1010	6MW7S	4/5	1.2-1130	6MW7S	3/3	649-1440	6MW2D	3/3	18.65-1460	6MW3D
Nickel	0/5	-	ND	0/5	-	ND	1/3	24.1	6MW6D	1/3	17.5	6MW3D
Potassium	5/5	3010-210000	6MW2S	5/5	3220-224000	6MW2S	3/3	14500-313000	6MW2D	3/3	14500-317000	6MW2D
Sodium	5/5	50600-5160000	6MW2S	5/5	48200-5540000	6MW2S	3/3	09500-756000	6MW3D	3/3	10000-773000	6MW3D
Vanadium	1/4	7.6	6MW2S	2/4	4.9-5.1	6MW3S	1/2	5.45	6MW6D	1/2	3.1	6MW3D
Zinc	1/5	11	6MW7S	2/5	7.1-16.1	6MW1S	2/3	4.2-105	6MW6D	0/3	-	ND
MISCELLANEOUS PARAMETERS												
Ammonia, as nitrogen (m	1/1	3.1	6MW3S	-	-	NA	-	-	NA	-	-	NA
COD (mg/L) [5]	1/1	312	6MW3S	-	-	NA	-	-	NA	-	-	NA
Hardness as $CaCO_3$ (mg/	5/5	72-3150	6MW2S	-	-	NA	3/3	70-4700	6MW3D	-	-	NA
Total organic carbon (mg/	1/1	2.5	6MW3S	-	-	NA	-	-	NA	-	-	NA

TABLE 1-4

DRMO FS
SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
NSB-NLON, GROTON, CONNECTICUT
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Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Total phosphorus (mg/L)	1/1	1	6MW3S	-	-	NA	-	-	NA	-	-	NA
TSS (mg/L) (6)	1/1	1	6MW3S	-	-	NA	-	-	NA	-	-	NA
Oil & grease (ug/L)	1/1	500	6MW3S	-	-	NA	-	-	NA	-	-	NA

NOTES:

1 Includes samples 6GW1S-2, 6GW2S-2, 6GW3S-2, 6GW6S-2, 6GW7S-2, and 6GW8S-2.
2 Includes samples 6GW2D-2, 6GW3D-2, 6GW6D-2, and 6GW6D-D-2 (field duplicate of 6GW6D-2). Duplicate sample results are averaged and counted as one sample.
3 Not Analyzed.
4 Not Detected.
5 COD - Chemical Oxygen Demand.
6 TSS - Total Suspended Solids.

the deep well sample 6MW5D at 3.1 pCi/L. Complete gamma spectrum analysis was performed only for samples from well 6MW1S collected during Rounds 1 and 2 of the Phase II RI. Only naturally occurring potassium-40 (140 pCi/L) was detected in the Round 2 Phase II RI sample from this well.

1.4.1.4 DRMO Surface Water

A surface water sample was collected in the Thames River. No organic chemicals were detected in the surface water sample. Several metals were detected including aluminum, calcium, copper, iron, magnesium, manganese, potassium, selenium, sodium, and zinc. Based on the levels of uncertainty reported with the laboratory results (i.e., uncertainty levels are greater than results), gross alpha and gross beta were considered as not detected in this sample.

1.4.2 Summary of Baseline Human Health Risk Assessment

A human health risk assessment was performed for the DRMO during the Phase II RI following the procedures described in Section 3.3 of the Phase II RI report (B&R Environmental, March 1997). The risks are associated with the soil remaining at the site. In order to determine if significant risks exist for potential human receptors at the DRMO, the risk assessment information contained in the Phase II RI Report was reviewed. The risk assessment conducted for the Phase II RI followed the most recent guidance from the U.S. EPA (U.S. EPA, December 1989 and March 25, 1991), including Regional guidance (U.S. EPA Region 1, August 1995, August 1994, and June 1989). To be consistent with this guidance, the original Phase II risk assessment did not include unvalidated soil analyte data. Because some of the concentrations in the unvalidated laboratory data exceeded those of the validated data, risks were recalculated using the combined validated and unvalidated data.

COC selection was repeated by comparing the new maximum concentrations to Region III residential soil screening levels. For soil, four additional COCs were selected including benzo(k)fluoranthene, barium, mercury, and nickel. Details of the revised COC selection process for human health risk assessment are provided in Appendix A.

The final list of potential COCs for soil at the DRMO consist of:

- VOCs: 1,1,2,2-tertrachloroethane and vinyl chloride.
- PAHs: benzo(a) anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- PCBs: Aroclors-1254 and -1260.
- Dioxins: 1,2,3,4,6,7,8-HpCDD and OCDD.
- Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, thallium, vanadium, and zinc.

Vinyl chloride, 1,1,2,2-tetrachloroethane, dibenz(a,h)anthracene, and dioxins were retained for the "all soil" (soil from depths of 0 to 10 feet) category only. Dioxins were not found at detectable levels in the surface soil samples.

Risks were recalculated for all original COCs including all previous scenarios and receptors. Risks were calculated for the first time for the new COCs. All exposure input parameters, except for analyte concentrations, remained the same.

It should also be noted that, although such a future land use scenario is extremely unlikely, the possibility of the DRMO site being used for residential purposes was considered for the determination of human health risks. This was done because the DRMO site constitutes riverfront real estate and that, since traditionally this kind of property has been highly desirable for residential development, such a future land use scenario cannot be completely ruled out.

Maximum soil detections were also compared to U.S. EPA's Soil Screening Levels (SSLs) for migration to groundwater in the Phase II RI. Maxima site concentrations exceeded SSLs (Generic SSLs, Soil Screening Guidance: EPA/540/R-95/128, May 1996) for antimony, arsenic, barium, cadmium, chromium, lead, mercury, nickel, silver, thallium, zinc, 1,1-dichloroethane, 1,2-dichloroethene (total), 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethene, vinyl chloride, methylene chloride, trichloroethene, 1,2,4-trichlorobenzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, Aroclors-1254, Aroclor-1260, hexachlorophenyl, and dieldrin. These chemicals may migrate to groundwater and potentially impact water quality.

For groundwater, all data from both shallow and deep wells were used to identify potential COCs. The following chemicals were retained for this medium:

- Halogenated aliphatic hydrocarbons (1,2-dichloroethene, trichloroethene, and vinyl chloride).
- 1,4-Dichlorobenzene
- Bis(2-ethylhexyl)phthalate
- Indeno(1,2,3-cd)pyrene
- Metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, lead, manganese, selenium and vanadium)

For screening purposes, concentrations of these chemicals were compared to Federal Maximum Contaminant Levels (MCLs). This comparison showed that maximum detections of trichloroethene, vinyl chloride, bis(2-ethylhexyl)phthalate, antimony, and lead exceeded primary MCLs. Antimony, which was not detected in the unfiltered samples, was selected as a COC in the Phase II RI because the concentration of this chemical in filtered sample 6GW3S exceeded the risk-based screening level.

One site surface water sample, 6SW1, was collected during the Phase I RI. Aluminum, copper, iron, manganese, selenium, zinc, and several primary inorganic human nutrients were detected at varying concentrations in this sample. All detections were below the risk-based COC screening criteria for tap water ingestion and National Ambient Water Quality Criteria (NAWQCs). No COCs were identified in the Phase II RI for surface water, indicating that potential exposure to this medium would result in minimal risks.

The following paragraphs summarize the estimated cumulative risks, and Table 1-5 presents a summary of the estimated risks (including those from validated and unvalidated data). Multiple potential receptor groups were considered for the DRMO including an older child trespasser, construction worker, future residents, and full-time employees. Carcinogenic risks, as quantified by lifetime Incremental Cancer Risks (ICRs), were compared to the U.S. EPA's target risk range of 1E-4 to 1E-6. Most cumulative ICRs were either less than 1E-6 or within the U.S. EPA's target risk range. An exception was a cumulative ICR of 1.4E-4 for future residents under the Reasonable Maximum Exposure (RME) scenario which assumes exposure to maximum concentrations of contaminants. In this case, potential risks are attributable to ingestion of soil containing PAHs, PCBs, dioxins, arsenic, and beryllium, as well as dermal contact with PCBs and inhalation of fugitive dust containing chromium. In general, exposure to soil contributes the

TABLE 1-5

DRMO FS
ESTIMATED HUMAN HEALTH RISKS
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Full-Time Employee		Construction Worker		Older Child Trespasser		Future Resident	
	RME(1)	CTE(2)	RME	CTE	RME	CTE	RME	CTE
HAZARD INDEX								
Incidental Ingestion of Soil	1.6E+0	5.9E-2	2.5E+0	1.9E-1	2.1E+0	3.4E-2	1.8E+0	2.1E-1
Dermal Contact with Soil(3)	2.9E+0	4.2E-2	9.6E-1	3.1E-2	3.1E+0	2.0E-2	1.6E+0	7.9E-2
Inhalation of Fugitive Dust and Volatile Emissions	NA(4)	NA	2.3E-2	1.2E-2	NA	NA	3.9E-2	2.0E-2
Dermal Contact with Groundwater	NA	NA	5.2E-1	1.3E-1	NA	NA	NA	NA
Cumulative Risk	**4.5E+0**	**1.0E-1**	**4.0E+0**	**3.6E-1**	**5.2E+0**	**5.4E-2**	**3.4E+0**	**3.1E-1**
INCREMENTAL CANCER RISK								
Incidental Ingestion of Soil	3.8E-5	7.6E-7	5.2E-6	4.1E-7	2.0E-5	2.1E-7	1.1E-4	4.2E-6
Dermal Contact with Soil(3)	3.9E-5	5.9E-8	5.1E-7	8.7E-9	1.7E-5	1.4E-8	2.5E-5	2.0E-7
Inhalation of Fugitive Dust and Volatile Emissions	NA	NA	5.0E-7	3.0E-7	NA	NA	5.6E-6	1.0E-6
Dermal Contact with Groundwater	NA	NA	4.3E-7	2.1E-7	NA	NA	NA	NA
Cumulative Risk:	**7.7E-5**	**8.2E-7**	**6.6E-6**	**9.3E-7**	**3.7E-5**	**2.2E-7**	**1.4E-4**	**5.4E-6**

NOTES:
1 RME - Reasonable Maximum Exposure.
2 CTE - Central Tendency Exposure.
3 Quantitative evaluation performed for cadmium, PCBs, and dioxins (if detected).
4 NA - Not applicable; exposure route not evaluated for this receptor.
Shading denotes exceedance of U.S. EPA's risk criteria

most to the cumulative cancer for all receptors. COCs for exposure to soil include PCBs (Aroclors), PAHs [especially benzo(a)pyrene] with somewhat less risk from certain inorganic contaminants (arsenic and beryllium).

Noncarcinogenic risks, as quantified by Hazard Indices (HIs), were compared to unity (1.0). For all receptors considered, the cumulative HIs under the RME scenario exceeded 1.0. HIs did not exceed unity for any receptor under the Central Tendency Exposure (CTE) scenario which assumes exposure to average concentrations of contaminants. Most risks stem from ingestion of and dermal contact with soils. The majority of the risk is contributed by the PCBs. Most of the remaining risks are attributable to antimony, cadmium, and, to some extent, chromium in soil. Exposure to lead in the soil at the DRMO was addressed in the Phase II RI using the U.S. EPA IEUBK model for lead uptake from soil. Although the conclusion in the Phase II RI was that blood levels would be below the level of concern for a child receptor (10μg/dL), higher soil concentrations (by over an order of magnitude) were detected in the unvalidated data from the confirmation sampling of the January 1995 time-critical removal action. The previously reported concentrations estimated blood lead levels of roughly half of the level of "concern" (10 μg/dL). However, because of the higher levels of lead reported in the results from the confirmation sampling of the January 1995 time-critical removal action (which remains unvalidated), it is expected that the corresponding blood level could be several times higher than the level of concern for a child receptor (10μg/dL) and, therefore, it is now concluded that lead is a COC for the soil at the DRMO.

There are numerous uncertainties associated with risk assessment, as discussed in the methodology section of the Phase II RI Report (B&R Environmental, March 1997). Typically, these arise from prediction of exposure pathways, selection of exposure assessment input parameters, reliability of toxicity values, determination of exposure point concentrations, potential for synergistic or antagonistic effects from chemical mixtures and various other factors. For the purpose of this risk assessment, the use of unvalidated data adds considerable uncertainty because this new data shows higher contaminant concentrations, and therefore greater potential risks. However, since the data is unvalidated, it is not clear whether these greater potential risks reflect actual site conditions.

For several chemicals, there are no available human health criteria. Therefore, these chemicals were not selected for quantitative analysis. Usually related materials have been selected (presumably with similar relative toxicity) and overall conclusions should not change significantly. In the Phase II RI Report (B&R Environmental, March 1997), several inorganic compounds are listed as falling below background levels. Upon reanalysis, this was not the case for any inorganic compounds.

In general, uncertainties are biased toward a conservative approach. This becomes apparent, to some degree, when CTE risk values are compared to the more conservative RME determinations.

1.4.3 Summary of Ecological Risk Assessment

An ecological risk assessment was performed for the DRMO during the Phase II RI following the procedures described in Section 3.4 of the Phase II RI report (B&R Environmental, March 1997). The ecological risk assessment for the DRMO consisted of an evaluation of contaminants in soils. Contaminant concentrations were compared to benchmark values protective of various terrestrial ecological receptors. Potential risks to terrestrial vegetation, soil invertebrates, and terrestrial vertebrates were evaluated. Both the maximum and average chemical concentrations in surface soils were compared to benchmark values protective of the terrestrial ecological receptors and Hazard Quotients (HQs) were determined. The HQs determined for this site are summarized in Tables 1-6 through 1-9. Chemicals associated with the DRMO were considered to represent a risk to receptors if the HQs exceeded 1.0. Risks to terrestrial receptors are expressed in terms of Hazard Indices (HIs), which are a sum of chemical-specific HQs. Tables 1-10 and 1-11 contain HI values calculated for each receptor exposed to the maximum and average surface soil chemical concentrations associated with the DRMO. Results of these comparisons indicate that terrestrial receptors exposed to both the maximum and average concentrations are potentially at risk.

The ecological risk assessment concluded that exposure to surface soils could adversely impact terrestrial ecological receptors using highly conservative estimates. However, the DRMO does not provide a suitable ecological habitat (paving, buildings, cap, etc.), and actual risks to ecological receptors are likely to be much less than those calculated for this area. It is unlikely that ecological receptors will utilize this area, essentially eliminating the possibility that these receptors will be exposed to these chemicals. Furthermore, the presence of the cap effectively eliminates direct contact with soil at the site. When the current site conditions are factored into this evaluation, it is concluded that soil at the DRMO represents little potential risk to ecological receptors.

Sediment toxicity tests conducted during the Phase II RI, indicated that conditions at a sediment sample collected near the DRMO (EC-T3504) may adversely impact sensitive benthic macroinvertebrates. It is not known if contaminant migration from the DRMO us the cause of these conditions. The major ecological concern is potential future transport of contaminated soils or groundwater to the Thames River.

TABLE 1-6

DRMO FS
MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VEGETATION BASED ON MAXIMUM CONCENTRATIONS
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	2.0E+2
Antimony	3.8E+0
Boron	5.8E+0
Cadmium	1.4E+0
Chromium	2.8E+1
Copper	2.9E+0
Mercury	2.9E+0
Silver	3.1E+0
Vanadium	1.7E+1
Zinc	5.7E+2

TABLE 1-7

DRMO FS
MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VEGETATION
BASED ON MEAN CONCENTRATIONS
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	1.6E+2
Antimony	1.5E+0
Boron	3.3E+0
Cadmium	1.0E+0
Chromium	2.1E+1
Copper	1.4E+0
Mercury	1.3E+0
Vanadium	1.3E+1
Zinc	4.5E+1

TABLE 1-8

DRMO FS
MAJOR CONTRIBUTORS TO RISK FOR SOIL INVERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Copper	9.7E+0
Lead	7.7E+0
Zinc	5.7E+0
Chromium	1.1E+0

TABLE 1-9

DRMO FS
MAJOR CONTRIBUTORS TO RISK FOR SOIL INVERTEBRATES
BASED ON MEAN CONCENTRATIONS
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Copper	4.6E+0
Lead	2.6E+0

TABLE 1-10

DRMO FS
MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-tailed Shrew	Antimony	3.4E+2	37.4
	Vanadium	7.2E+1	7.9
	Zinc	2.4E+2	26.4
	Lead	5.6E+1	6.1
	All others	2.0E+2	22.2
	Total Receptor HI	9.2E+2	
	Pathway	**Total HI per Pathway**	**% Contribution of Pathway to Total Receptor HI**
	Soil	4.7E+2	51.5
	Food	4.5E+2	48.5
	Water	0.0E+0	0.0
	Chemicals of Concern	**Total HI per COC for all Pathways**	**% Contribution of COC to Total Receptor HI**
Red-tailed Hawk	Zinc	1.7E+2	88.9
	4,4'-DDT	3.3E+0	1.7
	Antimony	7.8E+0	4.2
	4,4'-DDD	2.8E+0	1.5
	All others	6.9E+1	3.7
	Total Receptor HI	1.9E+2	
	Pathway	**Total HI per Pathway**	**% Contribution of Pathway to Total Receptor HI**
	Soil	5.9E+1	31.4
	Food	1.3E+2	68.6
	Water	0.0E+0	0.0

NOTES:
HI - Hazard Index
COC - Contaminant of Concern

TABLE 1-11

DRMO FS
MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MEAN CONCENTRATIONS
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Antimony	1.4E+2	58.8
	Zinc	1.9E+1	8.2
	Lead	1.9E+1	8.1
	Thallium	1.9E+1	8.0
	All others	4.0E+1	16.9
	Total Receptor HI	2.4E+2	
	Pathway	**Total HI per Pathway**	**% Contribution of Pathway to Total Receptor HI**
	Soil	1.3E+2	56.5
	Food	1.0E+2	43.5
	Water	0.0E+0	0.0
	Chemicals of Concern	**Total HI per COC for all Pathways**	**% Contribution of COC to Total Receptor HI**
Red-Tailed Hawk	Zinc	1.3E+1	73.7
	Antimony	3.1E+0	17.5
	Thallium	7.0E-1	3.9
	Cobalt	4.0E-1	2.2
	All others	4.8E-1	2.7
	Total Receptor HI	1.8E+1	
	Pathway	**Total HI per Pathway**	**% Contribution of Pathway to Total Receptor HI**
	Soil	8.0E+0	44.6
	Food	9.9E+0	55.4
	Water	0.0E+0	0.0

NOTES:
HI - Hazard Index
COC - Contaminant of Concern

1.4.4 Conclusions

The following conclusions are based on the information provided in Sections 1.4.1 through 1.4.3.

- The majority of the contamination in the soil has been removed and the area has been capped. A Time-Critical Removal Action has been conducted at this site which included removal of 4,700 tons of contaminated soil to a maximum depth of 3 feet below the ground surface.

- The groundwater is not significantly affected at the site. Although halogenated organics such as 1,2-dichloroethene and trichloroethene were detected in isolated soil samples at concentrations ranging to 16,000 and 7,100 μg/kg, respectively, the maximum concentrations in groundwater wells less than 100 feet downgradient of the soil detections yielded 8 μg/L for each of these constituents.

  There were several scenarios of exposure for which human health risks exceed established "safe" ranges. In many instances the ranges are minimally exceeded. Noncarcinogenic HIs are greater than unity for the employee, construction worker, trespasser, and future resident under the RME scenario. His do not exceed unity for any receptors under the CTE scenario. All lifetime cumulative ICRs were within the U.S. EPA's acceptable target risk range of 1E-6 to 1E-4, with the exception of the RME future resident. It should be noted that the risk scenarios assumed direct exposure to soil and groundwater at the DRMO. Exposure to soil at the DRMO is impossible due to the presence of the asphalt cap with the exception of the construction worker which assumes deliberate excavation and contact. However, it is required (per OSHA standards for work on hazardous waste sites) that health and safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker to acceptable levels. In addition, it is unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would, therefore, lower the risk to the future resident to U.S. EPA's acceptable levels.

- Ecological risks are low for the DRMO. The ecological risk assessment concluded that exposure to surface soils could adversely impact terrestrial ecological receptors using highly conservative estimates. However, the DRMO does not provide a suitable ecological habitat due to the presence of paving, buildings, etc., and the asphalt cap effectively eliminates direct soil contact. It is, therefore, concluded that soil at the DRMO represents little potential risk to ecological receptors.

- Sediment toxicity tests indicated that conditions at a sediment sample location near the DRMO may adversely impact sensitive benthic macroinvertebrates. It is not known if contaminant migration from the DRMO is the cause of these conditions. The major ecological concern is potential future transport of contaminated soil or groundwater to the Thames River.

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section develops remedial action objectives (RAOs) and derives preliminary remedial action goals (PRGs) for the contaminated media. The regulatory requirements and guidances (Applicable or Relevant and Appropriate Requirements [ARARs]) that may potentially govern remedial activities are presented in this section. In addition, this section presents the COCs and the conceptual pathways through which these chemicals may affect human health, and thus derives the environmental media of concern. The PRGs for the contaminated media are developed in this section, and general response actions that may be suitable to achieve the PRGs are presented. Finally, this section presents an estimate of the volumes of contaminated media.

2.1 REMEDIAL ACTION OBJECTIVES

The purpose of this section is to develop RAOs for the DRMO. Development of RAOs is a key step in the FS process. The RAOs are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and an acceptable range contaminant level (i.e., PRGs) for the site.

The development of PRGs takes into consideration ARARs and "to be considered" criteria (TBCs). Section 2.1.1 identifies the ARARs and TBCs, Section 2.1.2 identifies the media of concern, and Section 2.1.3 identifies the COCs for remediation.

2.1.1 Statement of Remedial Action Objectives

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. RAOs may be developed to permit consideration of a range of treatment and containment alternatives. This FS addresses soil contamination at the DRMO. To protect the public from potential current and future health risks, as well as to protect the environment, the following RAOs have been developed:

- Prevent exposure (unacceptable risk) to receptors under either a current industrial or future, possible although unlikely, residential land use scenario either through institutional controls and/or removal/treatment/disposal.

- Prevent unacceptable risk to ecological receptors in the Thames River from potential migration of DRMO contaminants.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

ARARs consist of the following:

- Any standard, requirement, criterion, or limitation under Federal environmental law.

- Any promulgated standard, requirement, criteria, or limitation under a state environmental or facility-siting law that is more stringent than the associated Federal standard, requirement, criterion, or limitation.

TBCs are nonpromulgated, nonenforceable guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment. Examples of TBCs include U.S. EPA's Drinking Water Health Advisories, Reference Doses, and Cancer Slope Factors.

One of the primary concerns during the development of remedial action alternatives for hazardous waste sites under CERCLA or "Superfund" is the degree of human health and environmental protection offered by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent Federal and state environmental requirements.

2.1.2.1 Definitions

The definitions of ARARs are given below:

- Applicable Requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and Appropriate Requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law, while not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

- TBCs are a category created by the U.S. EPA that includes non-promulgated criteria, advisories, and guidance issued by Federal or state government that are not legally binding and do not have the status of potential ARARs. However, pertinent TBCs will be considered along with the ARARs in determining the necessary level of cleanup or technology requirements.

Under CERCLA Section 121(d)(4), the U.S. EPA may waive compliance with an ARAR if one of the following conditions can be demonstrated:

- The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control upon completion;

- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives;

- Compliance with the requirement is technically impracticable from an engineering perspective;

- The remedial action selected will attain a standard of performance that is equivalent to that required by the ARAR through the use of another method or approach;

- With respect to a state requirement, the state has not consistently applied the ARAR in similar circumstances at other remedial actions within the state; or

- Compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Superfund money for response at other facilities (fund-balancing). This condition only applies to Superfund-financed actions.

The National Oil and Hazardous Substances Pollution Contingency Plan (called the National Contingency Plan) has identified three categories of ARARs [40 CFR Section 300.400 (g)]:

- <u>Contaminant-Specific</u>: Health/risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include Maximum Contaminant Levels (MCLs) and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC).

- Location-Specific: Restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of these areas regulated under various Federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

- Action-Specific: Technology- or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include wastewater discharge standards.

This section discusses contaminant- and location-specific ARARs and TBCs. Action-specific ARARs and TBCs are presented in Section 2.3 along with the discussion of general response actions.

2.1.2.2 Contaminant-Specific ARARs and TBCs

This section presents a summary of Federal and state contaminant-specific ARARs and TBCs. All of these ARARs and TBCs provide some medium-specific guidance on “acceptable” or “permissible” concentrations of contaminants.

Tables 2-1 and 2-2 present a list of Federal and State of Connecticut's chemical-specific ARARs and TBCs for the DRMO FS.

2.1.2.3 Location-specific ARARs and TBCs

Table 2-3 and 2-4 present a list of Federal and State of Connecticut's location-specific ARARs and TBCs for the DRMO FS.

2.1.3 Media of Concern

Based upon the discussion in Section 1.0 involving toxicity and risk assessment for both ecological and human health receptors, the contaminated medium at the DRMO was determined to be soil (surface and subsurface). The DRMO is in an area where groundwater has recently (March 5, 1997) been reclassified as GB (nondrinking water source); therefore, drinking water standards are not considered ARARs for this site. However, several contaminants have been detected in the groundwater at concentrations which exceeded ARARs for the protection of surface water, therefore the groundwater is also a media of concern. If it is determined that the soil or groundwater is impacting the surface water of the Thames River, remedial alternatives will be developed to prevent further adverse impacts.

TABLE 2-1

DRMO FS
FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Cancer Slope Factors (CSFs)		TBC	CSFs are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Primary basis for development of human health protection PRGs for soil at this site.
Reference Dose (RfDs)		TBC	RfDs are guidance values used to evaluate the potential noncarcinogenic hazard caused by exposure to contaminants.	Primary basis for development of human-health protection PRGs for soil at this site.

TABLE 2-2

DRMO FS
STATE OF CONNECTICUT CHEMICAL-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no state chemical-specific ARARs.

TABLE 2-3

DRMO FS
FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Executive Order 11988 RÉ: Floodplain Management	Executive Order 11988	Applicable	Requires federal agencies, wherever possible, to avoid or minimize adverse impacts upon floodplains. Requires reduction of risk of flood loss, minimization of the impact of floods on human safety, health and welfare, and restoration and preservation of natural and beneficial values of floodplains.	Measures would be taken to minimize impacts to Thames River floodplain during any remedial activities. Remedial activities would not take place during periods of flooding.
Coastal Zone Management Act	16 USC Parts 1451 *et seq.*	Applicable	This act requires that any actions must be conducted in a manner consistent with state approved management programs.	This site is located in a state coastal flood zone (within the 100 year Floodplain). Therefore, applicable state coastal management requirements will be addressed.
Fish and Wildlife Coordination Act	16 USC Part 661 *et. seq.* ; 40 CFR Section 6.302	Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers. Consultation with U.S. Fish and Wildlife Service is needed to develop measures to prevent and mitigate loss.	USFWS and appropriate CT State department would be consulted on how to minimize impacts of any remedial activities on any wildlife that may be dependent on the Thames River.

TABLE 2-4

DRMO FS
STATE OF CONNECTICUT LOCATION-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Coastal Management Act	CGS 22a-90 to 112	Applicable	Requires project within a state-designated coastal zone to minimize adverse impacts on natural coastal resources.	Any remedial actions would be carried out so as to minimize impacts to coastal resources..
Tidal Wetlands	RCSA 22a-30-1 to 17	Applicable	Activities within or affecting tidal wetlands are regulated.	Any remedial action would be implemented so as to not negatively impact tidal resources.
CT Endangered Species Act	CGS 26-303 to 314	Applicable	Regulates activities affecting state-listed endangered or threatened species or their critical habitat.	The state-threatened Atlantic sturgeon inhabits the Thames River. Any remedial action, would be implemented so as to not negatively impact the sturgeon or any of its critical habitat which may occur within the river.

2.1.4 Chemicals of Concern for Remediation

COCs for the DRMO were determined based on a human health and ecological risk assessment and based on screening of maximum concentrations with state and Federal criteria. The final COCs will be comprised of chemicals in the soil and groundwater which impact the surface water of the Thames River. The COC list will be developed by comparing maximum detected chemical concentrations in the soil and groundwater to appropriate criteria as discussed below.

2.1.4.1 Soil Chemicals of Concern

CTDEP Soil Remediation Standards COCs

Site-specific soil data were compared to the State of Connecticut's remediation standards for direct exposure and pollutant mobility in the Phase II RI. Both validated and unvalidated analytical data were used for this comparison. Direct exposure criteria for residential exposure were used to conservatively evaluate potential exposure to the soil at the site. The following chemicals were found at maximum concentrations exceeding the state remediation standards for direct exposure under residential land use and were retained as COCs in the Phase II RI:

- 1,1,2,2-Tetrachloroethane
- Vinyl chloride
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Aroclor-1260
- Beryllium
- Chromium
- Zinc

Human Health Risk COCs

A human health risk assessment was performed under the Alternative Direct Exposure Scenario as allowed by CTDEP (see Section 1.4.2) to determine risks associated with exposure to site soils based on re-analyzed data. This risk assessment considered potential COCs which had concentrations that exceeded risk-based concentrations for contaminated soil. The human health risk assessment identified the following chemicals as COCs (i.e., chemicals contributing to a cumulative ICR > 1E-4 and/or an HI > 1.0) in the DRMO surficial and subsurface soil:

- Aroclors-1254 & 1260
- Hexachlorobiphenyl
- 1,2,3,4.6,7,8-HpCDD
- OCDD
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Lead
- Vinyl Chloride
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

These chemicals were retained in this FS as potential soil COCs for the protection of human health.

Ecological Risk COCs

In addition, the Phase II RI ecological risk assessment evaluated risk to ecological receptors associated with contamination in surface soil. The following compounds were identified as potential COCs:

- 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
- 4,4'-DDT
- 4,4'-DDD
- Aroclor 1260
- Aluminum
- Antimony
- Barium
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Manganese
- Mercury
- Silver
- Thallium
- Vanadium
- Zinc

The above listed chemicals were retained in this FS as potential surface soil COCs for the protection of ecological receptors.

Groundwater Protection COCs

To address concerns regarding migration of chemicals from soil to groundwater, maximum surface and subsurface soil concentrations were compared to Connecticut Department of Environmental Protection (CTDEP) Pollutant Mobility Criteria for soil in an area where groundwater has been designated as GA/GAA (CTDEP, December 1995) in the Phase II RI. Until recently, the groundwater classification at the DRMO site was GA but, in 1996, the Navy submitted an application to reclassify the groundwater to GB. In response to this application, a letter, dated October 21, 1996, was received by the Navy in which CTDEP stated that the application appears to meet the criteria for reclassification, pending the results of a public hearing. The public hearing was conducted December 13, 1996 and, as a result, reclassification occurred on March 5, 1997. Therefore, the list of COCs determined in the Phase II RI was revised to reflect chemicals detected in the soil above GB Pollutant Mobility Criteria. The following chemicals exceeded the pollutant mobility criteria for the protection of groundwater:

- 1,1,2,2-Tetrachloroethane
- 1,2-Dichloroethane
- 1,2-Dichloroethene (total)
- Trichloroethene
- Vinyl Chloride
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Fluorene
- Fluoranthene
- Naphthalene
- Phenanthrene
- Pyrene
- Heptachlor Epoxide
- Aroclors-1254 & 1260
- Hexachlorobiphenyl
- Cadmium
- Lead

However, since ground elevation at the DRMO is below the high seasonal water table and based upon discussions between the Navy, U.S. EPA, and CTDEP, the GB Pollutant Mobility Criteria have been identified as not applicable at the DRMO. Therefore, the contaminant list will be further screened in this FS to be protective of the surface water of the Thames River.

Surface Water Protection COCs

To determine soil COCs to be protective of the surface water of the Thames River, surface water quality values will be used to back calculate soil concentrations that will not adversely impact the Thames River. It is unlikely that human receptors will consume aquatic life that has only been exposed to contaminants from the DRMO. Therefore, surface water values protective of aquatic life will be used to calculate allowable soil values when available. Any of the above contaminants present in the soil above these calculated concentrations will be retained as COCs. An allowable soil value will be calculated to be protective of the surface water using the following equation:

$$PRG = \frac{SWV}{MCL \text{ or } HBL} \times SSL$$

Where:

SWV	=	Surface Water Quality Value
MCL	=	Federal Maximum Contaminant Level
HBL	=	Federal Health Based Limit
SSL	=	Federal Soil Screening Level

The proposed surface water quality screening values to be used for this calculation were derived from several sources and are based on chronic NAWQCs for fresh water. Values for several inorganic compounds, acenaphthene, fluoranthene, and endrin are based on chronic NAWQCs. These values were developed by the U.S. EPA for the protection of most aquatic species most of the time with a reasonable level of confidence (ORNL, 1996; Suter and Mabrey, 1994). All other proposed values are Tier II secondary chronic values. These values are presented in the Oak Ridge National Laboratory database of ecological benchmark values (ORNL, 1996). The methodology used to derive the Tier II chronic values is described in U.S. EPA's Proposed Water Quality Guidance for the Great Lakes System (U.S. EPA, 1993) and uses a similar approach to that used to derive NAWQCs but includes conservation factors which adjust for fewer data points. The value presented for heptachlor epoxide is based on the Tier II chronic value for heptachlor. CTDEP's Surface Water Protection Criteria (SWPCs) were used when NAWQCs were not available. The proposed values are all based on freshwater criteria.

The CTDEP's SWPCs were developed by considering the NAWQCs and a dilution factor of 10. The Remediation Standard Regulations allow for determination of a site specific SWPC based upon a higher dilution factor if the receiving body of water (Thames River) is of sufficient size. Based on minimum freshwater flows from the Shetucket and Yantic Rivers which join to form the Thames River, the approximate flow of the freshwater portion of the Thames River is 1,512,000 cubic feet/day (B&R Environmental, March 1997). In actuality, the flow rate in the Thames River is higher due to tidal exchange. The groundwater discharge into the Thames River from the DRMO is estimated to be 1,666 cubic feet/day (B&R Environmental, March 1997). The calculated dilution factor for the DRMO groundwater entering the Thames River is 226. Therefore, for conservativeness, a dilution factor of 100 was used to calculate site-specific SWPC values, which stands approximately mid-range between CTDEP's standard SWPC dilution factor of 10 and the calculated maximum dilution factor of 226.

Federal SSLs for the migration of chemicals to groundwater are available with a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface (U.S. EPA, May 1996). A DAF of 20 is acceptable for sites 0.5 acres in size. However, because the DRMO is larger, a DAF of 10 was used. To be conservative the DAF of 20 was divided by 2 to obtain an SSL with a 10 DAF. The Federal SSLs for pollutant mobility are based on achieving MCLs in the groundwater or a health based limit (HBL) calculated for a 30-year exposure duration, (ICR of 1E-6 or HI of 1.0).

Table 2-5 presents the calculated maximum soil concentrations that are protective of the surface water in the Thames River. Table 2-6 compares the maximum soil concentrations to their respective revised screening values. The following COCs based on protection of surface water will be retained for this FS:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Barium
- Cadmium
- Chromium
- Silver
- Zinc
- Benzoic Acid
- 4,4'-DDD
- Aroclors-1254 & 1260
- Hexachlorobiphenyl

In addition, the maximum groundwater concentrations for the soil contaminants that exceeded groundwater protection standards were compared to the surface water quality screening values a shown on Table 2-5. None of the above listed chemicals have been detected in the groundwater at concentration which exceed the calculated screening criteria for the protection of the surface water of the Thames River.

2.1.4.2 Groundwater Chemicals of Concern

The Phase II RI human health risk assessment did not identify any chemicals in the groundwater as a concern to human receptors. In addition, since at the DRMO there is no direct contact between ecological receptors and the groundwater, no COCs were identified for groundwater ecological risks.

Analytical groundwater data for the site were compared to Connecticut MCLs and remediation standards for groundwater and surface water protection. The groundwater protection criteria used in the Phase II RI were applicable for GA or GAA designated groundwater.

Although COCs were identified in the Phase II RI as a concern, the groundwater of the site was recently reclassified to GB as discussed in Section 2.1.4.1. Therefore, groundwater at the DRMO is not considered a drinking water source and the COCs identified for direct contact in the Phase II RI are not retained as COCs for this FS.

TABLE 2-5

DRMO FS
SUMMARY OF CONCENTRATIONS AND DETERMINATION OF SURFACE WATER PROTECTION LEVELS - SOIL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Maximum Concentrations			SSL	MCL (2)	HBL (3)	SW Quality	Calculated
	Soil - Sur	Soil - All	Groundwater	10 DAF (1)			Screening Values	Max Soil Conc.
	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/L	mg/L (4)	mg/kg
Aluminum	15400	18900	19.3	-(6)	0.05 - 0.2(11)	-(6)	8.7	-(6)
Antimony	134	134	ND	2.5	0.006	-(9)	3	1250.00
Arsenic	17	16.4	0.021	14.5	0.05	-(9)	19	5510.00
Barium	934	934	0.288	800	2	-(9)	0.4	160.00
Beryllium	14.3	24.9	0.001	31.5	0.004	-(9)	0.066	519.75
Boron	2.9	2.9	2.37	-(6)	-(6)	-(6)	0.16	-(6)
Cadmium	126	126	0.004	4	0.005	-(9)	0.11	88.00
Calcium	11500	16300	274	-(6)	-(6)	-(6)	-(6)	-(6)
Chromium	1210	1210	0.0476	19	0.1	-(9)	1.1	209.00
Cobalt	83.3	179	0.0143	-(6)	-(6)	-(6)	2.3	-(6)
Copper	7170	8730	0.355	-(6)	1.3	-(9)	1.2	-(6)
Cyanide	7.68	7.68	ND	20	0.2	-(9)	0.52	52.00
Iron	48600	103000	44.8	-(6)	-(6)	-(6)	100	-(6)
Lead	5980	5980	0.0527	400(8)	0.015	-(9)	0.32	8530.00
Magnesium	7190	7190	949	-(6)	-(6)	-(6)	-(6)	-(6)
Manganese	ND	1260	1.44	-(6)	0.05(11)	-(6)	12	-(6)
Mercury	3.25	20.7	0.0003	1	0.002	-(9)	0.13	65.00
Nickel	321	1250	0.0329	65	0.1	-(9)	16	10400.00
Potassium	6520	6520	364	-(6)	-(6)	-(6)	-(6)	-(6)
Selenium	0.773	0.773	0.0235	2.5	0.05	-(9)	0.039	1.95
Silver	24.3	24.3	ND	17	0.1(11)	-(9)	0.036	6.12
Sodium	4220	4220	7560	-(6)	-(6)	-(6)	-(6)	-(6)
Thallium	0.64	0.64	ND	0.35	0.002	-(9)	0.9	157.50
Vanadium	331	368	0.0642	3000	-(6)	0.3	2	20000.00
Zinc	28300	28300	0.356	6000	5(11)	-(9)	11	13200.00
1,4-Dichlorobenzene	ND	ND	0.0005	1	0.075	-(9)	1.5	20.00
1,1-Dichloroethane	0.0036	0.00625	0.003	11.5	-(6)	4	4.7	13.51
1,2-Dichloroethane	0.00668	0.00668	ND	0.01	0.005	-(9)	91	182.00
1,2-Dichoroethene (total)	ND	ND	0.008	0.2 (cis)	0.07 (cis)	-(9)	59	168.57
2-Butanone	0.0144	0.0144	ND	-(6)	-(6)	-(6)	1400	-(6)
Acetone	1.63	1.63	ND	8	-(6)	4	150	300.00
Benzene	0.00641	0.00641	ND	0.015	0.005	-(9)	13	39.00
Carbon Disulfide	0.00537	0.00537	0.003	16	-(6)	4	0.092	0.37
Chloroethane	ND	0.00155	ND	-(6)	-(6)	-(6)	-(6)	-(6)
Ethylbenzene	ND	0.00907	ND	6.5	0.7	-(9)	0.73	6.78
2-Hexanone	ND	0.00303	ND	-(6)	-(6)	-(6)	9.9	-(6)
Methylene Chloride	0.427	0.427	ND	0.01	0.005	-(9)	220	440.00
4-Methyl-2-pentanone	ND	0.00121	ND	-(6)	-(6)	-(6)	17	-(6)

TABLE 2-5

DRMO FS
SUMMARY OF CONCENTRATIONS AND DETERMINATION OF SURFACE WATER PROTECTION LEVELS - SOIL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Maximum Concentrations			SSL	MCL (2)	HBL (3)	SW Quality	Calculated
	Soil - Sur	Soil - All	Groundwater	10 DAF (1)			Screening Values	Max Soil Conc.
	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/L	mg/L (4)	mg/kg
4-Methylphenol	ND	0.209	ND	-(6)	-(6)	-(6)	0.013	-(6)
Styrene	0.00128	0.00259	ND	2	0.1	-(9)	-(6)	-(6)
1,1,2,2-Tetrachloroethane	ND	0.000178	ND	0.0015	-(6)	0.0004	61	228.75
Tetrachloroethene	0.0147	0.0147	ND	0.03	0.005	-(9)	9.8	58.80
Toluene	0.00986	0.0122	ND	6	1	-(9)	0.98	5.88
Trichloroethene	0.04	0.0931	0.008	0.03	0.005	-(9)	47	282.00
Vinyl chloride	ND	0.00166	0.005	0.005	0.002	-(9)	78.2	195.50
Xylenes, Total	0.00464	0.0297	ND	95	10	-(9)	1.3	12.35
1,3-Dichlorobenzene	ND	1.06	ND	-(6)	0.6	-(6)	7.1	-(6)
1,2,4-Trichlorobenzene	4.94	4.94	ND	2.5	0.07	-(9)	11	392.86
2-Methylnaphthalene	8.36	8.36	ND	-(6)	-(6)	-(6)	-(6)	-(6)
Acenaphthene	6.19	13.7	ND	285	-(6)	2	2.3	327.75
Acenaphthylene	0.373	5.6	ND	-(6)	-(6)	-(6)	0.003(5)	-(6)
Anthracene	7.22	29.3	ND	6000	-(6)	10	0.073	43.80
Benzo(a)anthracene	12.3	43.7	ND	1	-(6)	0.0001	0.0027	27.00
Benzo(a)pyrene	8.81	40.6	ND	4	0.0002	-(9)	0.0014	28.00
Benzo(b)fluoranthene	8.87	78.6	ND	2.5	-(6)	0.0001	0.003 (5)	75.00
Benzo(g,h,i)perylene	3.6	11	0.001	-(6)	-(6)	-(6)	-(6)	-(6)
Benzo(k)fluoranthene	13.8	19.4	ND	24.5	-(6)	0.001	0.003 (5)	73.50
Benzoic Acid	12	12	0.021	200	-(6)	100	4.2	8.40
Bis(2-ethylhexyl)phthalate	9.73	12.5	0.01	1800	0.006	-(9)	0.012	3600.00
Butyl benzyl phthalate	ND	0.423	ND	465	-(6)	7	1.9	126.21
Carbazole	3.61	14.2	ND	0.3	-(6)	0.004	-(6)	-(6)
Chrysene	12.7	47.1	ND	80	-(6)	0.01	-(6)	-(6)
Dibenzo(a,h)anthracene	ND	1.16	ND	1	-(6)	0.00001	-(6)	-(6)
Di-N-Butyl Phthalate	ND	ND	0.001	1650	-(6)	4	0.1	41.25
Dibenzofuran	3.39	14.3	ND	-(6)	-(6)	-(6)	0.37	-(6)
Diethyl Phthalate	ND	ND	0.003	235	-(6)	30	21	164.50
Dimethyl Phthalate	ND	ND	0.0009	-(6)	-(6)	400	-(6)	-(6)
Di-N-Octyl Phthalate	ND	ND	0.005	5000	-(6)	0.7	-(6)	-(6)
Fluoranthene	35.1	95.1	ND	2150	-(6)	1	0.62	1333.00
Fluorene	9.43	19.2	ND	280	-(6)	1	0.39	109.20
Indeno(1,2,3-cd)pyrene	3.6	9.29	0.001	7	-(6)	0.0001	-(6)	-(6)
Naphthalene	4.56	23.7	ND	42	-(6)	1	1.2	50.40
Phenanthrene	35.7	96.9	ND	-(6)	-(6)	-(6)	0.63	-(6)
Phenol	ND	ND	0.004	50	-(6)	20	11	27.50
Pyrene	25.4	174	ND	2100	-(6)	1	-(6)	-(6)
4,4'-DDD	0.227	0.227	ND	8	-(6)	0.0004	0.0000041	0.08

TABLE 2-5

DRMO FS
SUMMARY OF CONCENTRATIONS AND DETERMINATION OF SURFACE WATER PROTECTION LEVELS - SOIL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Maximum Concentrations			SSL	MCL (2)	HBL (3)	SW Quality	Calculated
	Soil - Sur	Soil - All	Groundwater	10 DAF (1)			Screening Values	Max Soil Conc.
	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/L	mg/L (4)	mg/kg
4,4'-DDE	0.0359	0.0359	ND	27	-(6)	0.0003	-(6)	-(6)
4,4'-DDT	0.0634	0.0634	ND	16	-(6)	0.0003	0.0000041	0.22
Aroclors (1254+1260)	40.4	51.5	ND	1	0.0005	-(9)	0.00019	0.38
Delta-BHC	0.00509	0.00509	ND	-(6)	-(6)	-(6)	0.0004	-(6)
Dieldrin	0.00468	0.00468	ND	0.002	-(6)	0.000005	-(6)	-(6)
Endosulfan II	0.0254	0.0254	ND	9	-(6)	0.2	0.0051	0.23
Endosulfan Sulfate	0.0379	0.0379	ND	-(6)	-(6)	-(6)	-(6)	-(6)
Endrin	0.0125	0.0125	ND	0.5	0.002	-(9)	0.0061	1.53
Endrin Aldehyde	0.00686	0.00686	ND	-(6)	-(6)	-(6)	-(6)	-(6)
Endrin Ketone	0.0319	0.0319	ND	-(6)	-(6)	-(6)	-(6)	-(6)
Gamma-Chlordane	0.0204	0.0204	ND	5	0.002	-(9)	0.0037	9.25
Heptachlor Epoxide	0.0207	0.0207	ND	0.35	0.0002	-(9)	0.00069 (7)	1.21

NOTES:
1 From the USEPA Soil Screening Guidance (USEPA, May 1996).
2 Maximum Contaminant Level (USEPA, 1995).
3 Water Health Based Limit calculated for 30-year exposure duration, 10E-6 risk or hazard quotient = 1(USEPA, May 1996).
4 Chronic Criteria for Aquatic Life with a dilution factor of 100 (ORNL, 1996) unless otherwise noted.
5 CTDEP Surface Water Protection Criteria for Substances in Groundwater with a dilution factor of 100 (CTDEP, December 1995).
6 Criteria is unavailable for this chemical.
7 Based on Tier II chronic value for heptachlor (ORNL, 1996).
8 A screening level of 400 mg/kg has been set for lead based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (USEPA, 1994).
9 MCL is available for this chemical; therefore, HBL value not required.
10 Recommended preliminary remediation goal set by EPA (USEPA, May 1996).
11 Secondary MCL.

DAF = Dilution and attenuation factor
SSL = Soil Screening Level
SW = Surface Water
HBL = Health Based Limit

MCL = Maximum Contaminant Level
Sur = Surface
All = All soil (0 - 4 ft.)
ND = Not detected

TABLE 2-6

DRMO FS
DEVELOPMENT OF SOIL COCs
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

CHEMICAL	INITIAL SCREENING	REVISED SCREENING	MAX CONCENTRATION	COC FOR FS
Soil	**Pollutant Mobility (1) (mg/kg)**	**Max Allowable Concentration (mg/kg)**	**Max Soil Concentration (mg/kg)**	**Yes/No**
1,1-Dichloroethane	14	13.51	0.00625	No
1,2-Dichloroethane	0.2	182.00	0.00668	No
2-Butanone	80	NA	0.0144	No
Acetone	140	300.00	1.63	No
Benzene	0.2	39.00	0.00641	No
Carbon Disulfide	NA	0.37	0.00537	No
Chloroethane	NA	NA	0.00155	No
Ethylbenzene	10.1	6.78	0.00907	No
2-Hexanone	NA	NA	0.00303	No
Methylene Chloride	1	440.00	0.427	No
4-Methyl-2-pentanone	14	NA	0.00121	No
4-Methylphenol	NA	NA	0.209	No
Styrene	20	NA	0.00259	No
1,1,2,2-Tetrachloroethane	0.1	228.75	0.00178	No
Tetrachloroethene	1	58.80	0.0147	No
Toluene	67	5.88	0.0122	No
Trichloroethene	1	282.00	0.0931	No
Vinyl Chloride	0.4	195.50	0.00166	No
Xylenes, Total	19.5	12.35	0.0297	No
1,3-Dichlorobenzene	120	NA	1.06	No
1,2,4-Trichlorobenzene	NA	392.86	4.94	No
2-Methylnaphthalene	NA	NA	8.36	No
Acenaphthene	NA	327.75	13.7	No
Acenaphthylene	84	NA	5.6	No
Anthracene	400	43.80	29.3	No
Benzo(a)anthracene	1	27.00	43.7	Yes
Benzo(a)pyrene	1	28.00	40.6	Yes
Benzo(b)fluoranthtene	1	75.00	78.6	Yes
Benzo(g,h,i)perylene	NA	NA	11	No
Benzo(k)fluoranthene	1	73.50	19.4	No

TABLE 2-6

DRMO FS
DEVELOPMENT OF SOIL COCs
NSB-NLON, GROTON, CONNECTICUT
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CHEMICAL	INITIAL SCREENING	REVISED SCREENING	MAX CONCENTRATION	COC FOR FS
Soil	**Pollutant Mobility (1)**	**Max Allowable Concentration**	**Max Soil Concentration**	**Yes/No**
Benzoic Acid	NA	8.40	12	Yes
Bis(2-ethylhexyl)phthalate	11	3600.00	12.5	No
Butyl benzyl phthalate	200	126.21	0.423	No
Carbazole	NA	NA	14.2	No
Chrysene	NA	NA	47.1	No
Dibenzo(a,h)anthracene	NA	NA	1.16	No
Dibenzofuran	NA	NA	14.3	No
Fluoranthene	56	1333.00	95.1	No
Fluorene	56	109.20	19.2	No
Indeno(1,2,3-cd)pyrene	NA	NA	9.29	No
Naphthalene	56	50.40	23.7	No
Phenanthrene	40	NA	96.9	No
Pyrene	40	NA	174	No
4,4'-DDD	NA	0.08	0.227	Yes
4,4'-DDE	NA	NA	0.0359	No
4,4'-DDT	NA	0.22	0.0634	No
Aroclors (1254+1260)	0.005	0.38	51.5	Yes
Delta-BHC	NA	NA	0.00509	No
Dieldrin	0.007	NA	0.00468	No
Endosulfan II	NA	0.23	0.0254	No
Endosulfane Sulfate	NA	NA	0.0379	No
Endrin	NA	1.53	0.0125	No
Endrin Aldehyde	NA	NA	0.00686	No
Endrin Ketone	NA	NA	0.0319	No
Gamma-Chlordane	0.066	9.25	0.0204	No
Heptachlor Epoxide	0.02	1.21	0.0207	No

TABLE 2-6

DRMO FS
DEVELOPMENT OF SOIL COCs
NSB-NLON, GROTON, CONNECTICUT
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CHEMICAL	INITIAL SCREENING	REVISED SCREENING	MAX CONCENTRATION	COC FOR FS
Soil	**Pollutant Mobility (1) TCLP (mg/L)**	**Max Allowable Concentration (mg/kg)**	**Max Soil Concentration (mg/L / mg/kg)**	**Yes/No**
Aluminum	NA	NA	18900	No
Antimony	0.06	1250.00	134	No
Arsenic	0.5	5510.00	16.4	No
Barium	10	160.00	1.3 / 934	Yes
Beryllium	0.04	519.75	24.9	No
Boron	NA	NA	2.9	No
Cadmium	0.05	88.00	0.087 / 126	Yes
Calcium	NA	NA	16300	No
Chromium	0.5	209.00	0.11 / 1210	Yes
Cobalt	NA	NA	179	No
Copper	13	NA	8730	No
Cyanide	2 (SPLC)	52.00	7.68	No
Iron	NA	NA	103000	No
Lead	0.15	8530.00	0.87 / 5980	No
Magnesium	NA	NA	7190	No
Manganese	NA	NA	1260	No
Mercury	0.02	65.00	20.7	No
Nickel	1	10400.00	1250	No
Potassium	NA	NA	6520	No
Selenium	0.5	1.95	0.1 / 0.773	No
Silver	0.36	6.12	0.029 / 24.3	Yes
Sodium	NA	NA	4220	No
Thallium	0.05	157.50	0.64	No
Vanadium	0.5	20000.00	368	No
Zinc	50	13200.00	28300	Yes

NOTES:

1 CTDEP Pollutant Mobility Criteria for Soil for GB Areas (CTDEP, December 1995).

COC Chemical of Concern

NA Criteria unavailable to calculate a maximum allowable soil screening level.

Since groundwater at the DRMO eventually discharges to the Thames River, site-specific groundwater data were compared to CTDEP's SWPC (CTDEP, December 1995). The following compounds were detected in the groundwater above their respective site-specific SWPCs and were retained as COCs in the Phase II RI:

- Arsenic
- Copper
- Lead
- Zinc

Table 2-7 compares the maximum groundwater concentrations to these site-specific SWPC values and shows that, since no detected concentrations exceed these SWPC values, no groundwater COCs need be retained for this FS.

2.2 PRELIMINARY REMEDIATION GOALS

Preliminary Remediation Goals (PRGs) are concentrations of contaminants in the environmental media that, when attained, should achieve Remedial Action Objectives (RAOs). PRGs are developed to ensure that contaminant concentration levels left on site are protective of human and ecological receptors. In general, PRGs are established with consideration given to:

- Protecting human receptors from adverse health effects;
- Protecting the environment from detrimental impacts from site-related contamination;
- Compliance with Federal and state ARARs.

2.2.1 Preliminary Remediation Goals for Soil

Soil PRGs were determined for the COCs identified in Section 2.1. The soil PRGs were based on the following criteria:

- Protection of human health
- Protection of ecological receptors
- Protection of surface water

TABLE 2-7

DRMO FS
DEVELOPMENT OF GROUNDWATER COCs
NSB-NLON, GROTON, CONNECTICUT

CHEMICAL	INITIAL SCREENING	REVISED SCREENING	MAX CONCENTRATION	COC
Groundwater	**SWPC (1) (ug/L)**	**SWPC with 100 DF (ug/L)**	**Max Groundwater Concentration (ug/L)**	**Yes/No**
Aluminum	NA	NA	19300	No
Arsenic	4	40	21	No
Barium	NA	NA	288	No
Beryllium	4	40	1	No
Boron	NA	NA	2370	No
Cadmium	6	60	4	No
Calcium	NA	NA	274000	No
Chromium	110	1100	47.6	No
Cobalt	NA	NA	14.3	No
Copper	48	480	355	No
Iron	NA	NA	44800	No
Lead	13	130	52.7	No
Magnesium	NA	NA	949000	No
Manganese	NA	NA	1440	No
Mercury	0.4	4	0.3	No
Nickel	880	8800	32.9	No
Potassium	NA	NA	364000	No
Selenium	50	500	23.5	No
Sodium	NA	NA	7560000	No
Vanadium	NA	NA	64.2	No
Zinc	123	1230	356	No
1,1-Dichloroethane	NA	NA	3	No
1,2-Dichloroethene (total)	NA	NA	8	No
Carbon disulfide	NA	NA	3	No
Trichloroethene	2340	23400	8	No
Vinyl chloride	15750	157500	5	No
1,4-Dichlorobenzene	26000	260000	0.5	No
Benzo(g,h,i)perylene	NA	NA	1	No
Benzoic acid	NA	NA	21	No

TABLE 2-7

DRMO FS
DEVELOPMENT OF GROUNDWATER COCs
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

CHEMICAL	INITIAL SCREENING	REVISED SCREENING	MAX CONCENTRATION	COC
Groundwater	SWPC (1) (ug/L)	SWPC with 100 DF (ug/L)	Max Groundwater Concentration (ug/L)	Yes/No
Bis(2-ethylhexyl)phthalate	59	590	10	No
Di-N-butyl phthalate	120000	1200000	1	No
Di-N-octyl phthalate	NA	NA	5	No
Diethyl phthalate	NA	NA	3	No
Dimethyl phthalate	NA	NA	0.9	No
Indeno(1,2,3-cd)pyrene	NA	NA	1	No
Phenol	92000000	920000000	4	No

NOTES:

1 Surface Water Protection Criteria for Substances in Groundwater, using a dilution factor of 10 (CTDEP, December 1995).

COC Chemical of Concern
DF Dilution Factor
SWPC Surface Water Protection Criteria

2.2.1.1 Human Health Risk-Based PRGs

Using recalculated risk values based on the analyte concentrations with validated and unvalidated data and for "all soil" data from 0 to 10 feet bgs, Preliminary Remediation Goals (PRGs) were calculated for several potential human receptors at NSB-NLON. The set of chemicals considered for PRG evaluation consisted of the COCs described in Section 2.1.4.1. Initially, all exposure pathways (considering all receptors, media, and routes of exposure) with Incremental Cancer Risks (ICRs) of more than 1E-06 and/or Hazard Indices (HIs) of more than 1.0 were identified. If the risk or hazard values approached these levels, the relevant scenarios were also included for initial consideration. For each scenario, individual chemicals which contributed at least 1E-6 to the ICR or 0.1 to the HI were selected. If the risk or hazard values approached these levels, the contributing chemicals were also included in the PRG calculations. Upon further consideration, the ICR level of 1E-4, established by U.S. EPA as representing an unacceptable risk, was used instead to initially screen potential cancer risks for development of PRGs.

Site-specific PRGs were calculated using the following equation:

Exposure Concentration/Calculated Risk Value = PRG/Desired Risk Level

Solving for the PRG, the equation becomes:

PRG = (Exposure Concentration) (Desired Risk Level)/Calculated Risk Value

For example, assuming that the total ICR (ingestion and dermal routes) for an employee exposed to Aroclors in surface soil was 1.86 E-6 (B&R Environmental, March 1997) and that the soil concentration was 0.35 mg/kg, the PRG at the 1E-6 level would be calculated as follows:

PRG = (0.35 mg/kg) (1E-6)/1.86E-6 = 0.19 mg/kg

PRG calculations are included in Appendix A.

The final PRGs for soil COCs were selected by identifying chemicals which contributed at least a 1E-06 risk to an overall ICR of more than 1E-4 and/or a major portion of an overall HI greater than 1.0. Typically the COCs for non-carcinogenic risk contributed an HQ approaching or greater than 1.0. The following PRGs were developed for the COCs identified during the human health risk assessment:

Soil PRGs For Full-Time Employee:

- Aroclors (1254 and 1260) 10 mg/kg

Soil PRGs For Construction Worker:

- Aroclors (1254 and 1260) 6 mg/kg
- Cadmium 84 mg/kg

Soil PRGs For Older Child Trespasser:

- Aroclors (1254 and 1260) 10 mg/kg

Soil PRGS For Future Resident:

- Benzo(a)anthracene 2 mg/kg
- Benzo(a)pyrene 0.2 mg/kg
- Benzo(b)fluoranthene 2 mg/kg
- Dibenzo (a,h)anthracene 0.2 mg/kg
- Indeno(1,2,3-cd)pyrene 2 mg/kg
- Aroclors (1254 and 1260) 0.35 mg/kg
- Hexachlorobiphenyl 0.35 mg/kg
- Dioxins (HpCDD & OCDD) 0.00059 mg/kg
- Arsenic 0.96 mg/kg
- Beryllium 0.35 mg/kg
- Cadmium 67 mg/kg
- Chromium 11 mg/kg

2.2.1.2 Ecological Risk-Based PRGs

Although, as per the Phase II RI, under the current land use the ecological receptor exposure risks for the DRMO are low. However, under a future land use scenario, removal of the asphalt cap could be anticipated allowing ecological receptors to be exposed to surface soil. Therefore, PRGs for soil at the DRMO were derived from values presented in either the Area A Downstream/OBDA FFS (B&R Environmental, July 1997) or the ORNL database (ORNL, 1996) of toxicological benchmarks for ecological risk assessment. The value for DDT/DDD was derived using a risk-based approach to calculate a site-specific value which is protective of terrestrial receptors such as the short-tailed shrew (B&R Environmental, July 1997). The PRG for zinc was based on a screening value determined to be protective of terrestrial plants (ORNL, 1996; Will and Suter, 1994). All other soil PRGs presented were derived by ORNL and were chosen by comparing the ORNL benchmarks for plants, microorganisms, and earthworms in soils to calculate PRGs for wildlife. The most conservative value was selected as the soil PRG (Efroymson et al., 1996). PRGs were only developed for COCs determined to contribute the major portion of the cumulative risk to the ecological receptors. Table 2-8 lists the PRGs developed for the COCs determined to be major contributors in the Ecological Risk Assessment.

2.2.1.3 PRGs for the Protection of Surface water

PRGs were developed for the soil at the DRMO to be protective of the surface water of the Thames River by leaching of contaminants from the soil to the groundwater and then to the surface water. Federal guidance for pollutant mobility are based on achieving MCLs in the groundwater. An allowable soil value was calculated to be protective of the surface water by taking a ratio of the maximum SWPC divided by the MCL or HBL and multiplying by the Federal pollutant mobility criteria (see Section 2.1.4.1). The following PRGs were developed for the COCs identified in the soil to be protective of the surface water from contaminants leaching from the soil:

- Benzoic Acid 8.4 mg/kg
- Benzo(a)anthracene 27 mg/kg
- Benzo(a)pyrene 28 mg/kg
- Benzo(b)fluoranthene 75 mg/kg
- Barium 160 mg/kg
- Cadmium 48 mg/kg
- Chromium 209 mg/kg
- Silver 6.12 mg/kg
- Zinc 13,200 mg/kg
- Aroclors-1254 & 1260 0.38 mg/kg
- Hexachlorobiphenyl 0.38 mg/kg
- 4,4'-DDD 0.08 mg/kg

2.2.1.4 Summary of Soil PRGs

Table 2-9 summarizes the PRGs developed for the chemicals determined to be COCs in the soil based on the human health and ecological risk assessment conducted for a particular land use scenario or based upon protection of surface water.

2.3 GENERAL RESPONSE ACTIONS AND ACTION SPECIFIC ARARS

General Response Actions (GRAs) are broadly defined remedial approaches that may be used (by themselves or in combination with one or more of the others) to attain the RAOs. Action-specific ARARs and TBCs are those regulations, criteria, and guidances that must be complied with or taken into consideration during remedial activities on site.

TABLE 2-8

DRMO FS
ECOLOGICAL RISK-BASED SOIL PRELIMINARY REMEDIATION GOALS
NSB-NLON, GROTON, CONNECTICUT

Contaminant of Concern	PRG (mg/kg)	Source/Notes
Aluminum	50	Efroymson et al., 1996 (plant)
Antimony	5	Efroymson et al., 1996 (plant)
Boron	0.5	Efroymson et al., 1996 (plant)
Cadmium	3	Efroymson et al., 1996 (plant)
Chromium	0.4	Efroymson et al., 1996 (earthworm)
Cobalt	20	Efroymson et al., 1996 (plant)
Copper	50	Efroymson et al., 1996 (earthworm)
Lead	50	Efroymson et al., 1996 (plant)
Mercury	0.128	Efroymson et al., 1996 (shrew)
Silver	2	Efroymson et al., 1996 (plant)
Thallium	1	Efroymson et al., 1996 (plant)
Vanadium	2	Efroymson et al., 1996 (plant)
Zinc	50	Will and Suter, 1994 (plant)
DDT, DDD	5	B&R Environmental, December 1996 (shrew)

TABLE 2-9

DRMO FS
SUMMARY OF SOIL PRGs
NSB-NLON, GROTON, CONNECTICUT

MEDIA: SOIL COCs	LAND USE (1)			ARAR (2)
	Current Industrial Scenario	Future Residential Scenario	Ecological Risk PRG (mg/kg)	Alternate Pollutant Mobility to be Protective of the Surface Water (mg/kg)
	Human Health Risk PRG (mg/kg)	Human Health Risk PRG (mg/kg)		
Benzoic acid				8.4
Benzo(a)anthracene		2*		27
Benzo(a)pyrene		0.2*		28
Benzo(b)fluoranthene		2*		75
Dibenzo(a,h)anthracene		0.2		
Indeno(1,2,3-cd)pyrene		2		
Aroclors (1254+1260)	6	0.35*		0.38
4,4'-DDT			5	
4,4'-DDD			5	0.08*
Arsenic		1		
Aluminum			50	
Antimony	178	256	5*	
Beryllium		0.35		
Barium				160
Boron			0.5	
Cadmium			3*	88
Chromium		11	0.4*	209
Cobalt			20	
Copper			50	
Lead			50	
Mercury			0.128	
Silver			2*	6.12
Thallium			1	
Vanadium			2	
Zinc			50*	13200

TABLE 2-9

DRMO FS
SUMMARY OF SOIL PRGs
NSB-NLON, GROTON, CONNECTICUT

NOTES:

1 Risk-based PRGs for chemicals contributing at least 1E-06 to a cumulative cancer risk of greater than 1E-04 or a major portion of a noncancer hazard index of greater than 1.0.

2 Calculated value using Federal or State water quality standards (see Table 2-3).

* Lowest value selected as overall PRG.

2.3.1 General Response Actions

GRAs describe categories of actions that could be implemented to satisfy or address a component of a remedial action objective (RAO) for the site. Remedial action alternatives will then be composed using general response actions singly or in combination to meet the remedial action objectives. The remedial action alternatives, composed of GRAs, will be capable of achieving the RAOs for each contaminated medium at the site. The contaminated media of concern at the DRMO site is the soil. The following GRAs will be considered for the DRMO site:

- No Action
- Institutional Controls
- Containment
- Removal
- Treatment
- Disposal

2.3.1.1 No Action

A no action response is included to act as a baseline in the comparison of all the alternatives. The no action response is retained during the FS process as required by NCP [40 CFR 300.430(e)(6)]. This response encompasses exactly what the name implies. No remedial action is taken and the contaminated media is left undisturbed without the implementation of any institutional controls, containment, removal, treatment, or other mitigating actions. The no action response also does not provide for monitoring of contamination or any restrictive use controls. For the DRMO, the no action response would leave the existing cap in place but would not include any maintenance of that cap.

2.3.1.2 Institutional Controls

Access controls and/or land use restrictions are included in the institutional control response action. These measures are taken to reduce or eliminate pathways of exposure to hazardous substances at the site. These controls could involve the use of groundwater monitoring networks and/or groundwater use restrictions and access controls. The physical qualities of the contaminants, volume, mobility and toxicity, are not changed with the application of these controls. For the DRMO, the institutional controls response action would also include maintenance of the existing cap.

2.3.1.3 Containment

Another method of reducing the risk to the public and the environment is through containment, which involves the application of physical measures to reduce the potential for exposure to contaminants and/or contaminant migration. To reduce the migration of contaminants, the contaminated media must be isolated from the primary transport mechanisms, such as wind, erosion, surface water, and groundwater. Contaminated media may be isolated by installing surface and subsurface barriers that either block or divert any transport media (i.e., groundwater, wind, etc.) or exposure pathway from the contaminants. Pumping wells used for gradient control can provide a type of barrier to contain the migration of contaminated groundwater plumes. For the DRMO, some containment is already provided by an existing cap.

2.3.1.4 Removal

Technologies under the removal response action category are used to move contaminated media from its present location in order to be treated and/or disposed of elsewhere. Removal process options are combined with treatment and/or disposal process options to develop alternatives and could involve the installation of extraction wells or collection trenches to remove contaminated groundwater. For the DRMO, the removal response action would also include repair and restoration of these areas of the existing cap which have been damaged by this response action.

2.3.1.5 Treatment

The treatment response action includes both in situ and ex situ treatment process options and could include physical, chemical, biological, solidification and/or thermal measures designed to reduce the toxicity, mobility, and/or volume of the contaminants present. Ex situ treatment process options are used with removal and disposal process options to develop alternatives.

2.3.1.6 Disposal

Disposal technologies include placement of removed or treated materials in an onsite or an offsite permanent disposal facility. The disposal process options are used with removal options and possible treatment options to develop alternatives. The toxicity, mobility, or volume of the contaminants is not reduced through the singular application of disposal. This response action will reduce or eliminate exposure pathways related to direct human contact with contaminated material and also includes discharge/release of untreated to treated groundwaters.

2.3.2 Action-Specific ARARs

Action-specific ARARs and TBCs are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Tables 2-10 and 2-11 present a list of Federal and State of Connecticut's action-specific ARARs and TBCs for the DRMO FS.

2.4 ESTIMATED VOLUMES OF CONTAMINATED MEDIA

For remedial action purposes, preliminary volumes of contaminated media were estimated from samples that contained contaminants at concentration levels that exceeded PRGs for current industrial land use and future residential land use.

Figure B-1 in Appendix B presents the sample locations and concentrations of contaminants that exceed PRGs for the current industrial land use scenario. Under the current industrial land use scenario, concentrations of antimony and chromium detected in the soil samples were not above the calculated PRG values. Figure B-2 through B-6 in Appendix B present the sample locations and concentrations of contaminants that exceed PRGs for the future residential land use scenario. Figures B-7 and B-8 show the areas of soil that contain concentrations of chemicals exceeding PRGs. Based on the known extent of contamination, the following are the estimated areas and volumes of contaminated soil:

	Estimated Area (sq ft)	Average Depth (ft)	Estimated Volume (cu yd)
Current Industrial Land Use			
Areas 6TB2 and DRMO 51-65	2,745	8	718
Areas DRMO 39-6TB9 and DRMO 40	4,800	6	1,066
Area DRMO 57-72	3,683	10	1,364
Total			3,148
Future Residential Land Use			
Main Ecological Area	82,926	3(1)	9,214
Areas 6TB2, DRMO40-71, and 6MW4S	6,100	6(2)	678
Areas DRMO51-65, 6TB20, 6MW3D, and 6TB10-6MW2	9,490	8(3)	1,425
Areas 6TB3, DRMO45, and DRMO57-72	5,483	10(4)	1,422
Area 6MW1S	900	8	267
Area 6MW7S	900	10	333
Total			13,572

NOTES:

(1) A 1:1 sideslope is assumed for stability during excavation.
(2) Areas previously excavated to a depth of 3 feet. Additional excavation of 3 feet only.
(3) Areas previously excavated to a depth of 3 feet. Additional excavation of 5 feet only.
(4) Areas previously excavated to a depth of 3 feet. Additional excavation of 7 feet only.

TABLE 2-10

DRMO FS
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken to Attain ARAR
Clean Water Act, National Pollution Discharge Elimination System (NPDES)	40 CFR Parts 122 through 125, and 131	Potentially Relevant and Appropriate	NPDES (National Pollution Discharge Elimination System) permits are required for any discharges to navigable waters. If remedial activities include such a discharge, the NPDES standards would be ARARs.	Any alternative which would discharge into the Thames River or any navigable water would require compliance with these regulations including treatment, if necessary.
Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Potentially Applicable	NESHAPs are a set of emissions standards for specific chemicals from specific production activities.	Emissions of hazardous air pollutants would be minimized by fugitive dust control and off gas treatment from the thermal desorption facility.
RCRA, Treatment Standards for Hazardous Debris - Thermal Desorption	40 CFR §268.45	Potentially Applicable	Sets treatment standards for utilizing thermal desorption.	Any thermal desorption unit would be operated in compliance with treatment standards.
PCB Regulations Under TSCA	40 CFR §§ 761.60 through 761.71	Potentially Relevant and Appropriate	The regulations govern the storage, transportation and disposal of PCBs, and the cleanup of PCB spills. For the most part, these standards only apply to PCB items with concentrations above 50 ppm or to materials contaminated from such items.	These regulations are not applicable because PCB levels at the site have been measured at no greater than 47.2 ppm. However, if PCBs are detected at greater than 50 ppm any activities regarding storage, transportation, and disposal of such PCB-contaminated soil would be conducted in compliance with these standards.
Guidance of Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive 9355.4-01	To be considered	This guidance describes how to address PCB contamination issues as part of remedial actions.	Low levels of PCBs (47.2 ppm or less) are present within soils at the site. This guidance document will be considered in evaluating PCB issues as part of the remedial action.
Air/Superfund National Technical Guidance	EPA Guidance: EPA/450/1-89/001-EPA/450/1-89/004	To be considered	This guidance describes methodologies for predicting risks due to air release at a Superfund site.	These guidance documents will be considered when risks due to air releases from fugitive dust and thermal desorption are being evaluated.

TABLE 2-11

DRMO FS
STATE OF CONNECTICUT ACTION-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Solid Waste Management	RCRA 22a - 209-1 through 12	Potentially Applicable	These sections establish operating and closure standards for solid waste disposal areas (SWDAs) including closure, post-closure, and groundwater monitoring requirements.	Following remediation at the site, the area would be closed in accordance with these requirements.
Hazardous Waste Management: Generator and Handler Requirements	RCSA § 22a-449(c) 100-101	Potentially Applicable	These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR 260-261 are incorporated by reference.	For all soils excavated hazardous waste determinations would be performed, and the wastes would be managed in accordance with requirements of these regulations, if necessary.
Hazardous Waste Management: TSDF Standards	RCSA § 22a-449(c) 104	Potentially Applicable	This section establishes standards for treatment, storage, and disposal facilities. The standards of 40 CFR 264 are incorporated by reference.	Any hazardous waste which is treated or temporarily stored on this site as part of the remedy would be managed in accordance with the requirements of this section.
Hazardous Waste Management: Generator Standards	RCSA § 22a-449(c)-102	Potentially Applicable	This section establishes standards for various classes of generators. The standards of 40 CFR 262 are incorporated by reference. Storage requirements given at 40 CFR 265.15 are also included.	Any hazardous waste generated through excavation, treatment or other activities would be managed in accordance with the substantive requirements of these regulations.
Hazardous Waste Management Facility Siting Regulations	CGS 22a-117-123; RCSA § 22a-116B-1 through 11	Potentially Applicable	Requires certificate of public safety and necessity from the CT Siting Counsel prior to construction of any new hazardous waste disposal facility.	These requirements would be applicable to on-site-treatment of wastes. The substantive requirements of these regulations would be met.
Control of Noise Regulations	RCSA § 22a-69-1 through 7.4	Potentially Applicable	These regulations establish allowable noise levels. Noise levels from construction activities are exempt from these requirements.	Noise generated by any remedial actions other than construction would meet the standards of these regulations. Noise generated by the thermal desorption unit would have to meet the standards in these regulations. Noise from well installation and excavation activities is not expected to exceed these standards.
Air Pollution Control	RCSA § 22a-174	Potentially Applicable	These regulations require permits to construct and to operate specified types of emission sources and contain emission standards that must be met prior to issuance of a permit. Pollutant abatement controls may be required. Specific standards include fugitive dust (18b), incineration (18c), emissions of sulfur compounds (19a), emissions of organic compounds (20f), control of odors (23), and allowable stack concentrations (29).	Any on-site treatment unit, which produces an air discharge, would be designed to meet the substantive requirements of these regulations. Emission standards for fugitive dust would be met with dust control measures during excavation, transportation and offsite disposal to comply with substantive requirements.

TABLE 2-11

DRMO FS
STATE OF CONNECTICUT ACTION-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Guidelines for Soil Erosion and Sediment Control	The Connecticut Council on Soil and Water Conservation	To be considered	These guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	These guidelines would be incorporated into any remedial designs for this site. Erosion and sediment control measures would be implemented during excavation activities.
Remediation Standards Regulations	RCSA § 22a-133k-3	Potentially Relevant and Appropriate	These regulations provide specific numeric cleanup criteria for a wide variety of contaminants in soil, groundwater, and soil vapor. These criteria include volatilization criteria, pollutant mobility criteria, direct exposure criteria, and surface water protection criteria.	Although no groundwater plume has been identified at this site, the proposed groundwater monitoring would be conducted to determine if any contaminants of concern are migrating offsite at levels above CTDEP surface water protection or volatilization standards for GB groundwater. Excavation of hot spots and maintenance of the cap and institutional controls would satisfy the Remediation Standards Regulations for soil.
Water Pollution Control	RCSA § 22a-430-1 through 8	Potentially Applicable	These rules establish permitting requirements and criteria for water discharge to surface water, groundwater, and POTWs.	Any discharges, including storm water, would have to meet the substantive requirements of this section. No discharge is proposed to the Groton POTW. Discharges would be treated to meet the substantive requirements of these regulations, if necessary.
Water Quality Standards	CGS 22a-426	Potentially Applicable	Connecticut's Water Quality Standards establish specific numeric criteria, designated uses, and anti-degradation policies for groundwater and surface water.	Remedial activities would be undertaken in a manner which is consistent with the anti-degradation policy in the Water Quality Standards.
Disposition of PCBs	CGS 22a-467	Potentially Applicable	This section regulates the disposal or destruction of PCBs in a manner not inconsistent with the Requirements of the Toxic Substances Control Act (TSCA), listed at 40 CFR Part 761.	Any disposal of low levels of PCBs (47.2 ppm or less) present within soils at the site would be conducted in compliance with this statue. All PCB-contaminated materials would be handled in accordance with the substantive requirements of this statue.

TABLE 2-11

DRMO FS
STATE OF CONNECTICUT ACTION-SPECIFIC ARARs AND TBCs
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Air Pollution Control: Control of Odors	RCSA 22a=174-23	Potentially Applicable	This regulation prohibits emission of any substance that constitutes a nuisance because of objectionable odor.	Any remedial activities would be planned and performed to avoid the emission of objectionable odors.
Air Pollution Control: Control of Hazardous Air Pollutants	RCSA 22a-174-29	Potentially Applicable	This regulation establishes testing requirements and allowable stack concentrations for many substances.	Any remedial activities which results in the emission of substances identified as hazardous would comply with the substantive requirements of this regulation.
Regulations For the Well Drilling Industry	RCSA 25-128-33 to 128-64	Potentially Applicable	These regulations apply to new water supply or withdrawal wells. Non-water supply wells must be constructed so that they are not a source or cause of groundwater contamination.	No water supply or withdrawal wells will be installed. Groundwater monitoring wells would be installed so as not to be either the source or cause of groundwater contamination.
Registration and Permitting of Wells and Well Drillers	CGS 25-126 to 131	Potentially Applicable	These regulations require well drillers to be registered. Separate registration apply to water supply and non-water supply wells. Permits are not required for non-water supply wells. However, the driller must file a completion report for both water supply and non-water supply wells.	No water supply wells will be installed. Any groundwater monitoring wells would be installed by a properly registered driller and completion reports would be filed.
CT Guidelines for Soil Erosion and Sediment Control	The Connecticut Council on Soil and Water Conservation	TBC	The guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	These guidelines would be incorporated into any remedial designs for this site.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential technologies and process options that may be applicable to assemble the remedial alternatives for the DRMO site at NSB-NLON. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options that will be used for developing the preliminary remedial alternatives.

The basis for technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Identification of applicable or relevant and appropriate requirements (ARARs)
- Development of remedial action objectives (RAOs)
- Identification of volumes or areas of media of concern
- Identification of general response actions (GRAs)

Technology screening evaluation is performed in this section with the completion of the following analytical steps:

- Identification and screening of remedial technologies and process options
- Evaluation and selection of representative process options

Technologies and process options will be identified for the remediation of soil in the following sections. The groundwater is not considered a media of concern since no COCs were identified.

3.1 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

In this section a variety of technologies and process options are identified under each general response action (discussed in Section 2.4.1) and screened. The selection of technologies and process options for initial screening is based on the "Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA" (U.S. EPA, 1988). The screening is first conducted at a preliminary level to focus on relevant technologies and process options. Then the screening is conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the technologies that have passed the detailed evaluation and screening. Electronic treatment technologies databases such as "ReOpt," "Remediation Technologies Screening Matrix and Reference Guide," "CLUIN", and U.S.

EPA's Vendor Information System for Innovative treatment Technologies were reviewed to confirm that all reasonable treatment technologies have been considered.

3.1.1 Preliminary Screening of Technologies and Process Options

This subsection identifies and screens technologies and process options for soil at a preliminary stage based on implementation with respect to site conditions and contaminants of concern. Table 3-1 summarizes the preliminary screening of technologies and process options applicable to soil. It presents the general response actions, identifies the technologies and process options, and provides a brief description of each process option followed by the screening comments. All technologies and process options that are not eliminated in Table 3-1 will be evaluated in greater detail in Section 3.3.

3.2 EVALUATION CRITERIA

The evaluation criteria for detailed screening of technologies and process options that have been retained after the preliminary screening in Section 3.1 are effectiveness, implementability, and cost. The following are descriptions of the evaluation criteria:

- Effectiveness
  - Protection of human health and environment; reduction in toxicity, mobility, or volume; and permanence of solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated medium.
  - Ability of the technology to meet the remediation goals identified in the remedial action objectives.
  - Technical reliability (innovative versus well-proven) with respect to contaminants and site conditions.

- Implementability
  - Overall technical feasibility at the site.
  - Availability of vendors, mobile units, storage and disposal services, etc.
  - Administrative feasibility.
  - Special long-term maintenance and operation requirements.

- Cost (Qualitative)
  - Capital cost.
  - Operation and maintenance (O&M) costs.

TABLE 3-1

DRMO FS
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
NSB-NLON, GROTON, CONNECTICUT

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No Action	None	Not Applicable	No further activities would be conducted at the site in addition to existing cap to address contamination.	Required by NCP. Retain for baseline comparison to other technologies.
Institutional Controls	Monitoring	Groundwater/Surface Water Monitoring	Sampling and analysis of new or existing wells and surface water.	Potentially applicable to detect potential migration of contaminants from the soil to other media.
	Access/Use Restrictions	Active Restrictions: Physical Barriers	Fencing, markers, warning signs, and monitoring to restrict site access.	Potentially applicable to preclude human exposure to contaminated media.
		Passive Restrictions: Land Use Restrictions	Administrative action using land use prohibitions to restrict future site activities.	Potentially applicable to preclude human exposure to contaminated media.
Containment	Capping	Single Layer Cap/ Multilayer Cap	Low permeability cap made up of single or multiple layers over an area of contamination; materials used include concrete, asphalt, soil, clay, synthetic membrane, etc.	Site already has a GCL and asphalt cap installed. Repair and restoration of that cap may be required.
	Surface Water Control	Revegetation/ Diversion/ Collection	Use of dense plant growth, dikes, berms, channels, and ditches to control run-on, run-off, erosion, and infiltration.	Potentially applicable to minimize the disruptive effects of the remedial actions and for erosion control on caps.
Removal	Excavation	Mechanical Excavation/Dredging	Removal of soil and buried waste using conventional earthmoving equipment above or below the groundwater table.	Potentially applicable for the removal of contaminated soil and buried wastes.

TABLE 3-1

DRMO FS
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
NSB-NLON, GROTON, CONNECTICUT

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
In-situ Treatment	Biological	Aerobic/Anaerobic Bioremediation	In-situ degradation of organics using microorganisms in an aerobic/anaerobic environment. Nutrients could be injected into the subsurface to promote biological activity.	Not applicable to metals and limited effectiveness when treating halogenated compounds detected in the soil at the site.
	Physical/ Chemical	Chemical Fixation/ Solidification	In-situ process where cement, lime, or other pozzolanic materials are mixed with soil in the vadose zone to immobilize contaminants.	Not applicable. Difficult to implement because of the heterogeneous nature of the landfill contents.
		Soil Flushing	In-situ flushing of contaminants from the vadose zone into the saturated zone using water or solvents in conjunction with an injection/extraction well system.	Not applicable. Questionable effectiveness due to the variable contact time caused by heterogeneous subsurface site conditions. Increases the mobility of contaminants.
		Air Sparging/ Vapor Extraction	In-situ system of air injection and extraction wells to promote biodegradation and transfer of volatile organics to the vapor phase.	Not applicable. Not effective for inorganics or PAHs.
	Thermal	Vitrification	High-power electric current passed through an area of contamination in situ to melt material into a glass-like, solid matrix.	Not applicable. Not proven in effectiveness with heterogeneous subsurface material. Not appropriate for low level inorganic and organic contamination.

TABLE 3-1

DRMO FS
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
NSB-NLON, GROTON, CONNECTICUT

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Ex-situ Treatment	Biological	Bioslurry/ Land Farming	Treatment of excavated soil in a slurry reactor or by tilling under controlled conditions using natural or cultured microorganisms to biodegrade organic contaminants.	Not applicable. Not effective for inorganics and questionable effectiveness for PAHs, pesticides, and PCBs. Excavation of the soil is necessary and materials must be sized prior to treatment.
	Physical/ Chemical	Chemical Fixation-Solidification	Ex-situ mixing of cement, lime, or other pozzolanic materials with excavated soil to immobilize contaminants	Potentially applicable. Retain for treating soil with inorganic compounds and low concentrations of organic compounds to reducing contaminant mobility.
		Soil Washing/ Solvent Extraction	Ex-situ treatment to move contaminants from soil phase into a leaching agent using chemical and solubilization processes. Converts contaminants to a more concentrated or less toxic form.	Potentially applicable. Retain for treating soil with exclusively inorganic or organic contaminants.
		Dewatering	Removal of free water from wet material through use of passive gravity-driven stockpiling or mechanical expression with filter press, centrifuge, etc.	Potentially applicable. Retain for pre-treatment of wet excavated soil.
		Size Separation	Minimize waste by physically screening out size fractions of soils or sediments containing minimal contamination.	Potentially applicable. Retain as a pretreatment step for excavated heterogeneous waste and fill material.

TABLE 3-1

DRMO FS
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
NSB-NLON, GROTON, CONNECTICUT

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
		Crushing-Grinding-Shredding	Use of heavy-duty equipment to reduce the size of excavated waste and fill material.	Potentially applicable. Retain as a pretreatment step for excavated heterogeneous waste and fill material.
		Thermoplastic Solidification	Ex-situ process where soil is mixed with asphalt, bitumen, paraffin, polyethylene or other organic polymers, and heated to form a stable solid.	Not applicable. Typically applies to highly contaminated (especially nuclear) wastes and mobile wastes that are not amenable to chemical fixation.
	Thermal	Thermal Desorption	Application of heat to remove organics from excavated soil by volatilization. Vapor phase is treated by incineration or carbon adsorption.	Potentially applicable. Retain to treat soils containing mainly organic compounds. Additional treatment would be required for inorganic compounds.
		Incineration	Use of high temperature to pyrolize or oxidize organic contaminants in excavated soil into less toxic gases.	Potentially applicable. Retain to treat soils containing mainly organic compounds. Additional treatment would be required for inorganic compounds.
Disposal	On Site	Consolidation	Excavation and deposition of all wastes in one location to minimize space and closure requirements.	Not applicable. Requires cap removal and excavation of soil. Waste is already centralized.
		Engineered Disposal Cell	Disposal of contaminated waste/fill and soil in an on-property disposal cell.	Not applicable. Does not treat contaminants. Requires cap removal and excavation of soil. Site located within the 100 year floodplain.

TABLE 3-1

DRMO FS
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
NSB-NLON, GROTON, CONNECTICUT

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
	Off Site	Permitted Treatment, Storage, and Disposal (TSD) Facility	Disposal of contaminated waste/fill and soil at a permitted commercial TSD facility.	Potentially applicable for hazardous waste/fill.
		Solid Waste Disposal Facility	Disposal of landfill contents at an offsite, permitted, solid waste facility.	Potentially applicable for non-hazardous waste/fill.

NOTE:

Unshaded items indicate those passing the initial screening process.

All of the items listed above may not apply directly to each technology and, therefore, will be addressed only as appropriate. Screening evaluations at this stage generally focus on effectiveness and implementability, with less emphasis on cost evaluations. Technologies whose use would be precluded by waste characteristics and inapplicability under the given site conditions are screened and eliminated from further consideration. At this stage, no technologies will be eliminated based on cost. A process option within a technology category, however, may not be carried through if an equally effective process option under that technology is available at a lower cost. Each technology presented in this section is not necessarily intended to be implemented alone, as it may be combined with other technologies into remedial action alternatives.

3.3 FINAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

The final screening of technologies and process options is based on evaluation criteria described in Section 3.2. The following are the soil technologies and process options remaining for final screening:

General Response Action	Remedial Technology	Process Options
No Action	None	Not applicable
Institutional Controls	Monitoring	Groundwater/Surface Water Monitoring
	Access/Use Restrictions	Active: Physical Barriers/Security Guards
		Passive: Land Use Restrictions (Master Plan)
Containment	Surface Water Control	Revegetation/Diversion/Collection
	Capping	Repair & Restoration of Existing Cap
Removal	Excavation	Excavation/Dredging
Ex Situ Treatment	Physical/Chemical	Chemical Fixation-Solidification
		Soil Washing-Solvent Extraction
		Dewatering
		Size Separation
		Crushing-Grinding-Shredding
	Thermal	Thermal Desorption
		Incineration
Disposal	Off Site	RCRA Hazardous Waste TSD Facility
		Solid Waste Disposal Facility

3.3.1 No Action

No action consists of maintaining status quo at the site, including leaving the existing asphalt and GCL cap in place. No action is retained as a baseline for comparison purposes.

Effectiveness

No action would only have limited effectiveness in meeting the remedial action objectives for the site. The existing cap would reduce potential exposure to contaminated soil which could pose an unacceptable level of health hazard to current and future receptors. However, the persistence of this reduction would be unknown since the cap would not be maintained. No action would also not be effective in evaluating contaminant mobility and potential migration offsite since no monitoring would be performed.

Implementability

There would be no implementability concerns since no action would be implemented.

Cost

There would be no costs associated with no action.

Conclusion

No action is retained as required by NCP to provide a baseline comparison. However, no action would not be sufficient for long-term attainment of the RAOs since the existing cap would not be maintained and no monitoring would be performed.

3.3.2 Institutional Controls

Institutional controls would consist of maintaining the existing cap and surface water controls, limiting access through fencing and security, restricting future land use, and performing monitoring. Modifications to the Master Plan would be made to prevent the land to be used in the future as a residential area to prevent the disturbance of buried waste. Fencing and security would be used to restrict access to contaminated media.

Monitoring would consist of sampling and analysis of groundwater to determine if contamination is migrating from the soil. If contaminant migration is detected, monitoring would also include sampling and analysis of the Thames River's water and sediment.

Effectiveness

Maintenance of the existing cap, limiting site access, and implementation of land use restrictions would be effective, depending on the administration of controls. These controls would minimize potential human health risks associated with ingestion and dermal exposure to contaminated soil.

Monitoring with sampling and analysis of environmental media would not by itself be effective in reducing the migration of contaminants in the environment, but it would identify a trend in COCs concentrations at the site and determine whether these COCs are migrating off site or to other site media. Monitoring could be used to determine the need for further action, if necessary. Sampling and analysis of environmental media would also be a technically effective means of assessing the progress of a remedial action.

Implementability

Institutional controls and monitoring would be readily implementable, assuming that the DRMO continues to be a Federal facility. Implementability of these controls would be more of a concern if the site is transferred to private property. Provisions would be incorporated in property transfer documents to insure the continued implementation of institutional controls. Currently there are no plans to close NSB-NLON.

Resources, equipment and materials are readily available for the maintenance of the existing cap and fence, the installation of new monitoring wells, the maintenance and sampling of new and existing wells, and the preparation of deed restrictions.

Cost

Costs of institutional cost and monitoring would be low.

Conclusion

Institutional controls and monitoring are retained for future consideration to minimize exposure to contaminated soil and assess the possibility of contaminant migration.

3.3.3 <u>Containment</u>

The technologies being considered under containment are surface water controls and capping, both of which currently exist at the DRMO.

3.3.3.1 Surface Water Controls

Surface water controls would consist of the use of stream diversion or other erosion control measures. Stream diversion typically involves the construction of channels, dikes, berms, etc., to provide a preferential pathway for surface water, collected from rainfall, to run off. Such preferential pathways minimize contact with the surface soils and consequently reduce the migration of contaminants from the surface soils into the environment. Moreover, preferred water channels are useful when large areas of land are capped. Other erosion control measures would consist of vegetative cover and/or rip-rap (i.e., rocks, stones, etc.) placed on the wastes, and a topsoil cover to minimize the entrainment of contaminated material or clean soil (cap material) in surface water runoff. Usually vegetation is seeded in a topsoil covering the wastes, whereas rip-rap material is used on the surface of the soil.

During the installation of the existing asphalt and GCL cap at the DRMO, surface water drainage channels were installed to divert the surface runoff water flow around that cap. In addition, riprap was installed along the bank of the Thames River.

Effectiveness

Surface water controls would be effective in the collection of rainfall and diversion of surface runoff water flow. In addition, surface water controls are technically reliable. The site is currently covered with an asphalt and GCL cap, and erosion of the cap due to precipitation and surface water flow is not considered to be significant.

Implementability

Surface water controls currently exist at the DRMO site. Repair and restoration of these controls following any additional remedial actions would be readily implementable with the use of normal construction equipment and materials.

Cost

Surface water controls already exist. Cost of repair and restoration of these controls following any additional remedial actions would be minimal.

Conclusion

No additional surface water controls are required for this site. Maintain existing surface water controls at the site. These controls are an effective means of reducing the migration of contaminated material into the environment.

3.3.4 Capping

Capping would consist of providing a horizontal barrier to prevent exposure of human and ecological receptors to contaminated soil and to minimize the extent of potential continued contaminant migration to surface water through soil erosion or to groundwater through percolation of precipitation through the vadose zone. As previously mentioned, the area of the former landfill at the DRMO is currently covered by an asphalt and GCL cap.

Effectiveness

Capping would be effective to prevent exposure of human and ecological receptors to contaminated materials and the reduction of the potential for cross-media contaminant migration. The existing asphalt and GCL cap is effective to prevent exposure of human and ecological receptors to contaminated soil and to minimize the potential for contaminant migration to the Thames River via soil erosion. However, the existing cap only provides limited reduction of the potential for contaminant migration to the Thames River via groundwater because the vadose zone at the DRMO is relatively shallow (about 3 feet) and, therefore, a significant volume of contaminated soil is already in constant contact with groundwater.

Implementability

An asphalt and GCL cap currently exists at the DRMO site. Repair and restoration of that cap following any additional remedial actions would be readily implementable with the use of normal construction equipment and materials.

Cost

An asphalt and GCL cap currently exists at the DRMO site. Cost of repair and restoration of that cap following any additional remedial actions would be minimal.

Conclusion

No additional cap is required at DRMO. As required, the existing asphalt and GCL cap would be restored and repaired following implementation of additional remedial activities.

3.3.5 Removal

The technologies typically considered under removal are excavation and dredging. Excavation can be performed by a variety of equipment, such as tractor shovels (front-end loaders), backhoes, grade-alls, etc. Dredging can be performed by clamshells, draglines, etc. These technologies are essentially identical, except for the type of equipment used for removal of contaminated material. The type of equipment selected must take into consideration several factors, such as the type of material to be removed, the load-bearing capacity of the ground surrounding the removal area, the depth and areal extent of removal, the required rate and of removal, and the presence of water above the material to be removed. Excavation is the technology of choice for the removal of well consolidated material, such as soil, to depth of up to 30 feet and from well-defined areas of ground with significant load bearing capacity (i.e., greater than 1,500 foot-pounds). Dredging is the technology of choice for the removal of loosely consolidated material, such as sediment, to depths typically not in excess of 10 feet bgs and from widespread and generally submerged areas of ground of low load bearing capacity. At the DRMO, since removal would take place in relatively small and well-defined areas and since most of this removal would be performed by such equipment as backhoes operating on relatively firm ground, the removal technology of choice will be designated as excavation, even though some removal would have to be performed under water and with equipment such as clamshell buckets which are normally associated with dredging.

Excavation of poorly cohesive soil, such as the sand and gravel present at the DRMO and/or significantly below the water table, which would also be the case at DRMO, requires shoring of the excavation walls. A typical mean of shoring would be to drive sheet piling along the periphery of the area to be excavated. Excavation significantly below the water table could also require pumping to prevent excessive accumulation of groundwater in the excavated areas. Groundwater would be pumped either from the excavated area itself or from wells located on the periphery of this area to locally depress water table elevation.

The logistics of excavation must take into account the available space for operating the equipment, loading/unloading to transport the removed material, location of the site, etc. Once excavation is completed, the location is filled and graded with clean fill material or treated soils.

Any damage to the existing cap and surface water control structures resulting from excavation would need to be repaired to restore protection from exposure to contaminated soil left in place.

Effectiveness

Excavation is well-proven and effective method of removing contaminated material from a site. Fill material and contaminated sandy/silty soils such as those present at the DRMO would be amenable to excavation. Properly designed excavation could remove virtually all of the soil contaminated above PRGs and remaining soil would not pose an unacceptable risk to human health or the environment.

Verification sampling is typically required to verify the effectiveness of the removal action. Soil samples are collected from the sidewalls and, as applicable, from the bottom of the excavation. These samples are analyzed for COCs to ensure that the remaining soil is not contaminated at unacceptable levels. However, the need for shoring of the excavated areas with sheet piling and/or the presence of water in excavated areas, both of which would be the case at the DRMO, would significantly limit the possibilities of verification sampling, especially at depth below 3 feet bgs.

If excavation of contaminated soil takes place below the water table, which would be the case at DRMO, the strong soil/water stirring action resulting from excavation could trigger a significant migration of hitherto stationary contaminants from soil to groundwater and to the Thames River.

Implementability

Excavation equipment is readily available from multiple vendors. This technology is well proven and established in the construction/remediation industry. During excavation, site-specific health and safety procedures and OSHA regulations would have to be complied with to ensure that the exposure of the workers to COCs is minimized.

However, at the DRMO, excavation of all soil contaminated above PRGs (either for the current industrial or future residential land use scenarios) would be difficult to implement because it would require removal of poorly cohesive soil to a depth of up to 10 feet bgs, which is significantly below the water table. This would lead to two significant implementability concerns. First, as noted above, extensive shoring would be required. Sheet piling would have to be installed on the periphery of the excavated areas to a depth at least three times that of excavation. Second, any excavation deeper than approximately 3 feet bgs would take place under water which would seriously impair precise visual control, and thus effectiveness, of that excavation. Typically and as noted above, this second implementability concern would be addressed by pumping to prevent significant accumulation of groundwater in the excavation. However, such pumping is not practically implementable at the DRMO because excavation would take place in a highly permeable stratum (i.e., sand and gravel) along the bank of a tidal river. Under these conditions, depressing of the groundwater table elevation, if it could be accomplished at all, would require the pumping (and treatment and discharge) of very large volumes of water, at least several hundreds, and probably several thousands, of gallons per minute (gpm). Also any significant lowering the groundwater table elevation would require a corresponding reinforcement and deepening of the sheet piling to counteract the pressure of the external groundwater on that piling.

Cost

Excavation costs are typically low. At the DRMO, excavation of soil below 4 feet would be relatively expensive because of the reasons discussed above.

Conclusion

Excavation is retained for further consideration in the development of remedial alternatives in spite of some concerns about effectiveness and significant concerns about implementability for excavation of soil below 4 feet.

3.3.6 Ex Situ Treatment

The following ex situ treatment technologies and process options for contaminated site soils are evaluated in this section.

- Chemical Fixation-Solidification
- Soil Washing-Chemical Extraction
- Dewatering
- Size Separation
- Crushing-Grinding-Shredding
- Thermal Desorption
- Incineration

3.3.6.1 Chemical Fixation-Solidification

Chemical fixation-solidification would consist of mixing the contaminated material to be treated, typically a soil or sludge, with chemical reagents which bind the contaminants with the solid particles of the material being treated to form a solid mass with low permeability. Typical fixation-solidification reagents include pozzolanic-based materials such as Portland cement, cement kiln dust, and fly ash. Additives such as lime or proprietary reagents (such as organophilic compounds) are often added to the fixation-solidification formula to increase the effectiveness of the treatment, especially if organic contaminants are present which may not readily respond to pozzolanic-based binding. Lime is often added to reduce the solubility of metals and neutralize acidity, which would otherwise destroy the cementitious matrix and release the metals into the environment.

The mixing of the material to be treated with the chemical reagents is normally accomplished in the presence of a controlled amount of water with specialized mechanical blending equipment, such as a pug mill

After the waste is mixed with the chemical reagents, the treated material is allowed to cure for a specified time period. The duration of curing is dependent on the strength required before handling or disposal. The solidified material can be formed into monolithic blocks or can be made into a material with a consistency of soil-cement.

Effectiveness

Effectiveness of chemical fixation-solidification is highly waste specific; therefore, the process must be designed to accommodate the specific waste. A thorough physical and chemical characterization of the waste and treatability testing would be required to determine the most suitable fixation-solidification agents and mixing ratios, as well as any special pretreatment or material handling methods that may be required.

Pozzolanic fixation-solidification would very likely be a viable option for the treatment of the contaminated soils and waste fill materials located at the DRMO and would be effective in solidifying the soil matrix and immobilizing the numerous inorganic and most of the organic contaminants. However, pozzolanic fixation-solidification would probably not be effective for the treatment of that portion of soil contaminated with relatively high concentrations of PAHs, such as in the vicinity of sampling location DRMO-45 where approximately 700 mg/kg of total PAHs were detected. Fixation-solidification would minimize the potential for site contaminants to migrate. However, because fixation-solidification would not reduce contaminant toxicity, the solidified mass would require some type of cover as a barrier to human access since contact with it would still create a health hazard. The fixation-solidification process would be effective in minimizing the leaching of contaminants to other environmental media. Long-term stability and leachability are potential concerns because the contaminants are not destroyed but remain within the solidified mass. Most fixation-solidification processes, including in particular the use of pozzolanic reagents result in an increase in the volume of the treated material typically ranging from 10 to 15 percent. This technology would be capable of handling the volume of contaminated soil and waste fill material at the DRMO. Fixation-solidification would not cause any adverse effects on human health and the environment.

Implementability

Ex situ fixation-solidification would be readily implementable. Monitoring would be required for the physical integrity of the treated material and the effectiveness of the process. The equipment and resources necessary to solidify the soil and waste/fill material on site are available from several vendors capable of performing this work. The equipment necessary for this process is similar to that used for cement mixing and handling. It includes a feed system, mixing vessel, and a curing area, plus a bulk storage area for the solidification agents. Treatability tests would also be required to determine the appropriate mix ratios prior to implementation. The substantive requirements of a RCRA hazardous waste treatment storage and disposal (TSD) facility would have to be met by an on site chemical fixation-solidification system.

Cost

Capital and O&M costs would be moderate for cement/pozzolan-based fixation-solidification.

Conclusion

Pozzolanic fixation-solidification is retained for further consideration as an effective means to reduce the mobility of inorganic contaminants in the soil.

3.3.6.2 Soil Washing-Chemical Extraction

Soil washing uses physical processes such as high-pressure water, screening, attrition scrubbing, froth flotation, electromagnetic separation, mechanical separation, hydrogravimetric separation (including hydrocyclones, mineral jigs, and spiral classifiers), and multigravity separation. Such physical separation processes achieve waste minimization through a volume reduction process by separating out a size fraction of the soil containing little or no contamination (such as coarse-grained soils and large-sized material) from the more contaminated, finer-grained material.

Chemical extraction is based on the use of water or other solvents to extract or desorb the contaminants from the soil and dissolve them into the liquid phase. Often, chemical extraction requires a preliminary treatment using physical separation to reduce the volume of material to be treated.

Effectiveness

The effectiveness of soil washing is highly waste specific. A thorough physical and chemical characterization of the waste and treatability testing is essential in determining the most suitable and efficient means of separating the contaminants from the clean soil. When different classes of contaminants are present (such as metals, VOCs, PAHs, etc.) a series of extraction operations using different solvents, pH adjustment. etc. may be required.

A combination of physical separation and various chemical extraction techniques might be used to remove the inorganic and organic contaminants from various hot spots at the DRMO. Physical separation of the wastes (debris, municipal refuse, etc.) from the soils may be required at certain areas for efficient treatment of the soils. Nontoxic organic solvents may be used for the removal of organic contaminants, whereas acidic solutions may be required for leaching of metals from the soils. The extraction process would yield clean soils that would require rinsing with clean water several times to remove the residual extractant. By-products from the process would consist of spent solvent streams containing the wastes requiring further treatment/disposal and recovery/recycle of the extractants. Because of the high number of COCs present in the soils, it will be difficult to find reagents that are effective in removing all contaminants successfully.

Implementability

Soil washing/chemical extraction could be implemented at DRMO. However, a full-scale soil washing/chemical extraction system would be very complex, consisting of physical separation operations and chemical extraction processes. Physical separation would consist of several operations depending on the type of debris, sizes, densities of materials, etc. Chemical extraction would require treatability studies to determine its effectiveness. Typically, waste streams produced from chemical extraction are more contaminated and greater in volume than waste streams from other processes. Because of the wide range of contaminants present in the soils, several reagents would be required to remove all contaminants. In order to treat the extracted liquid, an extensive wastewater treatment facility would be required to separate the reagents from the treated soils and then to treat the residuals. The wastewater facility would be required to have inorganic and organic treatment processes along with dewatering processes. Unless efficient recovery/recycle of the extractant is achievable, there would be significant implementability concerns for further treatment/disposal of the waste streams. The substantive requirements of a RCRA hazardous waste TSD facility would have to be met by an on site soil washing/chemical extraction system.

Cost

Capital and O&M costs for the soil washing/chemical extraction process are moderate to high. Additional costs for disposal of residues may be moderate to high.

Conclusion

Soil washing/chemical extraction is eliminated from further consideration because of significant effectiveness and implementability concerns, and therefore, it is eliminated from further consideration.

3.3.6.3 Dewatering

Dewatering is a process for reducing the free water content of a solid material. Dewatering would be achieved by either passive (gravity-aided) drainage of water from stockpiled material or by mechanical expression of that material.

Stockpiling of wet material on a drainage pad would cause most of the free water to drain as a result of gravity forces and of the mechanical expression of the lower strata of stockpiled soil by the weight of the upper strata. The free water would drain through a pad designed to filter out solid particles. This pre-filtered water would then be treated as required by such technologies as granular activated carbon (GAC) adsorption to meet the appropriate criteria for discharge to local surface water.

Depending on the physical characteristics of the material to be dewatered, free water could be mechanically expressed through the use of pressure or centrifugal forces developed by specialized equipment such as belt filter presses, plate-and-frame filter presses, vacuum filters, or centrifuges. The released water would also be treated on site as with the stockpiling option.

Effectiveness

Mechanical expression is generally more effective than stockpiling because the rate and extent of dewatering are usually higher when forces greater than gravity alone are applied to separate liquids from solids. However, stockpiling would provide a simple and yet effective mean of releasing most of the free water from a relatively granular material such as the soil at DRMO.

Implementability

Both stockpiling and mechanical expression are readily implementable. Resources, equipment, and material to implement either of these options are readily available. Stockpiling would be simpler to implement but require more space than mechanical expression. Mechanical expression would require more equipment and maintenance than stockpiling. The substantive requirements of a RCRA hazardous waste TSD facility would have to be met by an on site dewatering system. Also, the substantive requirements of an NPDES permit would have to be met for the surface discharge of the treated drainage water.

Cost

The cost of stockpiling would typically be low. The cost of mechanical expression would be moderate.

Conclusion

Stockpiling is retained as an on site pre-treatment option for wet soil.

3.3.6.4 Size Separation

Size separation consists in sorting out loose bulk solid material by particle size. This is typically accomplish through the use of stationary or vibrating screens with various mesh openings. Size separation is most often required ahead of treatment processes which are only effective if the size of the particles of the material to be treated is within a well-defined range. This is the case, in particular for such processes as thermal desorption and chemical fixation-solidification.

Effectiveness

Size separation is not generally effective as a stand-alone contaminant removal technology. To be effective, size separation must be used in conjunction with other treatment processes and is often required as a pre-treatment to optimize the effectiveness of these treatment processes. However, it should be noted that, since higher contaminant concentrations are typically associated with smaller particle size, size separation can in fact achieve a reduction of contaminated media volume by sorting out large sized material which may require little or no further treatment.

During construction, risk to site workers operating the screening equipment could be adequately minimized through the use of dust suppression controls, the wearing of appropriate personal protection equipment (PPE), and compliance with OSHA regulations and site-specific health and safety procedures..

Implementability

Size separation would be relatively simple to implement if conservative sorting decisions are made in the field. A method of quality assurance would need to be developed to calibrate the field readings with laboratory analysis to ensure that material sorted as non-contaminated is, in fact, clean. The resources for sorting using mechanical excavators and mechanical screening are readily available. The substantive requirements of a RCRA hazardous waste TSD facility would have to be met by an on site size separation system.

Cost

When compared to other removal options, size separation has a moderate capital cost and high O&M cost.

Conclusion

Size separation is retained for further consideration as a pretreatment step for other technologies that require contaminated waste to be separated prior to treatment or offsite disposal.

3.3.6.5 Crushing-Grinding-Shredding

Crushing-grinding-shredding would consist of reducing the size of contaminated debris so that they would meet the particle size requirements of subsequent treatment processes. This size reduction is accomplished by processing the oversized contaminated debris in specialized mechanical equipment such as hammer mill, grinders, and shredders.

Effectiveness

Crushing-grinding-shredding is not effective as a stand-alone contaminant removal technology. To be effective, crushing-grinding-shredding must be used in conjunction with other treatment processes and is often required as a pre-treatment to optimize the effectiveness of these treatment processes.

During construction, risk to site workers operating the size reduction equipment could be adequately minimized through the use of dust suppression controls, the wearing of appropriate personal protection equipment (PPE), and compliance with OSHA regulations and site-specific health and safety procedures..

Implementability

Crushing-grinding-shredding would be readily implementable as a pretreatment step. The equipment and labor to operate this equipment would be readily available. The substantive requirements of a RCRA hazardous waste TSD facility would have to be met by an on site crushing-grinding-shredding system.

Cost

Capital and O&M costs for crushing-grinding-shredding are typically low.

Conclusion

Crushing-grinding-shredding is retained for further consideration in the development of remedial alternatives, only as a potential intermediate step between excavation and treatment or disposal of waste material.

3.3.6.6 Thermal Desorption

Thermal desorption technology uses direct or indirect heating to thermally desorb or volatilize organic contaminants. The temperatures used are contaminant- and matrix-specific, with a range of approximately 200 to 1,200°F (95 to 650°C). Typically, wastes are processed through an externally fired pug mill or rotary drum system equipped with heat transfer surfaces that are heated by circulating hot oil. An induced air flow conveys the desorbed organic chemicals through a secondary treatment system, such as a GAC adsorption unit, a catalytic oxidation unit, a condenser unit, or even an afterburner. It should be noted, however, use of an afterburner for secondary treatment has typically resulted in the thermal desorption unit being considered as an incinerator by regulatory agencies. The offgas is then discharged through a stack. Thermal desorption processes are generally applicable to the removal of VOCs (Henry's law constant higher than 1.0×10^{-3} atm-m^3 per mole) and certain SVOCs (Henry's law constant lower than 1.0×10^{-3} atm-m^3 per mole). Thermal desorption units borrow technology from other well-established industrial applications, such as sludge or asphalt dryers. Some of the thermal desorption systems that are currently available are documented below.

Chemical Waste Management offers a proprietary process called X*TRAX. This process consists of a rotary dryer, externally fired with propane, and an off-gas handling system. Contaminated soils are fed by an auger or pump into the dryer and heated to a temperature range of 500 to 800°F (260 to 430°C). Nitrogen is used as a carrier gas that transports volatilized organics to a baghouse and then to a three-stage cooling and condensing train. Organics in the liquid condensate are removed for disposal. The carrier gas is reheated and recycled. A small portion of the carrier gas is filtered and treated by GAC adsorption prior to discharge to the atmosphere. A full-size unit can handle an average of 150 tons per day of soil with a moisture content of 20 percent. It requires a space of about 120 feet by 120 feet to set up and approximately 2 to 3 weeks for mobilization.

Weston Services, Inc., has a patented Low Temperature Thermal Treatment (LT^3) system. The system uses a thermal processor, which is an indirectly heated, auger-type heat exchanger. The processor is operated at approximately 400°F (205°C). Sweep gas, a mixture of air and exhaust gases from the indirect firing system (fired on propane, natural gas, or oil), carries volatiles to a baghouse, then through two condensers prior to being treated by GAC adsorption (Nielson et al., 1989; Cosmos, 1992, personal communication). The full-scale model is designed to process 7 tons per hour with a moisture content up to 20 percent. Mobilization takes 1 to 2 weeks and requires approximately 100 feet by 100 feet of space for equipment setup.

Clean Soils, Inc., provides an LTTS system called a Thermal Desorber. The three major components of the system are a primary treatment unit, a baghouse, and a secondary treatment unit. The primary treatment unit is a rotary chamber in which the soil is heated to 350 to 700°F (180 to 370°C). Off-gas from this unit, which contains both solid particulates and volatilized organic compounds, then passes through a baghouse. The solid particulates are collected in the baghouse and recirculated back to the primary soil discharge. The filtered exhaust gas then enters an afterburner (or thermal oxidizer) where a temperature of 1,400°F (760°C) or higher is maintained and residual organic compounds in the exhaust gas are oxidized. The Thermal Desorber can remove any organic of low volatility or with a boiling point below the operating temperature and oxidize it to carbon dioxide and water (Clean Soils, Inc., company brochure). However, screening out of materials with particle sizes greater than 1.5 to 3.0 inches would be required for this process. Oversized rocks, debris, and fill material must be disposed of appropriately.

Effectiveness

The effectiveness of thermal desorption is highly contaminant- and matrix-specific. Therefore a full characterization of the waste to be treated would be required and treatability testing would have to be performed to verify the level of effectiveness and determine the optimum operating temperature and detention time.

Thermal desorption would very likely be effective for the volatilization of the organic COCs at DRMO. On the other hand, most inorganic contaminants would not be reduced by this treatment process. The primary organic COCs, such as PAHs and PCBs, are not particularly volatile but would probably be removed with operating temperature in the range of 1,000 to 1,200°F (540 to 650°C). Thermal desorption effectiveness is very sensitive to particle size, therefore, pre-treatment would likely be required with size separation and crushing-grinding-shredding.

To be fully effective, thermal desorption would require additional treatment of the volatilized contaminants which would be accomplished through treatment of offgases by such processes as condensation, gas-phase GAC adsorption, or catalytic oxidation. Also, the presence of inorganic contaminants would require separate additional treatment.

Implementability

Thermal desorption would be implementable at the DRMO. Mobile units and contractors are readily available to perform onsite thermal desorption. However, it should be noted that the number of contractor experienced in the thermal desorption of PCB-contaminated materials is more limited. Pre-treatment of the excavated material for size separation and/or reduction would most likely be required. Offgas of the thermal desorption unit would have to be treated and the appropriate State agencies would have to be contacted to determine the degree of treatment required. Treatability testing would have to be performed. Offsite thermal desorption is not implementable because of the absence of available units. The substantive requirements of a RCRA hazardous waste TSD facility would have to be met by an on site thermal desorption system. Such a system would also have to meet the substantive requirements of applicable air pollution control regulations.

Cost

Capital and O&M costs of thermal desorption are moderate. Compared to incineration these costs are low.

Conclusion

Thermal desorption is be retained for further consideration as it is effective and implementable.

3.3.6.7 Incineration

Incineration is a thermal oxidation process that converts organic solids, liquids, and gases to inorganic substances at high temperatures in the presence of oxygen. The technology uses controlled flame combustion in an enclosed reactor to decompose organics. Carbon and hydrogen waste components are converted to carbon dioxide (CO_2) and water, respectively. Chlorine, if present, is mostly converted to hydrochloric acid (HCl). Other combustion products are also present in smaller quantities. These may include carbon monoxide, nitrogen oxides, chlorine, fluorine, and trace metals. Incineration produces a solid stream from the incombustible portion of the original material, which is removed as a bottom fly ash, detoxified soil, and/or other solid treatment residuals. If a wet scrubber air pollution control system is used, a liquid waste stream could also be generated. Screening of the contaminated material would be required to remove the noncombustible waste/debris from the soils. The noncombustible waste/debris must be treated or disposed of by other means, depending upon the level of contamination associated. Common, available incineration systems are described below.

Rotary Kiln Incineration. Rotary kilns are one of the most widely-used incinerators for wastes in the form of solids, sludges, liquids, and gases. An integrated system for incineration by rotary kiln includes a solid feed system; a rotary kiln and secondary combustion chamber; air pollution control units for particulate and acid gas removal; and an exhaust stack. Such a system employs a refractory-lined rotary kiln operating at high temperatures (1,470 to 2,910°F or 800 to 1,600°C) to combust wastes in the presence of oxygen. Wastes with a high salt or heavy metal content and explosive wastes require special evaluation. A typical throughput for a transportable rotary kiln is 75 to 200 tons per day. For wastes which have high heat content, the throughput may be limited by the capacity of the unit to control the heat generation rate. Fixed-based units, such as cement kilns that may be permitted to accept contaminated soils, are also available.

Infrared Incineration. An integrated system for infrared incineration consists of silicon resistance heating elements, a refractory-lined reactor chamber, a traveling-belt-type waste conveyor, and air pollution control units. Infrared energy, supplied from an electric power source, destroys organic waste components at high temperatures (1,000 to 2,300°F or 540 to 1,260°C). Off-gases from the primary reactor are exhausted to a secondary chamber to ensure complete combustion. Infrared incineration has been used primarily to treat solids and sludges, but incinerator modifications would allow liquid and gas treatment. Mobile units have a maximum processing capability of approximately 5 to 7 tons per hour of contaminated soil.

Fluidized Bed Incineration. Fluidized beds are vertical, refractory-lined chambers that contain an inert material, usually sand. Air is forced through a supporting distribution plate at the bottom of the bed at a rate sufficient to fluidize the inert material. Waste materials are introduced just above or directly into the fluidized bed. The passage of air through the bed causes agitation and promotes rapid and uniform mixing of the waste material, air, and bed particles. Heat is transferred from the bed particles to the waste material, which burns rapidly and transfers heat back to the bed. This bed is preheated (to start-up temperatures) using either preheated air or an impinging burner (located above the bed). Auxiliary fuel is usually added through nozzles within the bed. As the waste materials burn, the larger, inert particles remain in the bed, and the smaller particles are separated from the exhaust gases in a freeboard area above the bed. The fluidized bed must be regenerated as the inert material within the bed increases. Renovation of the bed can be performed as a batch process or continuously. As the bed material is removed from the incinerator, the inert particles are separated, and the material can then be reused. Normal operating temperatures vary from 850 to 2,100°F (455 to 1,150°C), and residence times vary with bed depth. Fluidized beds are available as mobile units.

Circulating Fluidized Bed Incineration. The circulating bed incinerator is similar to the fluidized bed incinerator, except that the system operates with high combustion air velocities and finer bed material. The higher velocities create greater turbulence within the reactor, which allows for efficient destruction of all types of hydrocarbons. The high turbulence entrains the solids and allows combustion to take place along the entire height of the unit. This allows uniform temperatures to be achieved in the unit. An integral cyclone is used to separate the fluidized solids from the off-gases. These solids are returned to the combustion zone.

Secondary air is injected into the upper portion of the unit. Burning the waste material in the presence of dry limestone controls the formation of acidic gases. Typical operating temperature is 850°F (455°C). Circulating beds are also available as mobile units.

Effectiveness

Incineration would be very effective for destroying the organic COCs in the DRMO soil. Incineration would typically achieve in excess of 99.99 percent destruction of organic contaminants with the resulting formation of inert carbon dioxide and water. Residual ash would consist of the non-combustible constituents of the soil, including most inorganic contaminants in the soil. Toxic metals which may be present in the soil could make incineration ash a hazardous waste subject to RCRA regulations and land disposal restrictions. Incineration would reduce the toxicity, mobility, and volume of organic COCs. Additional treatment would likely be required to achieve the same result for inorganic contaminants.

Implementability

Incineration is implementable, with several vendors capable of performing this work. Offsite incineration is typically more easily implemented than onsite incineration, since, whereas incineration at an existing offsite facility only requires pre-approval of the waste, on site incineration would require the acquisition of permits and the performance of trial burns, which are difficult and-time consuming procedures. Also, local citizen groups can significantly delay the permitting process. Other considerations include the need for treatment of off-gases and wastewater which result from operation of an incineration system. The substantive requirements of a RCRA hazardous waste TSD facility would have to be met by an on site incineration system. Such a system would also have to meet the substantive requirements of applicable air pollution control regulations.

Cost

The relative cost of incineration is high to very high compared to other ex situ treatment technologies.

Conclusion

Offsite incineration is an effective and implementable means for treatment of organic COCs for the DRMO. As a result, offsite incineration will be retained for further consideration. Although onsite incineration is effective it would be very difficult to implement and it is therefore eliminated from further consideration.

3.3.7 Offsite Disposal

Offsite disposal would consist of transporting the excavated material to an offsite disposal facility. A permitted TSD facility would be required for any hazardous waste, as defined by RCRA. A permitted, solid waste facility would be adequate for all non-hazardous waste, as defined by RCRA.

Effectiveness

Offsite disposal by landfilling would be highly effective over the long term. The contaminated soil would be taken off site, and no residual risks would remain at the DRMO. Landfilling would be effective for isolating contaminants from the environment. Based on the existing chemical analysis of the contaminated soil at the DRMO, a significant portion of that soil, if untreated, may have to be placed in a hazardous waste landfill. The waste-specific requirements vary from state to state and by individual landfills. The selection of the disposal facility would be based on waste-specific effectiveness, permitting, and cost considerations.

Implementability

Offsite landfilling of contaminated soil would be easily implementable. Waste acceptance requirements are variable based on the type and composition of the waste, state regulations, and landfill policies. Certain organic chemicals can deteriorate synthetic landfill liners and could therefore only be disposal at landfills which use predominantly compacted clay liners. Another common requirement for landfilling is the absence of free water in the waste so that it successfully passes the "paint filter test". Dewatering of waste material may be required prior to disposal. The substantive requirements of a RCRA TSD facility would have to be met by an on site landfill of hazardous (Title C) or non-hazardous (Title D) waste.

Cost

The cost of offsite landfilling is highly variable, ranging from low to moderate for landfilling of non-hazardous waste and from moderate to high for landfilling of hazardous waste.

Conclusion

Offsite disposal is retained for further consideration as effective and implementable.

3.4 SUMMARY OF SCREENING AND SELECTION OF REPRESENTATIVE PROCESS OPTIONS

All of the technologies and process options that were evaluated and retained for soil are summarized below:

General Response Action	Remedial Technology	Process Options
No Action	None	None
Institutional Controls	Access/Use Restrictions	Active: Physical Barriers
		Passive: Land Use Restrictions
	Monitoring	Groundwater/Surface Water Monitoring
Containment	Surface Water Controls	Revegetation-Diversion-Collection
	Capping	Repair & Restoration of Existing Cap
Removal	Excavation	Excavation
Ex-Situ Treatment	Physical/Chemical	Chemical Fixation-Solidification
		Dewatering
		Size Separation
		Crushing-Grinding-Shredding
	Thermal	On Site Thermal Desorption
		Offsite Incineration
Disposal	Off Site Disposal	RCRA Hazardous Waste TSD Facility
		Solid Waste Disposal Facility

With regard to treatment of soil, the specific process option selected will be based on the site-specific contaminants. It is anticipated that separate treatment processes will be required for organic and inorganic contaminants. Although on site thermal desorption and offsite incineration would both effectively remove organic contaminants, on site thermal desorption would achieve this at a considerably lower cost. Therefore, on site thermal desorption is selected as the representative process for thermal treatment. Chemical fixation-solidification will be used to remediate inorganic contaminants.

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 INTRODUCTION

This section presents the rationale for the development of the remedial alternatives that are evaluated in this FS. These alternatives are developed from combinations of technologies and process options evaluated in Section 3.0. A range of remedial alternatives, based on the GRAs discussed in Section 2.1.4, was developed for the DRMO. These alternatives are developed and described in Section 4.3.

4.1.1 National Oil and Hazardous Substance Pollution Contingency Plan Focus

The purpose of the FS and the overall remedy selection process is to identify remedial actions that eliminate, reduce, or control risks to human health and the environment (40 CFR 300). The national program goal for the FS process, as defined in the NCP, is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. The criteria for identifying potentially applicable technologies to achieve these goals are provided in EPA guidance (USEPA, 1988) and in the NCP. A strong statutory preference for remedies that will result in a permanent and significant decrease in toxicity, mobility, or volume and provide long-term protection is identified in Section 121 of CERCLA, as amended. The threshold criteria address overall protection of human health and the environment and compliance with ARARs. Primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; implementability; and cost.

In addition to the above objectives, the NCP defines certain expectations in developing and screening remedial action alternatives.

- The expectation to use treatment to address the principal threats posed by a site, wherever practical. Principal threats are considered to be liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.

- The expectation to use engineering controls, such as containment, for waste that poses a relatively low, long-term threat and for which treatment is impractical.

- The expectation to use a combination of methods, as appropriate, to achieve protection of human health and the environment. In appropriate site situations, treatment of principal threats will be combined with engineering controls (such as containment) and institutional actions for treatment residuals and untreated waste.

- The expectation to use institutional actions, such as water controls and deed restrictions, to supplement engineering controls for short- and long-term management to prevent or limit exposures to hazardous substances, pollutants, or contaminants.

- The expectation to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than previously demonstrated technologies.

- The expectation to return environmental media such as groundwater to their beneficial uses, wherever practical, within a time frame that is reasonable, given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practical, EPA expects to prevent further migration of the contaminant plume, prevent exposures to contaminated groundwater, and evaluate further risk reduction.

These expectations have been applied in the development of the DRMO remedial alternatives.

4.2 RATIONALE FOR ALTERNATIVE DEVELOPMENT

The purpose of the FS is to evaluate the information provided in the RI, which assesses site conditions, and develop an appropriate range of alternatives to allow remedy selection. The development of alternatives should reflect the scope and complexity of the site problems that are being addressed. The number and types of alternatives should also be based on the site characteristics and complexity of the site concerns. Development of alternatives for the DRMO is based on the following:

- Technologies and process options remaining after the screening evaluations from Section 3.0
- Land use scenarios for the DRMO
- Exposure scenarios
- Remedial goal options for each COC
- ARARs

4.2.1 Technologies and Process Options

The technologies and process options that remain from the screening evaluation will be combined as appropriate to develop alternatives which are protective of human health and the environment. Section 3.4 summarizes the remaining soil treatment technologies and process options for the DRMO. The primary process options (i.e., process options that form the major components of a remedial alternative) for the DRMO include the following:

- Capping and Surface Water Controls (existing)
- Mechanical Excavation
- Chemical Fixation-Solidification
- Thermal Desorption
- Solid Waste Disposal/Permitted TSD Facility

In addition, the secondary process options (i.e., process options that are used for pre-treatment) for the DRMO are as follows:

- Dewatering
- Size Reduction
- Crushing-Grinding-Shredding

These process options will be used individually or combined with each other, as appropriate, to form remedial alternatives. Additionally, ancillary process options (i.e., process options which, by themselves, do not address RAOs) will be combined with the primary process options to achieve RAOs for each alternative.

4.2.2 Land Use Scenarios

Potential exposure of the environmental media are evaluated in the context of two land use scenarios: (1) current industrial land use and (2) future residential land use. These land use designations reflect the current framework for assessing risk at the DRMO.

Under the current industrial land use scenario, the DRMO would remain part of NSB-NLON. Under this scenario the DRMO would also remain in its present function as a storage and collection area for items to be sold at auctions.

Under the future residential land use scenario, the DRMO could be developed for residential use either after sale to the public sector or still under the control of NSB-NLON. Currently, it is anticipated that the DRMO area will remain in its present function under control of NSB-NLON and a future residential land use scenario is therefore extremely unlikely. However, this scenario was still considered because the DRMO site constitute riverfront real estate and that, since this type of property is traditionally very desirable for residential development, such a possibility cannot be completely ruled out.

4.2.3 Exposure Scenarios

Assumptions for the land use scenarios and receptors used for alternative development are consistent with the DRMO risk assessment and allow quantification of risk for contaminants of concern at the DRMO.

Under the current industrial land use scenario, the DRMO is assumed to remain as it currently exists. Existing current industrial land use at and in the vicinity of the DRMO indicates that receptors most likely to be exposed to contaminants on and migrating from the site include full-time employees, older child trespasser, and construction worker. Potential current receptors, as identified in the revised risk assessment (see Section 1.4.2), for which possible adverse health effects could be expected include the following:

- Full-time Employee - Exposure routes include:
  - incidental ingestion of soil
  - dermal contact with soil

- Construction Worker - Exposure routes include:
  - incidental ingestion of soil
  - dermal contact with soil

- Older Child Trespasser - Exposure routes include:
  - incidental ingestion of soil
  - dermal contact with soil

Under the future residential land use scenario, the DRMO could be developed into a residential community or industrial complex. Potential future receptors for which possible adverse health effects could be expected include the following:

- Future resident - Exposure routes include:
  - incidental ingestion of soil
  - dermal contact with soil
  - inhalation of fugitive dust and volatile emissions

4.2.4 Accommodation of PRGs and ARARs

The PRGs differ for the two land use scenarios and their associated receptors. The PRGs for current industrial land use and its receptors (full-time employee, construction worker, and older child trespasser) are less stringent than the PRGs associated with the primary receptor under the future residential land use scenario, i.e., the future resident.

In general, it is desired to develop remedial alternatives that achieve compliance with ARARs and PRGs. However, in certain cases, technical limitations and costs may prevent the development of alternatives that comply with all ARARs and PRGs. For example, waste areas that pose relatively low levels of risk over long time frames are considered appropriate for containment technologies (i.e., capping) combined with institutional controls. Municipal landfills are identified in the preamble to the NCP as a type of site where treatment may be impractical because of the size and heterogeneity of the contents. Because treatment is usually considered impracticable for large municipal landfills, containment is often considered to be an appropriate response action or the "presumptive remedy".

Because the DRMO consists of a landfill with material to an undetermined depth and a shallow, tidally influenced groundwater table, it falls into a category where treatment of all of the landfill contents is impracticable. As a result, no alternatives will be developed that consider excavation and disposal (on site or off site) of the entire landfill contents. Alternatives will be developed that consider excavation, treatment, and disposal of selected areas of contamination for both the current and future land use scenarios, which is consistent with U.S. EPA's guidances.

4.3 DEVELOPMENT OF ALTERNATIVES FOR THE DRMO

This section will develop the remedial alternatives for the DRMO considering the information provided in Section 4.2. Additional site-specific information and assumptions will be provided in this section to further explain the alternative development process. All alternatives will be briefly explained in the following sections.

The DRMO is underlain by an upper layer of 2 to 20 feet of fill material (sand, gravel, metal and wood). Coarse-grained terrace deposits make up the natural overburden materials which are overlain by clayey silt. The water table is generally encountered within the fill material, with the underlying clayey silt and terrace deposits under saturated conditions.

The DRMO area is contaminated primarily with PAHs, inorganic compounds, and PCBs in the soil. As a result of the 1995 Time-Critical Removal Action, most of the highly contaminated soil was excavated, although residual contamination above the PRGs for both land use scenarios was left in place. Since completion of the Time-Critical Removal Action, the groundwater at the site has not been noticeably impacted either by materials storage or by the original fill material. Groundwater data did not indicate transport of soil contaminants into the groundwater except of the most soluble (volatile organic) constituents.

Currently, there are no human receptors for the surficial aquifer which discharges to the Thames River. Minimal levels of contamination have been detected in the Thames River surface water that may or may not be attributable to the DRMO. Human health risks calculated for dermal contact with groundwater were shown to be acceptable.

Therefore, the development of remedial alternatives will focus on the need for soil remediation because of exceedances of site-specific SWPCs and pollutant mobility criteria and because of potentially unacceptable risks to construction workers, future residents, and ecological receptors exposed to the soil. Alternatives will also be developed to monitor the potential for migration of contaminants from the soil to groundwater and the surface water of the Thames River.

The following alternatives have been developed for the DRMO:

- Alternative 1: No Action
- Alternative 2: Institutional Controls and Monitoring
- Alternative 3: "Hot Spots" Excavation, Offsite Disposal, Institutional Controls, and Monitoring
- Alternative 4: Excavation, Onsite Treatment (thermal desorption & fixation-solidification), and Offsite Disposal

A brief description of each alternative is provided in Sections 4.3.1 through 4.3.4. Each alternative is composed of various components (e.g., component 1 - Institutional Controls).

4.3.1 Alternative 1 - No Action

No action is required for this alternative. This alternative is required by the NCP and is used as a baseline comparison with other alternatives. At the DRMO this alternative would still include the existing cap but with no maintenance of that cap.

4.3.2 Alternative 2 - Institutional Controls and Monitoring

Alternative 2 would consist of two major components in addition to the existing cap: (1) institutional controls and (2) monitoring.

Institutional controls would include maintenance of the existing cap and implementation of limits to site access and land use restrictions. These controls would eliminate or reduce pathways of exposure to contaminants at the site.

Monitoring would include regular groundwater sampling and analysis in accordance with the Groundwater Monitoring Plan (B&R Environmental, September 1997). If groundwater COCs concentrations are shown to exceed Connecticut's SWPCs, the scope of this monitoring would be expanded to include surface water and river sediment sampling and analysis to determine if COCs are migrating from the DRMO to the Thames River and if additional action is required. Finally, monitoring would include 5-year reviews for the life of the project, i.e., 30 years.

4.3.3 Alternative 3 - "Hot Spots" Excavation, Offsite Disposal, Institutional Controls, and Monitoring

Alternative 3 would consist of four major components in addition to the existing cap: (1) excavation of contaminated soil "hot spots" excavation with dewatering of wet soil and repair and restoration of the existing cap, (2) offsite disposal of excavated soil, (3) institutional controls, and (4) monitoring.

Soil contaminated with COCs at concentrations exceeding industrial land use PRGs would be excavated, dewatered on site as required, and disposed of at an offsite RCRA hazardous waste TSD facility. Clean soil from an offsite borrow source would be backfilled in the excavated areas.

Institutional controls and monitoring would be identical to those for Alternative 2.

4.3.4 Alternative 4 - Excavation, Onsite Treatment (thermal desorption & fixation-solidification), and Offsite Disposal

Alternative 4 would consist of three major components: (1) excavation with dewatering of wet soil, (2) onsite treatment of excavated soil, and (3) offsite disposal of treated soil.

Soil contaminated with COCs at concentrations exceeding residential land use, ecological, and surface water protection PRGs would be excavated. Wet excavated soil would be dewatered on site if necessary.

Excavated soil would be treated on site using a combination of thermal desorption to remove and destroy organic COCs and chemical fixation-solidification to immobilize inorganic COCs. High-temperature thermal desorption would remove organic contaminants through volatilization and subsequent treatment and destruction of these volatilized contaminants. As required, the thermally treated soil would then undergo chemical fixation-solidification to bind inorganic contaminants with the soil in a leach-resistant matrix. Prior to thermal desorption, excavated soil would be pre-treated by size separation and/or crushing-grinding-shredding, if necessary.

It should be noted that, for this alternative, chemical fixation-solidification was also considered as a stand alone technology for the treatment of the contaminated soil. However, thermal desorption had to be added because, as previously noted, the effectiveness of chemical fixation-solidification would be limited for that portion of soil which contain relatively high concentrations of PAHs and also because chemical fixation-solidification does not reduce toxicity of contaminants but merely immobilizes them.

Following onsite treatment, the soil would be disposed of at an offsite solid waste disposal facility. Clean soil from an offsite borrow area would be backfilled into the excavated areas.

4.4 SCREENING OF ALTERNATIVES

The screening of alternatives is used to decrease the number of alternatives that are carried forward for detailed analysis. This step in the FS process is conducted, when appropriate, to eliminate alternatives that do not achieve protection of human health or the environment. Alternatives which are significantly less effective than other more promising alternatives, which are not technically or administratively implementable, or which have significantly higher costs should also be eliminated.

The alternatives developed and described for the DRMO are considered to represent an appropriate range of alternatives. All alternatives are considered effective and implementable. Therefore, all of the alternatives developed for the DRMO will be carried forward for detailed analysis.

5.0 DETAILED DESCRIPTION AND ANALYSIS OF ALTERNATIVES

In this section each remedial alternative developed in Section 4.0 for the DRMO is described and analyzed in detail in accordance with the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988) and the NCP (40 CFR 300). The detailed analysis of remedial alternatives provides information needed for the comparison of alternatives as well as for the final selection of the remedial action alternative(s).

5.1 CRITERIA FOR DETAILED ANALYSIS

The detailed analysis includes a presentation and assessment of relevant information which provides the basis for selecting an alternative and preparing a ROD. The analysis in each alternative provides the basis for technical and administrative feasibility of an alternative as well as a cost evaluation.

The detailed analysis evaluates each alternative against nine criteria which have been developed by the USEPA to address CERCLA requirements. Building on the development and screening of alternatives, the detailed analysis presents more in-depth information, including pertinent RI data, which are used in the assessment of the alternatives relative to the CERCLA criteria. Following the detailed analysis, a comparative of alternatives is presented in Section 6.0. The Proposed Plan (PP) documents selection of a preferred alternative and is used to solicit community and state agency comments.

The following nine criteria will be used for the detailed analysis for each remedial alternative:

1. Overall Protection of Human Health and the Environment
2. Compliance With ARARs and TBCs
3. Long-term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility, and Volume through Treatment
5. Short-term Effectiveness
6. Implementability
7. Cost
8. State and USEPA Acceptance
9. Community Acceptance

The first two criteria, overall protection of human health and the environment and compliance with ARARs, are the threshold criteria that relate directly to statutory findings that must be made in the ROD. The next five criteria, long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost are grouped together because they represent the primary criteria upon which the analysis is based.

State and USEPA acceptance will be evaluated after the State of Connecticut and USEPA Region I have reviewed and commented on the draft FS report. Community acceptance will be addressed in the Record of Decision that will be finalized after the public comment period for the FS and Proposed Plan. State, USEPA, and community acceptance must be considered during remedy selection. The following is a description of each of the nine evaluation criteria:

1. Overall Protection of Human Health and the Environment. The primary requirement for CERCLA remedial actions is that they are protective of human health and the environment. A remedy is protective if it adequately eliminates, reduces, or controls all current and potential health risks. All pathways of exposure must be considered when evaluating the remedial alternative. After the remedy is implemented, if hazardous substances remain without engineering or institutional controls, then the evaluation must consider unrestricted use and unlimited exposure for human and environmental receptors. For those sites where hazardous substances remain and unrestricted use and unlimited exposure are not allowable, engineering controls, institutional controls, or some combination of the two must be implemented to control exposure and thereby ensure reliable protection over time. In addition, implementation of a remedy cannot result in unacceptable short-term risks or cross-media impacts with regard to human health and the environment.

2. Compliance with ARARs and TBCs. Compliance with ARARs and TBCs is one of the statutory requirements for remedy selection. Alternatives are developed and refined throughout the FS process to ensure that they will meet all of their respective ARARs or that there is good rationale for obtaining a waiver or exemption. During the detailed analysis, information on Federal and state action-specific ARARs will be assembled along with previously identified chemical-specific and location-specific ARARs. Alternatives will be refined to ensure compliance with these requirements.

3. Long-term Effectiveness and Permanence. This criterion reflects CERCLA's emphasis on implementing remedies that will ensure protection of human health and the environment in the future, as well as in the near term. In evaluating alternatives for their long-term effectiveness and the degree of permanence they afford, the analysis should focus on the residual risks that will remain at the site after the completion of the remedial action. This analysis should include consideration of the following:

- Degree of threat posed by the hazardous substances remaining at the site.

- Adequacy of any controls (e.g., engineering and institutional controls) used to manage the hazardous substances remaining at the site.

- Reliability of those controls.

- Potential impacts on human health and the environment, should the remedy fail, based on assumptions included in the reasonable maximum exposure scenario.

4. Reduction of Toxicity, Mobility and Volume through Treatment. This criterion addresses the statutory preference for remedies that employ treatment as a principal element by ensuring that the relative performance of the various treatment alternatives in reducing toxicity, mobility, or volume will be assessed. Specifically, the analysis should examine the magnitude, significance, and irreversibility of reductions.

5. Short-term Effectiveness. This criterion examines the short-term impacts of the alternatives (i.e., impacts of the implementation) on the neighboring community, the workers, or the surrounding environment, including the potential threat to human health and the environment associated with excavation, treatment, and transportation of hazardous substances. The potential cross-media impacts of the remedy and the time to achieve protection of human health and the environment are also evaluated.

6. Implementability. Implementability considerations include the technical and administrative feasibility of the alternatives, as well as the availability of the goods and services (e.g., treatment, storage, or disposal capacity) on which the viability of the alternative depends. Implementability considerations often affect the timing of various remedial alternatives (e.g., limitations on the season in which the remedy can be implemented, the number and complexity of materials-handling steps that must be followed, the need to obtain permits for offsite activities, and the need to secure technical services (such as well drilling and excavation).

7. Cost. Cost encompasses all capital costs and operation and maintenance costs incurred over the life of the project. The focus during the detailed analysis is on the net present value of these costs. Costs are used to select the least expensive (or most cost-effective) alternative that will achieve the

remedial action objectives. For purposes of calculating the present worth for the annual operating and maintenance costs, a 30-year maintenance life and a 5 percent annual discount factor are used.

8. State and USEPA Acceptance. This criterion, which is an ongoing concern throughout the remediation process, reflects the statutory requirement to provide for substantial and meaningful state involvement.

9. Community Acceptance. This criterion refers to the community's comments on the remedial alternatives under consideration, where "community" is broadly defined to include all interested parties. These comments are taken into account throughout the FS process. However, only preliminary assessment of community acceptance can be conducted during the development of the FS, since formal public comment will not be received until after the public comment period for the preferred alternative is held.

5.2 DESCRIPTION AND ANALYSIS OF ALTERNATIVES

This section describes and analyzes in detail each of the alternatives that were assembled in Section 4.0. These alternatives are analyzed using the criteria described in Section 5.1.

5.2.1 Alternative 1 - No Action

5.2.1.1 Detailed Description

This alternative is a "walk-away" alternative that is required under CERCLA to establish a basis for comparison with other alternatives. In this alternative, although the existing cap would be left in place, any existing remedial activities, such as cap maintenance, monitoring programs, and institutional controls would be discontinued, and the property would be released for unrestricted use. This alternative cannot be chosen if waste remains on site

5.2.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 1 would provide some protection of human health and the environment because of the existing cap. However, since the cap would not be maintained, that protection would be limited. Under the current industrial land use, the potential for direct human and ecological exposure to contaminated soil could develop over time as the existing cap deteriorates. In addition, under a possible future residential land use scenario, unacceptable risks could develop for human receptors and an increased population of ecological receptors from exposure to contaminated soil. Although this has not occurred to date, contaminants in the DRMO soil could start migrating to groundwater and to the Thames River, which would adversely impact ecological receptors in that river. Since no monitoring would be performed, such potential contaminant migration would not be detected in time for appropriate action.

Compliance with ARARs and TBCs

A detailed assessment of compliance with chemical-specific, location-specific, and action-specific ARARs and TCBs is provided in Tables 5-1, 5-2, and 5-3.

Long-term Effectiveness and Permanence

Alternative 1 would have very limited long-term effectiveness and permanence because all contaminated soil would remain on site and the existing cap would not be maintained. Therefore, as the existing cap deteriorates over time, an unacceptable risk (HI > 1.0) could develop for site workers from direct exposure to contaminated soil. As there would be no institutional controls to limit site access or prevent residential development, the potential would also exist for unacceptable risk to develop for trespassers (HI > 1.0) and possible future resident (HI > 1.0 and ICR > 1E-4). Residential development of the DRMO could also result in unacceptable risk to a correspondingly increased population of ecological receptors from exposure to contaminated soil. Since there would be no monitoring, potential impact to the groundwater and to the Thames River from possible migration of soil contaminants would not be detected in time for appropriate remedial action.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce toxicity, mobility, or volume of contaminants through treatment since no treatment would occur. Some reduction of contaminant toxicity or volume might occur through natural dispersion, dilution, or other attenuation process but no monitoring would be performed to verify this. The existing cap might achieve some reduction of contaminant mobility by minimizing infiltration through the vadose zone which would somewhat reduce the potential for soil contaminants to migrate to groundwater and, from there, to the Thames River. However, since the cap would not be maintained this potential for reduction of contaminant mobility may not exist in the long-term.

TABLE 5-1

DRMO FS
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 1: NO ACTION
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no federal chemical-specific ARARs.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no state chemical-specific ARARs.

TABLE 5-2

DRMO FS
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 1: NO ACTION
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Executive Order 11988 RE: Floodplain Management	Executive Order 11988	Applicable	This order requires Federal agencies, wherever possible, to avoid or minimize adverse impacts upon floodplains. Requires reduction of risk of flood loss, minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values of the floodplains.	As existing cap would not be maintained, it would deteriorate over time and this would adversely impact the Thames River Floodplain.
Coastal Zone Management Act	16 USC Parts 1451 *et seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state approved management programs.	Applicable state coastal zone management requirements would not be addressed.
Fish and Wildlife Coordination Act	16 USC 661 *et seq.*; 40 CFR § 6.302	Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers. Consultation with U.S. Fish & Wildlife Services is needed to develop measures to prevent and mitigate loss.	The U.S. Fish & Wildlife Service would not be consulted as to measures required to protect fish and wildlife resources.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Coastal Management Act	CGS §§ 22a-92 and 94	Applicable	Requires projects within a state designated coastal zone to minimize adverse impacts on natural coastal resources.	As existing cap would not be maintained, it would deteriorate over time and this would adversely impact the Thames River floodplain. Since no monitoring would be performed the extent of this adverse impact would be unknown.
Tidal Wetlands	RCSA §§ 22a-30-1 through 17	Applicable	Activities within or affecting tidal wetlands are regulated.	Deterioration of the existing cap over time would negatively impact tidal resources.
CT Endangered Species Act	CGS §§ 26-303 through 314	Applicable	Regulates activities affecting state-listed endangered or threatened species or their critical habitat.	The state-threatened Atlantic sturgeon inhabits the Thames River. Deterioration of the existing cap over time could negatively impact the sturgeon or any of its critical habitat which may occur within the river.

TABLE 5-3

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 1 - NO ACTION
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no federal action-specific ARARs.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no state action-specific ARARs.

Short-term Effectiveness

Since no action would occur, implementation of Alternative 1 would not pose any risks to onsite workers or result in adverse impact to the local community and the environment. The RAOs would never be achieved.

Implementability

Since no actions would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. Implementability of administrative measures is not applicable since no such measures would be taken.

Cost

There would be no costs associated with the no-action alternative.

5.2.2 Alternative 2 - Institutional Controls and Monitoring

5.2.2.1 Detailed Description

Alternative 2 consists of two components: (1) institutional controls and (2) monitoring. This alternative would rely upon the existing asphalt and GCL cap, limitation of site access, restrictions of land use, and monitoring to eliminate or reduce exposure pathways. Although this alternative is based upon the assumption that the DRMO will continue to be owned and operated by NSB-NLON, provisions would be included in it for the continuation of institutional controls and monitoring under different ownership.

Component 1: Institutional Controls

Institutional controls would include maintenance of the existing cap, limitation of site access, and restrictions of land use.

Maintenance of the existing asphalt and GCL cap would consist of regular inspections of this cap to check that cracks or other damage have not reduced its integrity. Periodic repair and replacement of the asphalt layer would be performed.

Limitation of site access would consist of maintaining the existing chain link fence that surrounds the DRMO and posting of signs to warn potential trespassers that a health hazard is present. Signs would typically be posted along the perimeter and at the front entrance of the site. In addition, during operation of the site for its current military purpose, gates would be locked and a security desk be maintained at the entrance of the site.

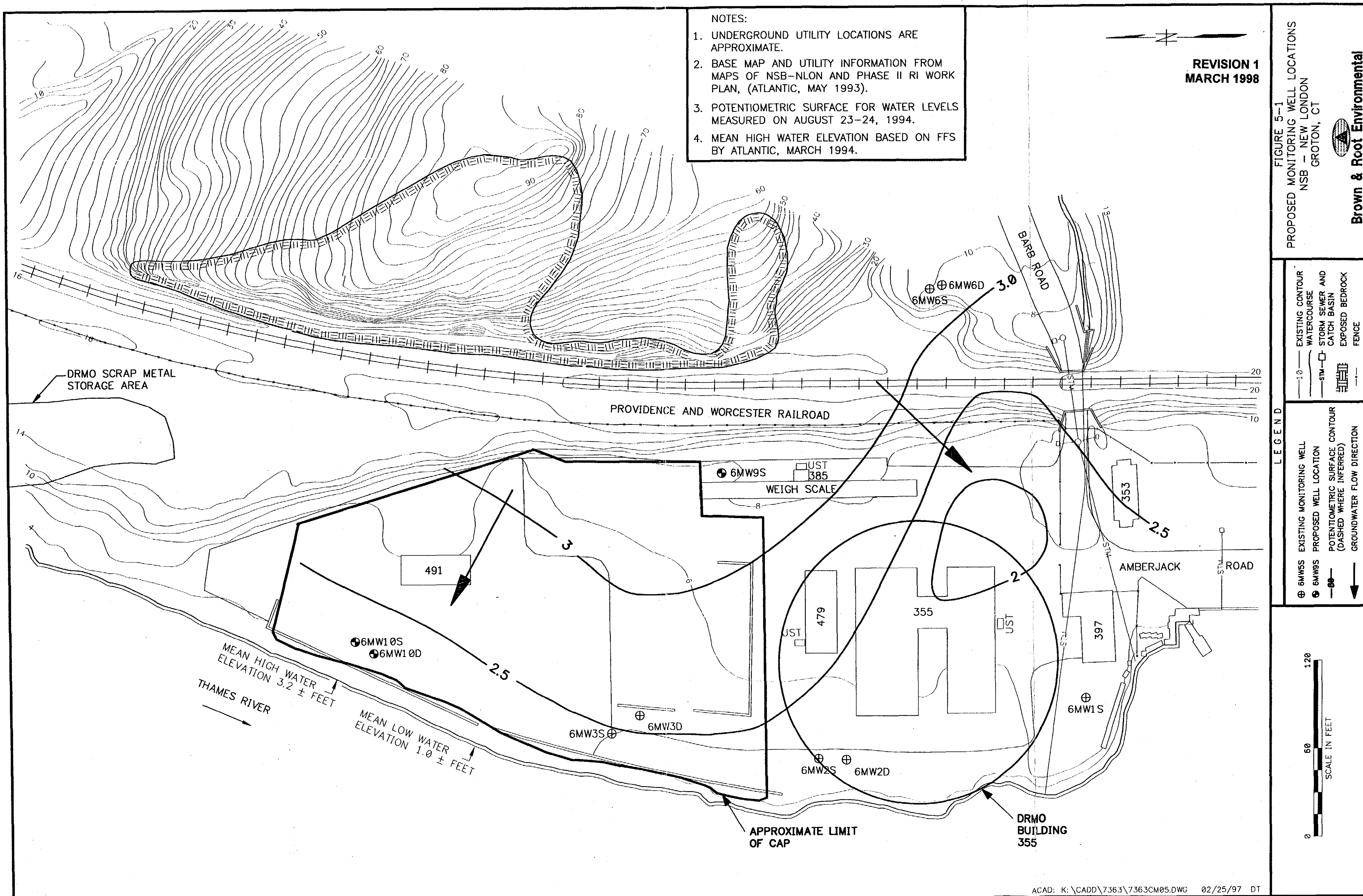
Restriction of land use would consist of documenting the presence of contamination at the site in the NSB-NLON Master Plan and Navy real estate records to ensure that, prior to any future land development at the DRMO, NSB-NLON would be able to take adequate measures to minimize adverse human health and environmental effects. In addition, Environmental Land Use Restrictions would be prescribed in accordance with Connecticut's regulations. Unless additional remediation Is undertaken, the DRMO could not be developed for residential land use. In the unlikely event of a change in the DRMO site ownership, provisions would be incorporated in the property transfer documents to insure continuation of the above-described institutional controls.

Component 2: Monitoring

Monitoring would be performed in accordance to the Groundwater Monitoring Plan for the DRMO site (B&R Environmental, September 1997) which may be summarized as follows.

Monitoring would consist of quarterly groundwater sampling and analysis for a period of 3 years. Groundwater samples would be collected from the 10 monitoring wells shown on Figure 5-1, including 7 existing wells (6MW1S, 6MW2S, 6MW2D, 6MW3S, 6MW3D, 6MW6S, and 6MW6D) and 3 new wells (6MW9S, 6MW10S, and 6MW10D). Sampling and analysis would be performed to verify that significant contamination is not leaching to the groundwater from the capped area at concentrations above regulatory criteria which would result in impacts to the Thames River. Once baseline conditions have been established, the monitoring program would be revised annually based on the analytical data collected from the previous sampling events. If, as a result of this monitoring, groundwater COCs are detected at concentrations above site-specific SWPCs, surface water and river sediment samples would also be collected and analyzed to determine if these COCs are migrating to the Thames River. If monitoring results show exceedance of volatilization criteria, then additional action would be taken, including determining the need for additional remedial action.

Once sufficient monitoring data has been collected (i.e., after baseline conditions are established), this data would be evaluated to determine the need for additional remedial action at the site. Based on discussions with the U.S. EPA and CTDEP, it was determined that a minimum of 3 years of data would need to be collected on a quarterly basis to evaluate if the site is impacting the environment. If after 3 years data shows that the site has not impacted the environment, the need for additional monitoring would be evaluated and modified, if appropriate.



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Every 5 years for 30 years, a site review would be conducted to evaluate the site status and determine whether further action is necessary. These site reviews are required because this alternative allows contaminants to remain in soil at levels that exceed PRGs. Figure 5-2 depicts the process block flow diagram for Alternative 2.

The monitoring component would also include the installation of the 3 above-mentioned new monitoring wells (6MW9S, 6MW10S, and 6MW10D) and the regular maintenance of the existing and new monitoring wells. In the unlikely event of a change in the DRMO site ownership, provisions would be incorporated in the property transfer documents to insure continuation of the above-described monitoring.

5.2.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 2 would be protective of human health and the environment.

Institutional controls would be protective of human health and the environment. Maintenance of the existing cap and limiting site access would be protective of human health by minimizing risk to site workers and trespassers from direct exposure with contaminated soil under the current industrial land use scenario. Restricting the DRMO to industrial use would be protective of human health by preventing unacceptable risks to future residents from direct exposure to contaminated soil. Maintenance of the existing cap and restricting the DRMO to industrial use would minimize risk to the limited existing ecological population from potential direct exposure to contaminated soil under the current industrial land use scenario and prevent risk to an increased ecological population from direct exposure to contaminated soil under a future residential land use scenario. Finally, maintenance of the existing cap would provide some protection of ecological receptors in the Thames River by minimizing infiltration through contaminated soil in the vadose zone, which would slightly reduce the potential for contaminants in soil to migrate to that river.

Monitoring would be protective of the environment by detecting potential migration of soil contaminants to the Thames River, which could adversely impact ecological receptors within that river.

Some short-term risks could be incurred by workers from exposure to contaminated soil during implementation of institutional controls and monitoring. However, the potential for exposure would be

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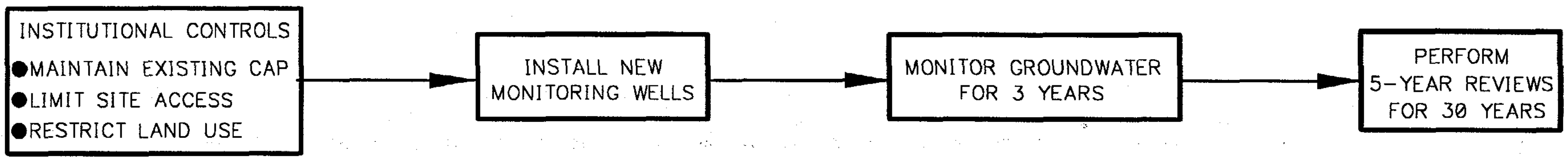

BLOCK FLOW DIAGRAM
ALTERNATIVE 2
DRMO, NSB-NLON, CT

FIGURE 5-2

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minimized by the wearing of appropriate PPE and compliance with site-specific health and safety procedures.

Compliance with ARARs and TBCs

Alternative 2 would comply with chemical-specific, location-specific, and action-specific ARARs and TBCs. A detailed assessment of this compliance is provided on Tables 5-4, 5-5, and 5-6, respectively.

Long-term Effectiveness and Permanence

Alternative 2 would provide long-term effectiveness and permanence. Although no removal of contaminated soil would occur, risks to human health and the environment would be significantly reduced.

Maintenance of the existing cap would effectively and permanently minimize risks to site workers and to the limited existing ecological population from potential exposure to contaminated soil under the current industrial land use scenario. In addition, by minimizing surface infiltration through the contaminated soil in the vadose zone, maintenance of the existing cap would have some effectiveness in reducing risk to ecological receptors in the Thames River from potential exposure to contaminants which might have migrated from the DRMO soil. Limiting site access (in conjunction with maintenance of the existing cap) would effectively and permanently minimize risk to trespassers from direct exposure to contaminated soil under the current industrial scenario. Restricting the DRMO to industrial use would effectively and permanently prevent its development as a residential area, thereby preventing unacceptable risk from direct exposure of future residents and of an increased ecological population to contaminated soil.

Long-term monitoring would be effective for the detection of potential migration of soil contaminants to the Thames River, which could adversely impact ecological receptors within this stream

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would not reduce toxicity, mobility, or volume of contaminants through treatment since no treatment would occur. A slight reduction of toxicity or volume might occur through natural dispersion, dilution, or other attenuating factors and monitoring would verify this. Maintenance of the existing cap would also achieve a slight reduction of contaminant mobility by minimizing infiltration through the vadose zone which would somewhat reduce the potential for soil contaminants to migrate to groundwater and, from there, to the Thames River.

TABLE 5-4

DRMO FS
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 2: INSTITUTIONAL CONTROLS & MONITORING
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no federal chemical-specific ARARs

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no state chemical-specific ARARs

TABLE 5-5

DRMO FS
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 2 - INSTITUTIONAL CONTROLS AND MONITORING
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken to Attain ARAR
FEDERAL				
Executive Order 11988 RE: Floodplain Management	Executive Order 11988	Applicable	This order required Federal agencies, wherever possible, to avoid or minimize adverse impacts upon floodplains. Requires reduction of risk of flood loss, minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values of the floodplains.	Monitoring well installation and groundwater monitoring activities within the 100-year floodplain would be carried out to minimize impacts to floodplain resources.
Coastal Zone Management Act	16 USC Parts 1451 *et seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state approved management programs.	This site is located in a state coastal flood zone (within the 100 year floodplain). Therefore, applicable state coastal zone management requirements would be addressed.
Fish and Wildlife Coordination Act	16 USC 661 *et seq.*; 40 CFR § 6.302	Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers. Consultation with U.S. Fish & Wildlife Service is needed to develop measures to prevent and mitigate loss.	If monitoring wells are required to be installed in the river or its tidal zone, the U.S. Fish & Wildlife Service would be consulted as to measures required to protect fish and wildlife resources.
STATE OF CONNECTICUT				
Coastal Management Act	CGS §§ 22a-92 and 94	Applicable	Requires projects within a state designated coastal zone to minimize adverse impacts on natural coastal resources.	Monitoring well installation and groundwater monitoring activities within the 100-year coastal floodplain would be carried out to minimize impacts to coastal resources.
Tidal Wetlands	RCSA §§ 22a-30-1 thru 17	Applicable	Activities within or affecting tidal wetlands are regulated.	If monitoring wells are required to be installed in the river or its tidal zone monitoring and maintenance activities would be implemented so as to not negatively impact tidal resources.
CT Endangered Species Act	CGS §§ 26-303 thru 314	Applicable	Regulates activities affecting state-listed endangered or threatened species or their critical habitat.	The state-threatened Atlantic sturgeon inhabits the Thames River. If monitoring wells are required to be installed in the river or its tidal zone monitoring and maintenance activities would be implemented so as to not negatively impact the sturgeon or any of its critical habitat which may occur within the River.

TABLE 5-6

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 2 - INSTITUTIONAL CONTROLS AND MONITORING
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken to Attain ARAR
FEDERAL				
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive 9355.4-01	To be considered	This guidance describes how to address PCB contamination issues as part of remedial actions	This guidance would be considered in evaluating PCB issues as part of the remedial action Low levels of PCBs (47.2 ppm or less) are present within soils at the site.
STATE OF CONNECTICUT				
Hazardous Waste Management: Generator and Handler Requirements	RCSA § 22a-449 (c) 100-101	Applicable	These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR 260-261 are incorporated by reference.	For any materials generated during monitoring well installation, hazardous waste determinations will be performed, and the wastes would be managed in accordance with requirements of these regulations, if necessary.
Hazardous Waste Management: TSDF Standards	RCSA § 22a-449 (c) 104	Applicable	This section establishes standards for groundwater monitoring and post-closure. The standards of 40 CFR 264 are incorporated by reference.	The remedy would comply with the post-closure requirements of this section through groundwater monitoring and institutional controls at the Site.
Control of Noise Regulations	RCSA § 22a-69-1 through 7.4	Applicable	These regulations establish allowable noise levels. Noise levels from construction activities are exempt from these requirements.	Noise generated by installation of monitoring wells will meet these regulations. This alternative involves drilling and monitoring activities which are not anticipated to generate excessive noise.
Guidelines for Soil Erosion and Sediment Control	The Connecticut Council on Soil and Water Conservation	To be considered	The guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	Erosion and sediment control measures would be implemented during well installation.
Water Quality Standards	CBS 22a-426	Relevant and appropriate	Connecticut's Water Quality Standards establish specific numeric criteria, designated uses, and anti-degradation policies for groundwater and surface water.	Standards would be used to evaluate monitoring results to determine if further remedial action is required to protect resources.
Remediation Standards Regulations	RCSA § 22a-133k-3	Relevant and appropriate	These regulations provide specific numeric cleanup criteria for a wide variety of contaminants in soil, groundwater and soil vapor. These criteria include volatilization criteria, pollutant mobility criteria, direct exposure criteria and surface water protection criteria.	Although no groundwater plume has been identified at this site, the proposed groundwater monitoring would be conducted to determine if any contaminants of concern are migrating offsite at levels above CTDEP surface water protection or volatilization standards for GB groundwater. Maintenance of the cap and institutional controls would satisfy the Remediation Standards Regulations for soil.

Short-term Effectiveness

Alternative 2 would have minimal short-term effectiveness concerns. Any exposure of workers to contaminated soil during the maintenance of the existing cap and fencing or during the installation of new monitoring wells and the maintenance and sampling of existing and new monitoring wells would be minimized by wearing of appropriate PPE and complying with site-specific health and safety procedures. Implementation of institutional controls and monitoring would not adversely impact the surrounding community or the environment. The RAOs would be achieved immediately upon implementation of institutional controls and monitoring. However, continued achievement of the RAO for protection of ecological receptors in the Thames River would have to be regularly modified through monitoring.

Implementability

Alternative 2 would be readily implementable. Maintenance of the existing cap and fence, posting of notices, maintenance of existing monitoring wells and installation of new ones, and sampling and analysis of groundwater and, if necessary, of surface water and river sediment would all be relatively simple to perform. The resources, equipment, and materials required for these activities would be readily available.

The administrative Implementability of Alternative 2 would be simple since the site is located within a military facility, where land uses can be strictly enforced. In the unlikely event that the site would be transferred to private ownership, concerns about administrative implementability would slightly increase but appropriate provisions could be incorporated in property transfer documents to insure continued implementation of institutional controls and monitoring.

Cost

The estimated costs for this alternative are:

Estimated capital costs:	$90,814
Total estimated O&M costs over 30 years:	$617,580
Estimated 30-year present worth:	$708,394

Cost estimates for this alternative are based on 3 years of groundwater monitoring and the performance of 5-year reviews for 30 years. The details of the cost estimates are provided in Appendix C.

5.2.3 Alternative 3 - Hot Spot Excavation, Offsite Disposal, Institutional Controls, and Monitoring

5.2.3.1 Detailed Description

Alternative 3 is developed to meet the human health PRGs for the full-time employee, older child trespasser, and construction worker under the current industrial land use scenario. Areas of soil with concentrations of COCs exceeding PRGs for the current industrial land use scenario, and which are designated as "hot spots", would be excavated and removed from the site. This action would require removal, and subsequent repair and restoration, of several sections of the existing asphalt and GCL cap.

Alternative 3 would consist of four major components in addition to the existing cap: (1) "hot spots" excavation with dewatering of wet soil and repair and restoration of existing cap, (2) offsite disposal of excavated soil, (3) institutional controls, and (4) monitoring. Figure 5-3 illustrates the block flow diagram for this alternative and Figure 5-4 shows the site location map and excavation areas.

Component 1: "Hot Spots" Excavation with Repair and Restoration of Existing Cap

Soil contaminated with COCs above their respective PRGs for the current industrial land use scenario would be excavated, which corresponds to a total volume of approximately 3,150 cubic yards of excavated material. Prior to excavation, the existing cap and clean material backfilled during the Time Critical Removal Action would be removed as required from the areas being excavated. As previously discussed, extensive sheet piling would be required to shore up excavated areas deeper than about 4 feet bgs and groundwater would have to be allowed to accumulate in these deeper areas, although this would considerably hinder excavation. After completion of excavation, and to the extent that the presence of sheet piling and water would allow, the sidewalls and bottom of the excavated areas would be sampled and analyzed to try and confirm that PRGs have been met. After each "hot spot" has been completely excavated, it would be backfilled with clean material from an offsite source and regraded to achieve desired surface elevation. Areas of the existing asphalt and GCL cap disturbed by excavation would be repaired and the cap would be restored to existing conditions.

The contaminated soil would be excavated using conventional construction equipment, such as backhoes, bulldozers, and front-end loaders. For excavation under water, clamshell buckets would be used. All excavating activities would be conducted in accordance to OSHA regulations and in compliance with appropriate health and safety procedures.

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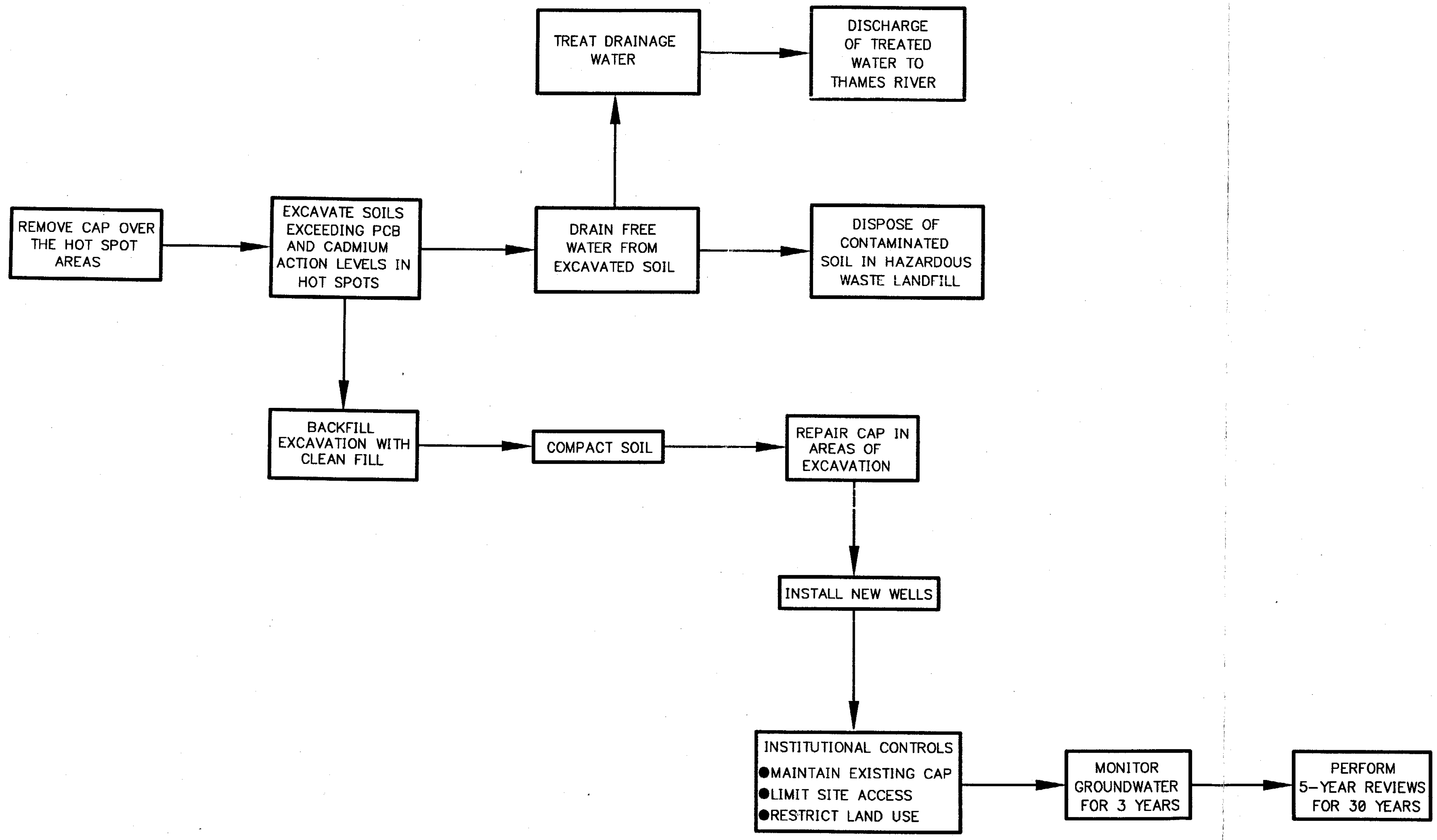
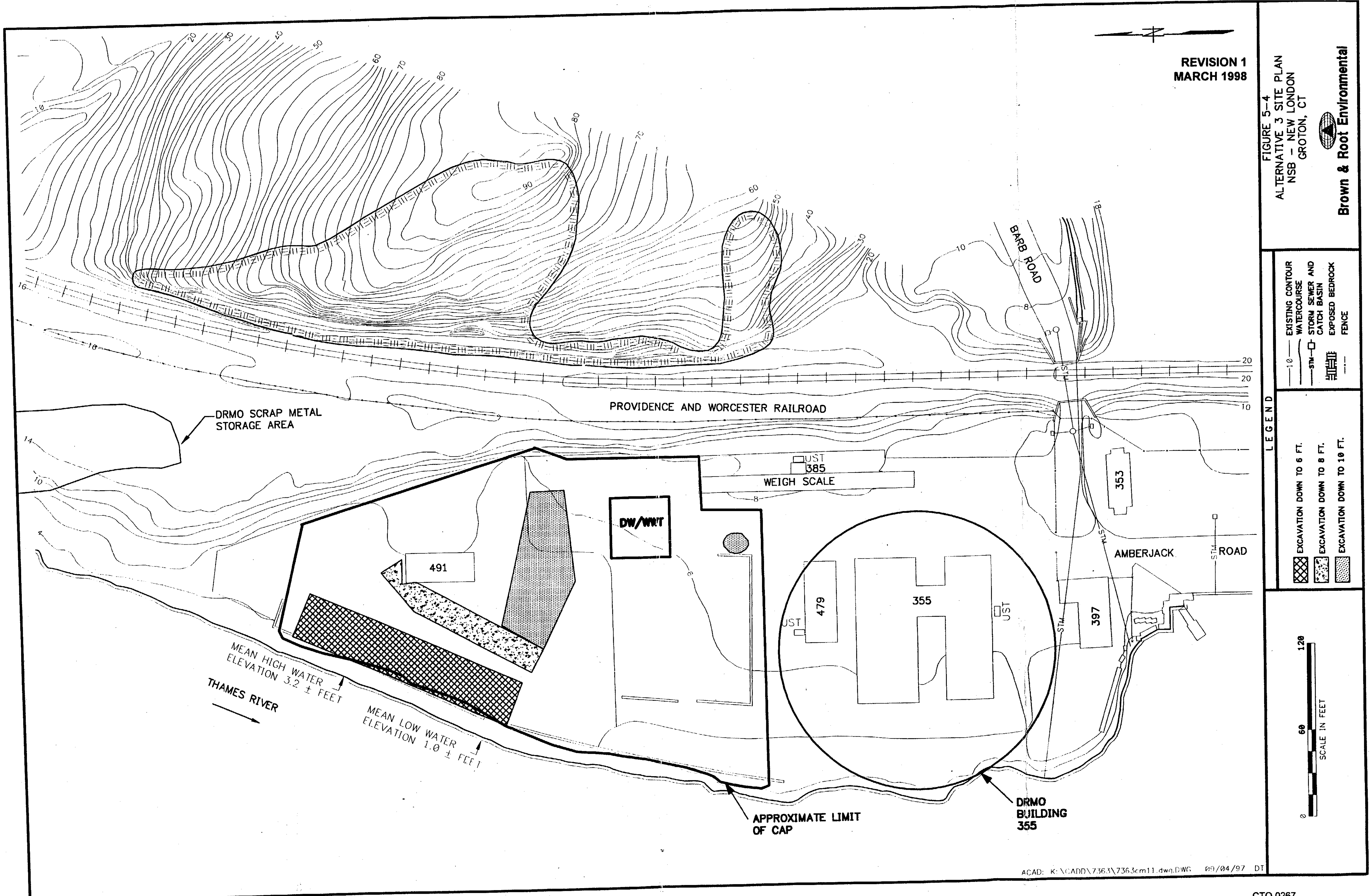


FIGURE 5-3

BLOCK FLOW DIAGRAM
ALTERNATIVE 3
DRMO, NSB-NLON, CT

Brown & Root Environmental


REVISION 1
MARCH 1998
FIGURE 5-4
ALTERNATIVE 3 SITE PLAN
NSB - NEW LONDON
GROTON, CT
Brown & Root Environmental
LEGEND
EXISTING CONTOUR
WATERCOURSE
STORM SEWER AND CATCH BASIN
EXPOSED BEDROCK
FENCE
EXCAVATION DOWN TO 6 FT.
EXCAVATION DOWN TO 8 FT.
EXCAVATION DOWN TO 10 FT.
SCALE IN FEET
0
60
120
BARB ROAD
PROVIDENCE AND WORCESTER RAILROAD
DRMO SCRAP METAL STORAGE AREA
UST
385
WEIGH SCALE
353
DW/WWT
491
479
355
397
AMBERJACK
ROAD
MEAN HIGH WATER ELEVATION 3.2 ± FEET
THAMES RIVER
MEAN LOW WATER ELEVATION 1.0 ± FEET
APPROXIMATE LIMIT OF CAP
DRMO BUILDING 355
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As excavation would take place below the groundwater table, a significant portion of the excavated soil would need to be pre-treated onsite to remove excess water (i.e., dewatered) prior to offsite transportation and disposal. Based upon typical offsite disposal requirements, all free water would have to be removed from the excavated wet soil so that it can pass the "paint filter test". Soil dewatering and treatment of the drainage water would be performed at an onsite Dewatering and Wastewater Treatment (DW/WWT) facility.

For the purpose of this FS, It is assumed that any soil excavated below a depth of 3 feet would require dewatering and that this soil would contain an average of 50 percent of free water by volume for a total anticipated volume of drainage water of approximately 200,000 gallons. It is also assumed that the average total suspended solids (TSS) concentration of that drainage water would be approximately 2,000 mg/L.

The DW/WWT facility would consist of a dewatering pad, a bag filtration unit, and a GAC adsorption unit. The dewatering pad would be a structure consisting of sand and gravel layers overlying an impermeable base. The sand layer would be sandwiched between two geotextile/geonet layers. The dewatering pad would be bermed and equipped with an underdrain system and collection sump. The pad would have approximate dimensions of 40-foot by 40-foot to provide a total of approximately 1,600 square feet of stockpiling area to accommodate approximately 300 cubic yards of soil, assuming an average stockpile height of 5 feet. The soil would be stockpiled on the dewatering pad and covered with an impervious liner (PE or PVC) to prevent potential rainfall infiltration. It is anticipated that a residence time of approximately one day on the dewatering pad would be required to achieve adequate soil dewatering, i.e., to reduce moisture content of the soil to 20 percent (by weight) or less. As necessary, a suitable weight (such as a concrete slab) would be placed on top of the pile to promote mechanical expression of the water. The top liner is also expected to prevent the weight from getting embedded in the pile. The cross section of the dewatering pad would consist of the following components in descending order as depicted in Figure 5-5:

- A graded sand layer: 1.0 foot in thickness, sandwiched between two geotextile/geonet membranes.

- A gravel layer: 1.0 foot in thickness.

- A High Density Poly Ethylene (HDPE) liner on a compacted and sloped soil base.

- A 4-inch diameter slotted PVC pipe placed within the gravel layer, along the entire deeper edge of the base.

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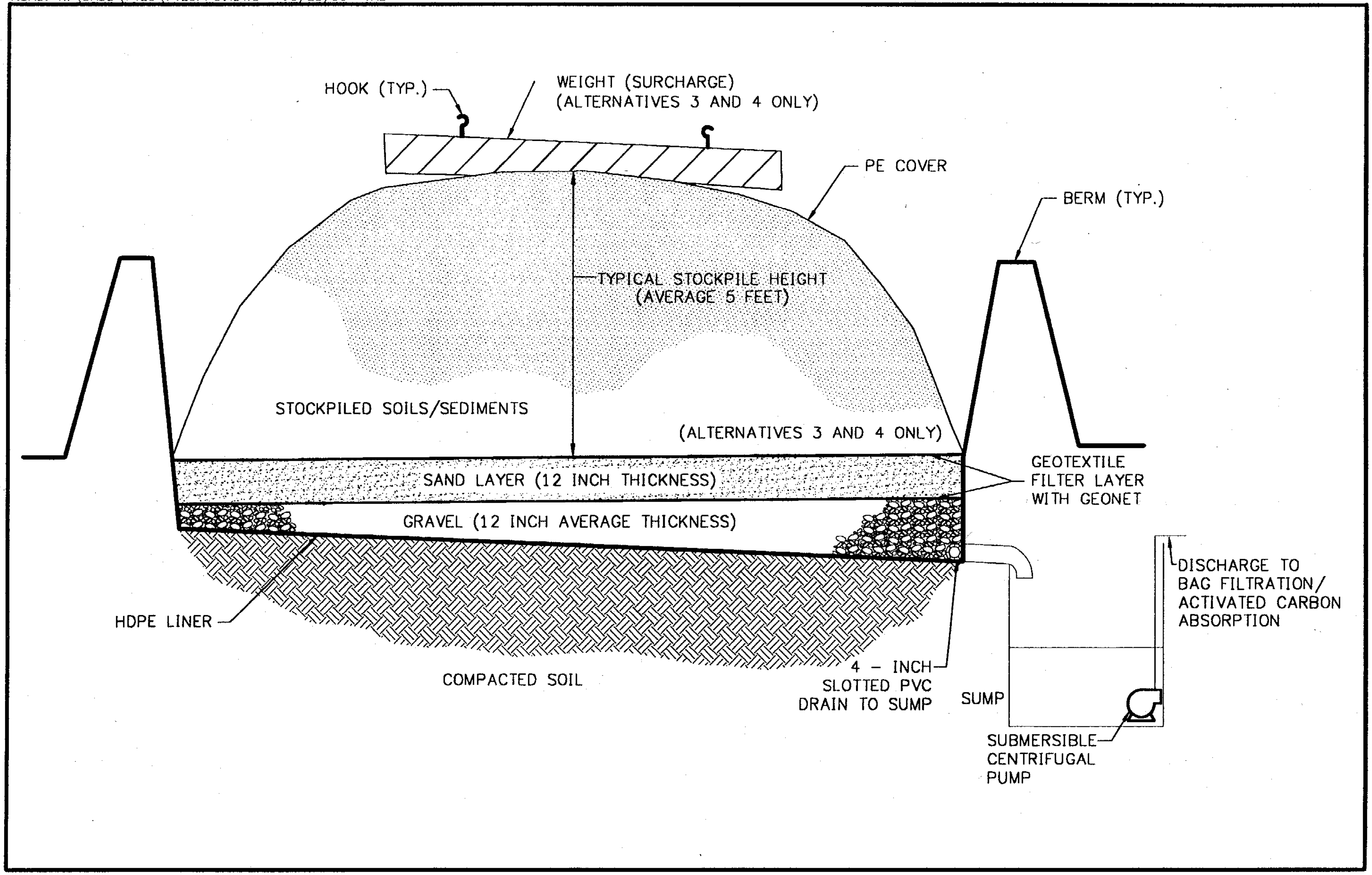

CONCEPTUAL DESIGN OF DEWATERING PAD
FOR ALTERNATIVES 3 AND 4, FS - SITE 6
NSB-NLON, GROTON, CT

FIGURE 5-5

Brown & Root Environmental

REVISION 1
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The sand and geotextile/geonet layers in the base of the pad are expected to function as a preliminary filter to retain most of the soil particles, while allowing relatively solids-free drainage water into the gravel underdrain layer. The slotted PVC pipe in the gravel layer would collect drainage water and transfer it to an adjacent collection sump. Drainage water would then be pumped into a bag filtration unit for secondary TSS removal, followed by GAC adsorption for removal of dissolved organic contaminants. The treated drainage water would then be discharged to the Thames River using a pump and a temporary pipeline.

Drainage water from the stockpile would be treated at a rate of up to 10 gpm by the DW/WWT. The sand filtration layer is assumed to a have a TSS retention capacity of one pound (dry basis) per square foot of filtration surface before it would require replacement. On that basis, assuming the above-mentioned drainage water volume of 200,000 gallons with a TSS concentration of 2,000 mg/L, it is anticipated that the sand and geotextile layers would need to be replaced at least once during soil dewatering operations. The spent sand and geotextile layers would be disposed of off site.

Component 2: Offsite Disposal

Excavated soil would be disposed of at an offsite permitted RCRA hazardous waste TSD facility. As certain characteristics and contaminant concentrations of the excavated soil may exceed disposal criteria, pre-disposal testing would be required to determine the final disposition requirements for the soil. Excavated material would be loaded into trucks and transported to the designated offsite TSD facility.

Component 3: Institutional Controls

This component would be identical to Component 1 of Alternative 2.

Component 4: Monitoring

This component would be identical to Component 2 of Alternative 2.

5.2.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment.

Excavation and offsite disposal of soil "hot spots" would be protective of human health and the environment. Although complete verification sampling would not be possible because of the presence of sheet piling and water in most excavated areas, excavation and offsite disposal of virtually all the soil "hot spots" would eliminate unacceptable risk to site workers from direct exposure to contaminated soil under the current industrial land use scenario. Risks would be lowered to below an ICR of 1E-4 and an HI below 1.0. Excavation of soil "hot spots" would also be protective of ecological receptors in the Thames River by removing the most contaminated soil, thereby significantly reducing the possibility that contaminants would migrate from the DRMO soil to that river.

Institutional controls would be protective of human health and the environment. Although excavation and offsite disposal of soil "hot spots" would already have brought human health risk from direct exposure to soil under the current industrial land use scenario within an acceptable range, maintenance of the existing cap and limiting site access would provide additional protection to site workers and trespassers from potential direct exposure to contaminated soil left on site. Although concentrations of ecological COCs would remain above PRGs, maintenance of the existing cap and restricting the DRMO to industrial use would minimize risk from direct exposure of the limited ecological population to contaminated soil under the current industrial land use scenario and prevent unacceptable risk from direct exposure of an increased ecological population to contaminated soil under a future residential land use scenario. Finally, maintenance of the existing cap would offer some degree of protection to ecological receptors in the Thames River by minimizing infiltration through the contaminated soil of the vadose zone, which would slightly reduce the potential for contaminants in soil to migrate to that river.

Monitoring would be protective of the environment by detecting potential migration of soil contaminants to the Thames River, which could adversely impact ecological receptors in that river.

In the short-term, the strong soil/water stirring action during the excavation of "hot spots" below the water table could trigger a significant migration of hitherto stationary contaminants from soil to groundwater and, from there, to the Thames River.

"Hot spots" excavation and offsite disposal could result in significant short-term risk for construction workers due to potential exposure to contaminated soil and groundwater. However, this potential for exposure would be minimized by the implementation of engineering controls such as dust suppression and air monitoring, the wearing of appropriate PPE, and compliance with site-specific health and safety procedures. Any potential negative short-term impacts to the surrounding community and environment from fugitive dust and/or spillage of contaminated soil could be prevented through the implementation of appropriate engineering controls (e.g., perimeter air monitoring, erosion and sedimentation controls, spill prevention procedures, etc.).

Some short-term risks could be incurred by workers from exposure to contaminated soil during the implementation of institutional controls and monitoring. However, the potential for exposure would be minimized by wearing appropriate personal protective equipment (PPE) and complying with site-specific health and safety procedures.

Compliance with ARARs and TBCs

Alternative 3 would comply with chemical-specific, location-specific, and action specific ARARs and TBCs. A detailed assessment of this compliance is provided on Tables 5-7, 5-8, and 5-9, respectively.

Long-term Effectiveness and Permanence

Alternative 3 would provide long-term effectiveness and permanence.

Although complete verification sampling would not be possible because of the presence of sheet piling and water in most excavated areas, excavation of virtually all of the soil "hot spots" and disposal of the excavated soil at an offsite RCRA hazardous waste TSD facility would effectively and permanently eliminate risks to site workers from direct exposure to soil contaminated above industrial land use PRGs. Maintenance of the existing cap would effectively and permanently minimize risks to site workers and to the limited existing ecological population from potential exposure to contaminated soil under the current industrial land use scenario. In addition, by minimizing surface infiltration through the contaminated soil in the vadose zone, maintenance of the existing cap would have some effectiveness in reducing risk to ecological receptors in the Thames River from potential exposure to contaminants which might have migrated from the DRMO soil. Limiting site access (in conjunction with maintenance of the existing cap) would effectively and permanently minimize risk to trespassers from direct exposure to contaminated soil under the current industrial scenario. Restricting the DRMO to industrial use would effectively and permanently prevent its development as a residential area, thereby preventing risk to future residents and to an increased ecological population from direct exposure to contaminated soil.

Long-term monitoring would be effective for the detection of potential migration of soil contaminants to the Thames River, which could adversely impact ecological receptors within this stream.

TABLE 5-7

DRMO FS
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs
ALTERNATIVE 3: "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, & MONITORING
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Cancer Slope Factors (CSFs)		To be considered	These are guidance values used in risk assessment to evaluate the potential carcinogenic or non-carcinogenic hazard caused by exposure to contaminants.	"Hot spot" contaminated soils would be excavated and removed from the site. Remaining contaminated soils would be recapped to minimize exposure to potential receptors.
Reference Dose (RfDs)		To be considered	These are guidance values used in risk assessment to evaluate the potential carcinogenic or non-carcinogenic hazard caused by exposure to contaminants.	"hot spot" contaminated soils would be excavated and removed from the site. Remaining contaminated soils would be recapped to minimize exposure to potential receptors.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no state chemical-specific ARARs.

TABLE 5-8

DRMO FS
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 3: "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, & MONITORING
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Fish and Wildlife Coordination Act	16 USC 661 *et seq.* 40 CFR § 6.302	Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers. Consultation with U.S. Fish & Wildlife Service is needed to develop measures to prevent and mitigate loss.	If monitoring wells are required to be installed in the Thames River or its tidal zone, the U.S. Fish & Wildlife Service would be consulted as to measures required to protect fish and wildlife resources.
Executive Order 11988 Re: Floodplain Management	Executive Order 11988	Applicable	This order requires Federal agencies, wherever possible, to avoid or minimize adverse impacts upon floodplains. Requires reduction of risk of flood loss, minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values of the floodplains.	Measures would be taken to minimize impacts to floodplains of Thames River during excavation/backfilling and installation of monitoring wells. Removed sections of the existing asphalt/GCL cap located within the 100-year floodplain would be replaced, monitored and maintained. Site excavation, monitoring well installation, and groundwater monitoring activities would not take place during times of potential flooding.
Coastal Zone Management Act	16 USC Parts 1451 *et seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state approved management programs.	This site is located in a coastal zone management area, therefore, applicable coastal zone management requirements need to be addressed.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Coastal Management Act	CGS §§22a-92 and 94	Applicable	Federal facilities are required to file a coastal zone consistency determination under these rules.	Excavation and removal of contaminated soils, replacement of the asphalt/GLC cap, monitoring well installation and groundwater monitoring activities within the 100-year coastal floodplain would be carried out to minimize impacts to coastal resources.
Tidal Wetlands	RCSA § 22a-30-1 through 17	Applicable	Activities within or affecting tidal wetlands are regulated.	If monitoring wells are required to be installed in the Thames River or its tidal zone, monitoring and maintenance activities would be implemented so as to not negatively impact tidal resources. Wastewater from dewatering of excavated material would not discharged into tidal wetlands.

TABLE 5-8

DRMO FS
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 3: "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, & MONITORING
NSB-NLON GROTON, CONNECTICUT

STATE OF CONNECTICUT (Continued)

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
CT State Endangered Species Act	CGS § 26-303-314	Relevant and Appropriate	Regulates activities affecting state-listed endangered or threatened species or their critical habitat.	The state-threatened Atlantic sturgeon inhabits the Thames River. If monitoring wells are required to be installed in the river or its tidal zone monitoring and maintenance activities would be implemented so as to not negatively impact the sturgeon or any of its critical habitat which may occur within the river. Wastewater from dewatering of excavated material would be adequately treated prior to discharge into the river.

TABLE 5-9

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 3: "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, & MONITORING
NSB-NLON, GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken TO Attain ARAR
Clean Water Act, National Pollution Discharge Elimination System (NPDES)	40 CFR Parts 122 through 125, and 131	Relevant and Appropriate	NPDES (National Pollution Discharge Elimination System) permits are required for any discharges to navigable waters. If remedial activities include such a discharge, the NPDES standards would be ARARs.	The quality of the treated water from the on site DW/WWT facility would meet NPDES standards for discharge to the Thames River. No formal discharge permit would be required.
PCB Regulations under TSCA	40 CFR §§ 761.60 through 761.71	Relevant and Appropriate	The regulations govern the storage, transportation and disposal of PCBs, and the cleanup of PCB spills. For the most part, these standards only apply to PCB items with concentrations above 50 ppm or to materials contaminated from such items.	These regulations are not applicable because PCB levels at the site have been measured at no greater than 47.2 ppm. However, if PCBs are detected at greater than 50 ppm, any activities regarding storage, transportation, and disposal of such PCB-contaminated soil would be conducted in compliance with these standards.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive 9355.4-01	To be considered	This guidance describes how to address PCB contamination issues as part of remedial actions.	This guidance document would be considered in evaluating PCB issues as part of the remedial action. Low levels of PCBs (47.2 ppm or less) are present within soils at the site.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Solid Waste Management	RCSA § 22a-209-1 through 13	Applicable	These standards establish closure standards for solid waste disposal areas (SWDAs).	After contaminated soil from the "hot spots" are removed the existing cap would be replaced in accordance with these requirements.
Hazardous Waste Management: Generator and Handler Requirements	RCSA § 22a-449(c) 100-101	Applicable	These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR 260-261 are incorporated by reference.	For all soils excavated from the "hot spots" and generated during monitoring well installation, hazardous waste determinations would be performed, and the wastes would be managed in accordance with requirements of these regulations, if necessary.

TABLE 5-9

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 3: "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, & MONITORING
NSB-NLON, GROTON, CONNECTICUT

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Hazardous Waste Management: TSDF Standards	RCSA § 22a-449 (c) 104	Applicable	This section establishes standards for post closure and groundwater monitoring. The standards of 40 CFR 264 are incorporated by reference.	Any hazardous waste which is temporarily stored on this site as part of the "hot spot" excavation or monitoring well installation would be managed in accordance with the requirements of this section. The remedy would comply with the post-closure requirements of this section through groundwater monitoring and institutional controls at the site.
Hazardous Waste Management: Generator Standards	RCSA § 22a-449(c)102	Applicable	This section established standards for various classes of generators. The standards of 40 CFR 262 are incorporated by reference. Storage requirements given at 40 CFR 265.15 are also included.	Any hazardous waste generated through excavation, monitoring well installation, or other activities would be managed in accordance with the substantive requirements of these regulations.
Air Pollution Control	RCSA § 22a-174	Applicable	These regulations require permits to construct and to operate specified types of emission sources and contain emission standards that must be met prior to issuance of a permit. Pollutant abatement controls may be required. Specific standards pertain to fugitive dust (18b) and control of odors (23).	Emission standards for fugitive dust would be met with dust control measures during excavation, transportation and offsite disposal to comply with substantive requirements.
Control of Noise Regulations	RCSA § 22a-69-1 through 7.4	Relevant and Appropriate	These regulations establish allowable noise levels. Noise levels from construction activities are exempt from these requirements.	Noise generated by any remedial actions other than construction would meet the standards of these regulations. This alternative involves excavation and monitoring activities which are not anticipated to generate excessive noise.
Guidelines for Soil Erosion and Sediment Control	The Connecticut Council on Soil and Water Conservation	To be considered	The guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	These guidelines would be incorporated into any remedial designs for this site. Erosion and sediment control measures would be implemented during excavation, recapping, and well installation activities.
Water Pollution Control	RCSA § 22a-430-1 through 8	Applicable	These rules establish permitting requirements and criteria for water discharge to surface water, groundwater, and POTWs.	No discharge for POTW is proposed. The quality of the treated water from the on site DW/WWT facility would meet the substantive requirements of this section for discharge to the Thames River. No formal discharge permit would be required.

TABLE 5-9

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 3: "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, & MONITORING
NSB-NLON, GROTON, CONNECTICUT

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Remediation Standards Regulations	RCSA § 22a-133k-3	Relevant and Appropriate	These regulations provide specific numeric cleanup criteria for a wide variety of contaminants in soil, groundwater, and soil vapor. These criteria include volatilization criteria, pollutant mobility criteria, direct exposure criteria, and surface water protection criteria.	Although no groundwater plume has been identified at this site, the proposed groundwater monitoring would be conducted to determine if any contaminants of concern are migrating offsite at levels above CTDEP surface water protection or volatilization standards for GB groundwater Excavation of hot spots and maintenance of the cap and institutional controls would satisfy the Remediation Standards Regulations for soil.
Water Quality Standards	CGS 22a-426	Applicable	Connecticut's Water Quality Standards establish specific numeric criteria, designated uses, and antidegradation policies for groundwater and surface water.	Standards would be used to evaluate monitoring results determined if further remedial action is required to protect resources. Remedial activities, including the disposal and potential treatment of groundwater from dewatering and removal from excavations, would be undertaken in a manner which is consistent with the antidegradation policy in the Water Quality Standards./
Disposition of PCBs	CGS § 22A-467	Applicable	This section regulates the disposal or destruction of PCBs in a manner not inconsistent with the Requirements of the Toxic Substances Control Act (TSCA), listed at 40 CFR Part 761.	Disposal of low levels of PCBs (47.2 ppm or less) are present within soils at the site. PCB contaminated soil would be conducted in compliance with this statute.

Reduction of Toxicity, Mobility or Volume through Treatment Alternative 3 would only achieve a very limited reduction of contaminant toxicity, mobility, or volume through treatment since the only treatment which would occur is that of the drainage water from wet excavated soil in the on site DW/WWT facility.

Any organic COCs contained in the drainage water would be effectively removed by GAC adsorption. Since the GAC would ultimately be disposed of through either offsite thermal regeneration or offsite incineration, the achieved reduction in organic COCs toxicity and volume would be 100 percent irreversible.

Alternative 3 would significantly reduce toxicity, mobility, and volume of contaminants through excavation and offsite disposal of soil "hot spots". Approximately 3,150 cubic yards of contaminated soil containing 135 pounds of PCBs and 406 pounds of cadmium would be removed from the site and securely disposed of at an offsite RCRA Hazardous waste TSD facility. Some additional reduction in the toxicity or volume of residual contaminant might occur through natural dispersion, dilution, or other attenuation process and monitoring would verify this. Maintenance of the existing cap would also achieve some reduction in the mobility of residual contaminants by minimizing infiltration through the vadose zone which would slightly reduce the potential for soil contaminants to migrate to groundwater and, from there, to the Thames River.

Short-term Effectiveness

There is a significant concern that the strong soil/water stirring action during excavation of "hot spots" below the water table could trigger a significant short-term migration of hitherto stationary contaminants from soil to groundwater and, from there, to the Thames River.

During implementation of the excavation and offsite disposal components of Alternative 3, construction workers could be exposed to contaminated soil and groundwater. This potential for exposure would be minimized by the implementation of engineering controls such as dust suppression and air quality monitoring, the wearing of appropriate PPE, and compliance with proper health and safety procedures. Excavation and offsite disposal of contaminated soil are not expected to adversely impact either the surrounding community or the environment. However, during these activities measures, such as spill prevention and containment, erosion and sedimentation control, and perimeter air monitoring would be taken to insure that impact remains acceptable.

Implementation of the institutional controls and monitoring components of Alternative 3 would have minimal short-term effectiveness concerns. Any exposure of workers to contaminated soil during the maintenance of the existing cap and fencing or during the installation and sampling of monitoring wells would be minimized through the wearing of appropriate PPE and compliance with proper health and safety procedures. Implementation of institutional controls and monitoring would not adversely impact the surrounding community or the environment.

Alternative 3 would be completed in approximately 5 months and would achieve the RAOs at completion. However, continued achievement of the RAO for protection of ecological receptors in the Thames River would have to be regularly modified through monitoring.

Implementability

As previously discussed, excavation of "hot spots" would be difficult to implement because it would require removal of poorly cohesive soil to a depth of up to 10 feet bgs, which at the DRMO is significantly below the water table. This would lead to two significant implementability concerns. First, extensive shoring would be required. Sheet piling would have to be installed on the periphery of the excavated areas to a depth at least three times that of excavation, Second, any excavation deeper than approximately 3 feet bgs would take place under water which would seriously impair precise visual control, and thus effectiveness, of that excavation. Typically, this second implementability concern would be addressed by pumping to prevent significant accumulation of groundwater in the excavation. However, such pumping is not practically implementable at the DRMO because excavation would take place in a highly permeable stratum (i.e., sand and gravel) along the bank of a tidal river. Under these conditions, depressing of the groundwater table elevation, if it could be accomplished at all, would require the pumping (and treatment and discharge) of very large volumes of water, at least several hundreds, and probably several thousands, of gpm. Also any significant lowering the groundwater table elevation would require a corresponding reinforcement and deepening of the sheet piling to counteract the pressure of the external groundwater on that piling.

Since complete post-excavation verification sampling would not be possible because of the presence of sheet piling and water in most excavated areas, a very thorough pre-excavation sampling would have to be performed to accurately determine the extent of soil contamination.

Independently of the above concerns, excavation of soil "hot spots" could be accomplished with readily available construction equipment such as backhoes, front-end loaders, and clamshell buckets.

Resources, equipment, and materials for the construction and operation of the on site DW/WWT facility would be readily available.

The offsite disposal component of Alternative 3 would be readily implementable since permitted, hazardous waste disposal facilities are available with adequate capacity to accept the excavated materials.

The institutional controls and monitoring components of Alternative 3 would be readily implementable. Maintenance of the existing cap and fence, posting of notices, maintenance of existing monitoring wells and installation of new ones, and sampling and analysis of groundwater and, if necessary, of surface water and river sediment would all be relatively simple to perform. The resources, equipment, and materials required for these activities would be readily available.

Implementation of Alternative 3 would also require the completion of numerous administrative procedures which, while requiring a significant effort, could readily be accomplished. On site remedial activities would have to meet the substantive requirements of a RCRA hazardous waste TSD facility. Offsite disposal of excavated soil would require compliance with all applicable RCRA requirements, including the proper manifesting of excavated soil shipments. If any waste generated by the treatment of the drainage water (e.g., spent filter layers and GAC) are determined to be hazardous, disposal of these wastes would have to comply with all applicable RCRA regulations. Although no formal permits would be required for discharge of the treated drainage water to the Thames River, State agencies would have to be contacted to determine applicable water treatment criteria. A Coastal Site Plan would have to be prepared and submitted to the local municipalities and some coordination would be required with the CTDEP Office of Long Island Sound Programs regarding a coastal zone consistency determination. The NSB-NLON Master Plan and Navy real estate records would have to document the presence of contamination at the site and the scope of ongoing institutional controls and monitoring. Environmental Land Use Restrictions would be required in accordance with Connecticut regulations to prevent residential development of the DRMO. In the unlikely event of a change in the DRMO site ownership, provisions would be incorporated in the property transfer documents to insure continuation of institutional controls and monitoring.

Cost

The estimated costs for Alternative 3 would be:

Estimated capital costs:	$4,363,156
Total estimated O&M costs over 30 years:	$617,580
Estimated 30-year present worth:	$4,980,736

Cost estimates for this alternative are based on a 5-month construction period, 3 years of groundwater monitoring, and the performance of 5-year reviews for 30 years. The details of the cost estimates are provided in Appendix C.

5.2.4 Alternative 4 - Excavation, On Site Treatment (thermal desorption & fixation-solidification), and Offsite Disposal

5.2.4.1 Detailed Description

Alternative 4 is developed to meet the PRGs for the future resident and potential ecological receptors in a future residential land use scenario, as well as the PRGs developed for the protection of the surface water of the Thames River. Soil with COCs concentrations above these PRGs would be excavated, treated on site, and disposed of offsite. Since complete verification sampling would not be possible because of the presence of sheet piling and water in most excavated areas, some relatively small amount of contaminated soil could remain on site but these would not present unacceptable risks to human health or the environment.

Alternative 4 consists of three major components: (1) excavation with dewatering of wet soil, (2) on site treatment of excavated soil with a combination of thermal desorption and chemical fixation-solidification, and (3) offsite disposal of treated soil. Figure 5-6 illustrates the block flow diagram for this alternative and Figure 5-7 shows a lay-out of the site and proposed excavation areas. .

Component 1: Excavation

The existing cap would be removed and soil contaminated with concentrations of COCs above residential land use, ecological, and surface water protection PRGs would be excavated which corresponds to a volume of approximately 13,600 cubic yards of excavated material. Prior to excavation, the existing cap and clean material backfilled during the Time Critical Removal Action would be removed as required from the areas being excavated. As previously discussed, extensive sheet piling would be required to shore up excavated areas deeper than about 4 feet bgs and groundwater would have to be allowed to accumulate in these deeper areas, although this would considerably hinder excavation. After completion of excavation, and to the extent that the presence of sheet piling and water would allow, the sidewalls and bottom of the excavated areas would be sampled and analyzed to try and confirm that PRGs have been met. Following excavation, the excavated areas would be backfilled with clean fill from an off site source and regraded to achieve desired surface elevations.

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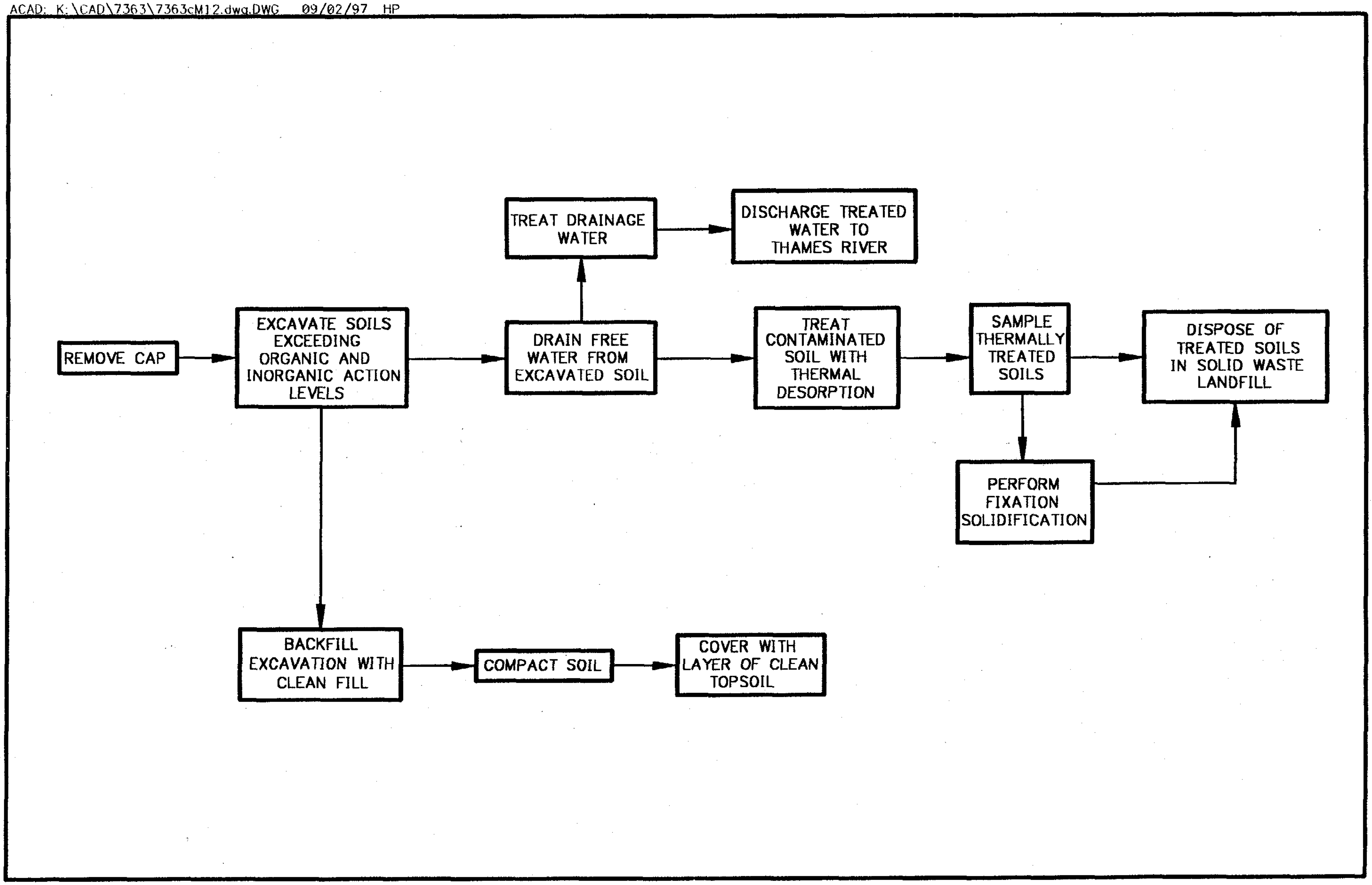
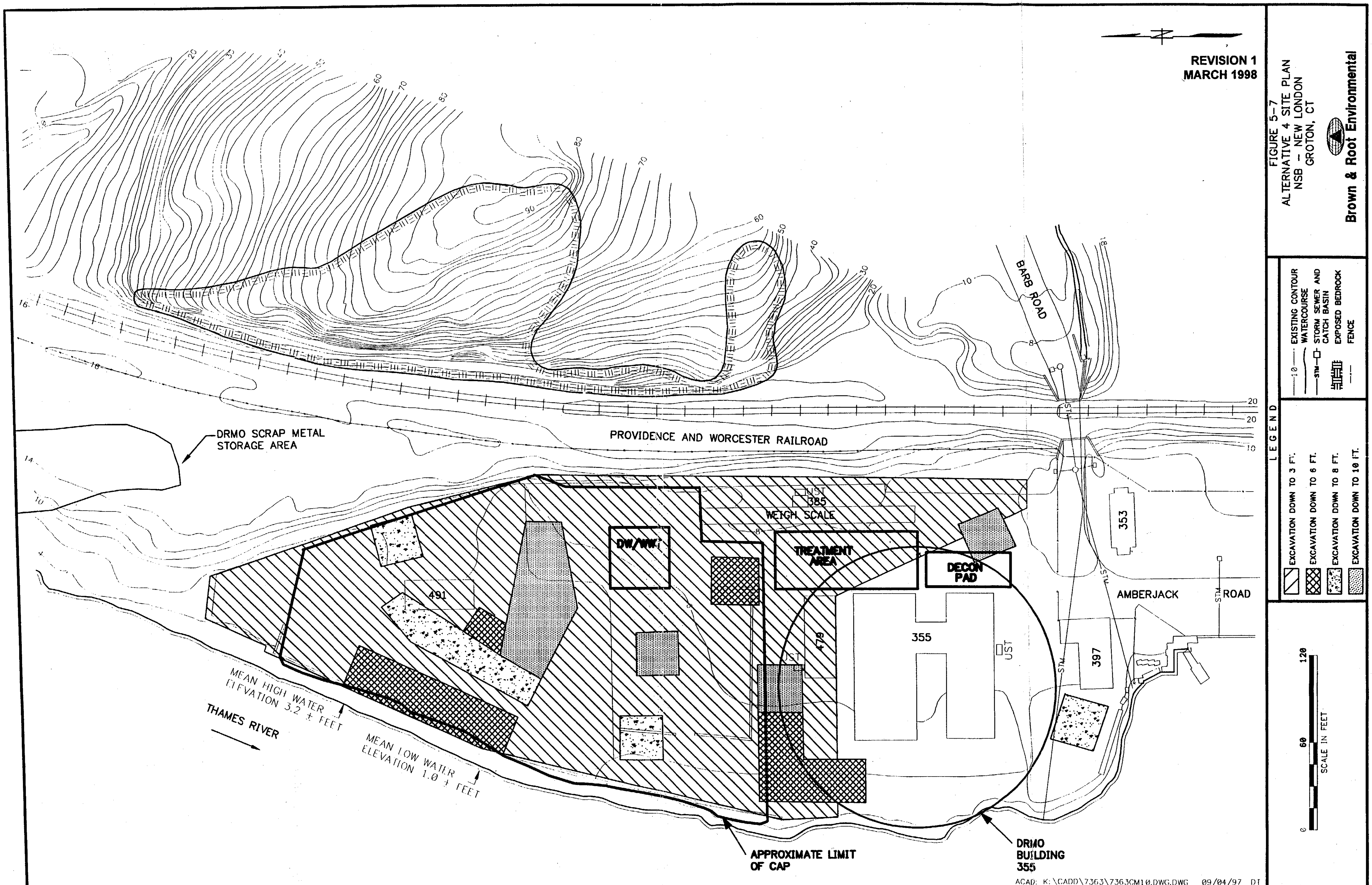


FIGURE 5–6

BLOCK FLOW DIAGRAM
ALTERNATIVE 4
DRMO, NSB–NLON, C

Brown & Root Environ ntal


REVISION 1
MARCH 1998
FIGURE 5-7
ALTERNATIVE 4 SITE PLAN
NSB - NEW LONDON
GROTON, CT
Brown & Root Environmental
LEGEND
EXISTING CONTOUR
WATERCOURSE
STORM SEWER AND CATCH BASIN
EXPOSED BEDROCK
FENCE
EXCAVATION DOWN TO 3 FT.
EXCAVATION DOWN TO 6 FT.
EXCAVATION DOWN TO 8 FT.
EXCAVATION DOWN TO 10 FT.
SCALE IN FEET
BARB ROAD
PROVIDENCE AND WORCESTER RAILROAD
DRMO SCRAP METAL
STORAGE AREA
WEIGH SCALE
DW/WW
TREATMENT AREA
DECON PAD
AMBERJACK ROAD
MEAN HIGH WATER
ELEVATION 3.2 ± FEET
MEAN LOW WATER
ELEVATION 1.0 ± FEET
THAMES RIVER
APPROXIMATE LIMIT
OF CAP
DRMO
BUILDING
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As excavation in several areas would take below the groundwater table, a significant portion of the excavated soil would need to be dewatered prior to on site treatment. Based upon typical requirements for thermal desorption, moisture content of wet soil would need to be reduced to approximately 20 percent (by weight). Soil dewatering and treatment of the drainage water would be performed at an onsite DW/WWT facility which would be identical to that described for Alternative 3, except that the estimated volume of drainage water would be approximately 150,000 gallons. As for Alternative 3, it is anticipated that a one-day holding time would be adequate for dewatering.

Component 2: On Site Treatment (thermal desorption & fixation-solidification) of Excavated Soil

Onsite treatment would consist of thermal desorption of excavated soil to remove and destroy organic COCs, followed by chemical fixation-solidification of thermally treated soil to immobilize inorganic COCs, if required.

Prior to transfer to the thermal desorption unit, excavated soil, including that portion of it dewatered at the DW/WWT facility, would be crushed or shredded as necessary to meet the size requirement for feeding to that unit. Thermal desorption would be performed using a commercially available unit designed to treat approximately 150 tons of soil per day. Prior to equipment selection, bench-scale treatability tests would be performed to determine optimum operating temperature and residence time. An off-gas treatment system would be provided and the residual waste generated by this system would be appropriately disposed of.

Thermally treated soils would be tested (for TCLP) to determine the need to immobilize inorganic COCs through chemical fixation-solidification. That portion of the thermally treated soil which requires chemical fixation-separation would be blended with a cement-pozzolan based agent using a standard pug mill type mixer. Bench-scale treatability tests would be performed to optimize the formulation of the fixation-solidification mix (i.e., the optimum ratio of soil-to-pozzolan agent-to-moisture).

Component 3: Offsite Disposal of Treated Soil

The treated soil would be disposed of at an offsite permitted solid waste disposal facility. Treated material would be loaded into trucks and transported to an off-site non-hazardous waste landfill.

5.2.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 4 would be protective of human health and the environment.

Excavation would be protective of human health and the environment. Although complete verification sampling would not be possible because of the presence of sheet piling and water in most excavated areas, excavation of virtually all the soil contaminated above residential land use and ecological PRGs would eliminate unacceptable risks from direct exposure of human and ecological receptors to soil under all scenarios. Human health risks would be lowered to an ICR of less than 1E-4 and an HI of less than 1.0. Excavation of virtually all soil contaminated above surface water protection PRGs would also be protective of ecological receptors in the Thames River by removing the sources of potential contaminant migration from the DRMO soil to that river. On site thermal desorption and chemical fixation-stabilization of the excavated soil and offsite disposal of the treated soil would protect human health and the environment by irreversibly removing and destroying organic COCs, by immobilizing inorganic COCs, and by containing treated soil, respectively.

In the short-term, the strong soil/water stirring action during excavation below the water table could trigger a significant migration of hitherto stationary contaminants from soil to groundwater and, from there, to the Thames River.

Some short-term risks could be incurred by workers from exposure to contaminated soil and thermal desorption offgas during on site remedial activities. However, the potential for exposure would be minimized by the implementation of engineering controls (e.g., dust suppression, offgas treatment), the wearing of appropriate PPE, and compliance with OSHA regulations and site-specific health and safety procedures. Any potential negative short-term impacts to the surrounding community and environment from fugitive emissions and/or spillage of contaminated soil could be prevented through the implementation of appropriate engineering controls (e.g., offgas treatment, perimeter air monitoring, spill prevention procedures, etc.).

Compliance with ARARs and TBCs

Alternative 4 would comply with chemical-specific, location-specific, and action-specific ARARs and TBCs. A detailed assessment of this compliance is provided in Tables 5-10, 5-11, and 5-12, respectively.

TABLE 5-10

DRMO FS
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 4: EXCAVATION, ON SITE TREATMENT, AND OFFSITE DISPOSAL OF CONTAMINATED SOIL
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Cancer Slope Factors (CSFs)		To be considered	These are guidance values used in risk assessment to evaluate the potential carcinogenic or noncarcinogenic hazard caused by exposure to contaminants.	Contaminated soils would be excavated, treated and removed. Remaining soils would pose no hazard to potential receptors.
Reference Dose (RfDs)		To be considered	These are guidance values used in risk assessment to evaluate the potential carcinogenic or noncarcinogenic hazard caused by exposure to contaminants.	Contaminated soils would be excavated, treated and removed. Remaining soils would pose no hazard to potential receptors.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR

There are no state chemical-specific ARARs.

TABLE 5-11

DRMO FS
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 4: EXCAVATION, ON SITE TREATMENT, AND OFFSITE DISPOSAL OF CONTAMINATED SOIL
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Executive Order 11988 RE: Floodplain Management	Executive Order 11988	Applicable	This order requires Federal agencies, wherever possible, to avoid or minimize adverse impacts upon floodplains. Requires reduction of risk of flood loss, minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values of the floodplains.	Measures would be taken to minimize impacts to floodplains of Thames River during remedial activities. Site excavation and treatment activities would not take place during times of potential flooding. Contaminants would be treated and removed from the site.
Coastal Zone Management Act	16 USC Parts 1451 *et seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state approved management programs.	This site is located in a coastal zone management area, therefore, applicable state coastal zone management requirements need to be addressed.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Coastal Management Act	CGS §§22a-92 and 94	Applicable	Requires projects within a state designated coastal zone to minimize adverse impacts on natural coastal resources.	The site occurs within the coastal 100 year flood zone. The proposed thermal desorption unit would be located to minimize impacts to coastal resources. If contaminated soil is temporarily exposed or placed below the 100 year flood elevation, measures would be taken to protect coastal resources. Site excavation would not take place during times of potential flooding. Contaminants would be treated and removed from the site.
Tidal Wetlands	RCSA § 22a-30-1 through 17	Relevant and Appropriate	Activities within or affecting tidal wetlands are regulated.	Wastewater from dewatering of excavated material would not be discharged into tidal wetlands.
Hazardous Waste Management - Floodplain	RCSA § 22a-449(c)104	Applicable	The standards of 40 CFR § 264 are incorporated by reference.	Regulates the siting and operation of the thermal desorption unit within the coastal 100 year flood plain.
CT State Endangered Species Act	CGS § 26-303-314	Relevant and Appropriate	Regulates activities affecting state-listed endangered or threatened species or their critical habitat.	The state-threatened Atlantic sturgeon inhabits the Thames River. Dewatering of excavated material and removal of groundwater from excavations would be adequately treated prior to discharge into the river.

TABLE 5-12

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 4: EXCAVATION, ON SITE TREATMENT, AND OFFSITE DISPOSAL OF CONTAMINATED SOIL
NSB-NLON, GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken to Attain ARAR
Clean Water Act, National Pollution Discharge Elimination System (NPDES)	40 CFR Parts 122 through 125 and 131	Relevant and Appropriate	NPDES (National Pollution Discharge Elimination System) permits are required for any discharges to navigable waters. If remedial activities include such a discharge, the NPDES standards would be ARARs.	The quality of the treated water from the on site DW/WWT facility would meet NPDES standards for discharge to the Thames River. No formal discharge permit would be required.
Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Applicable	NESHAPs are a set of emissions standards for specific chemicals from specific production activities	Emissions of hazardous air pollutants would be minimized by fugitive dust controls and off gas. Treatment from the thermal desorption facility.
RCRA, Treatment Standards for Hazardous Debris - Thermal Desorption	40 CFR §268.45	Applicable	Sets treatment standards for utilizing thermal desorption.	Thermal desorption would be operated in compliance with treatment standards.
PCB Regulations under TSCA	40 CFR §§ 761.60 through 761.71	Relevant and Appropriate	The regulations govern the storage, transportation and disposal of PCBs, and the cleanup of PCB spills. For the most part, these standards only apply to PCB items with concentrations above 50 ppm or to materials contaminated from such items.	These regulations are not applicable because PCB levels at the site have been measured at no greater than 47.2 ppm. However, if PCBs are detected at greater than 50 ppm any activities regarding storage, transportation, and disposal of such PCB-contaminated soil would be conducted in compliance with these standards.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive 9355.4-01	To be considered	This guidance describes how to address PCB contamination issues as part of remedial actions.	Low levels of PCBs (47.2 ppm or less) are present within soils at the site. This guidance document would be considered in evaluating PCB issues as part of the remedial action.
Air/Superfund National Technical Guidance	EPA Guidance. EPA/450/1-89/001-EPA/450/1-89/004	To be considered	This guidance describes methodologies for predicting risks due to air release at a Superfund site.	These guidance documents would be considered when risks due to air releases from fugitive dust and thermal desorption are being evaluated.

STATE OF CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Solid Waste Management	RCSA § 22a-209-1 through 13	Applicable	These standards establish operating and closure standards for solid waste disposal areas (SWDAs) including closure, post-closure, and groundwater monitoring requirements.	After contaminated soils are treated and removed from the site the area would be closed in accordance with these requirements.

TABLE 5-12

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 4: EXCAVATION, ON SITE TREATMENT, AND OFFSITE DISPOSAL OF CONTAMINATED SOIL
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Hazardous Waste Management: Generator and Handler Requirements	RCSA § 22a-449(c) 100-101	Applicable	These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR 260-261 are incorporated by reference.	For all soils excavated hazardous waste determinations would be performed, and the wastes would be managed in accordance with requirements of these regulations, if necessary.
Hazardous Waste Management: TSDF Standards	RCSA § 22a-449(c)104	Applicable	This section establishes standards for treatment, storage, and disposal facilities. The standards of 40 CFR 264 are incorporated by reference.	Any hazardous waste which is treated or temporarily stored of on this site as part of the remedy would be managed in accordance with the requirements of this section.
Hazardous Waste Management: Generator Standards	RCSA § 22a-449(c)-102	Applicable	This section establishes standards for various classes of generators. The standards of 40 CFR 262 are incorporated by reference. Storage requirements given at 40 CFR 265.15 are also included.	Any hazardous waste generated through excavation, treatment or other activities would be managed in accordance with the substantive requirements of these regulations.
Hazardous Waste Management Facility Siting Regulations	CGS 22a-117-123; RCSA § 22a-116B-1 through 11	Applicable	Requires certificate of public safety and necessity from the CT Siting Counsel prior to construction of any new hazardous waste disposal facility	The requirements are applicable to this alternative's on-site-treatment of wastes through thermal desorption. The substantive requirements of these regulations would be met.
Control of Noise Regulations	RCSA § 22a-69-1 through 7.4	Applicable	These regulations establish allowable noise levels. Noise levels from construction activities are exempt from these requirements.	Noise generated by any remedial actions other than construction would meet the standards of these regulations. Noise generated by the thermal desorption unit would have to meet the standards in these regulations. Noise from excavation activities is not expected to exceed these standards.
Air Pollution Control	RCSA § 22a-174	Applicable	These regulations require permits to construct and to operate specified types of emission sources and contain emission standards that must be met prior to issuance of a permit. Pollutant abatement controls may be required. Specific standards include fugitive dust (18b), incineration (18c), emissions of sulfur compounds (19a), emissions of organic compounds (20f), control of odors (23), and allowable stack concentrations (29).	The thermal desorption unit, which produces an air discharge, would be designed to meet the substantive requirements of these regulations. Emission standards for fugitive dust would be met with dust control measures during excavation, transportation and offsite disposal to comply with substantive requirements.
Guidelines for Soil Erosion and Sediment Control	The Connecticut Council on Soil and Water Conservation	To be considered	The guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	These guidelines would be incorporated into any remedial designs for this site. Erosion and sediment control measures would be implemented during excavation activities.

TABLE 5-12

DRMO FS
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 4: EXCAVATION, ON SITE TREATMENT, AND OFFSITE DISPOSAL OF CONTAMINATED SOIL
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis	Action to be Taken to Attain ARAR
Water Pollution Control	RCSA § 22a-430-1 through 8	Applicable	These rules establish permitting requirements and criteria for water discharge to surface water, groundwater, and POTWs.	No discharge to a POTW is proposed. The quality of the treated water from the on site DW/WWT facility would meet the substantive requirements of this section for discharge to the Thames River. No formal discharge permit would be required.
Remediation Standards Regulations	RCSA 22a-133k-s	Relevant and Appropriate	These regulations provide specific numeric cleanup criteria for a wide variety of contaminants in soil, groundwater, and soil vapor. These criteria include volatilization criteria, pollutant mobility criteria, direct exposure criteria, and surface water protection criteria.	Excavation, on site treatment, and off site disposal of contaminated soil would satisfy the Remediation Standards Regulations for soil.
Water Quality Standards	CGS 22a-426	Applicable	Connecticut's Water Quality Standards establish specific numeric criteria, designated uses, and antidegradation policies for groundwater and surface water.	Remedial activities would be undertaken in a manner which is consistent with the antidegradation policy in the Water Quality Standards.
Disposition of PCBs	CGS 22a-467	Applicable	This section regulates the disposal or destruction of PCBs in a manner not inconsistent with the Requirements of the Toxic Substances Control Act (TSCA), listed at 40 CFR Part 761.	Disposal of low levels of PCBs (47.2 ppm or less) are present within soils at the site. PCB contaminated soil will be conducted in compliance with this statute. All PCB-contaminated materials would be handled in accordance with the substantive requirements of this statute.

Long-term Effectiveness and Permanence

Alternative 4 would provide long-term effectiveness and permanence.

Although complete verification sampling would not be possible because of the presence of sheet piling and water in most excavated areas, excavation of virtually all soil contaminated above residential land use, ecological, and surface water protection PRGs would effectively and permanently protect human and ecological receptors from exposure to soil under all scenarios. Thermal desorption would effectively and permanently remove at least 90 percent of the organic COCs from the excavated soil. Chemical fixation-solidification and offsite disposal would complete the remedial process by effectively and permanently immobilizing inorganic COCs in the excavated soil and containing treated soil, thus minimizing the potential for soil contaminants to leach out to other media.

There is some uncertainty regarding the thermal desorption process. Full-scale thermal desorption units have successfully treated PCB contaminated materials. However, bench-scale treatability tests would be required to verify the site-specific effectiveness of thermal desorption and to determine the optimum operating temperature and residence time. Although chemical fixation-solidification is a well-proven treatment technology, bench-scale treatability tests would also be required to determine site-specific operating criteria.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 4 would reduce toxicity, mobility, or volume of contaminants through treatment.

Thermal desorption and offgas treatment of would remove 90 percent or more of organic COCs from the excavated soil. Since the desorbed COCs would ultimately be destroyed (e.g., through catalytic oxidation or thermal regeneration of the GAC used for offgas treatment), the achieved reduction in organic COCs toxicity and volume would be 100-percent irreversible. Approximately 1,100 pounds of PAHs and PCBs would be removed by thermal desorption.

Chemical fixation-solidification would effectively eliminate the mobility of inorganic COCs. However, chemical fixation-solidification most often results in an increase in volume for the treated material. Typically this increase is in the order of 10 to 15 percent. Although some very long-term degradation of the fixated-solidified soil matrix cannot be entirely ruled out, the achieved reduction in mobility of inorganic COCs would almost be completely irreversible.

In addition, some reduction in contaminant toxicity and volume would be achieved through treatment of the drainage water from wet excavated soil in the on site DW/WWT facility. Any organic COCs contained in the drainage water would be effectively removed by GAC adsorption. Since the GAC would ultimately be disposed of through either offsite thermal regeneration or offsite incineration, the achieved reduction in organic COCs toxicity and volume would be 100-percent irreversible.

Short-term Effectiveness

There is a significant concern that the strong soil/water stirring action during excavation below the water table could trigger a significant short-term migration of hitherto stationary contaminants from soil to groundwater and, from there, to the Thames River.

Implementation of the excavation, onsite treatment, and offsite disposal components of Alternative 4, could expose construction workers to contaminated soil, groundwater, and thermal treatment emissions. This potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression, offgas treatment, and air quality monitoring. The potential for worker exposure would be further reduced by the wearing of appropriate PPE, and compliance with applicable OSHA regulations and proper site-specific health and safety procedures. The safety concerns inherent to the thermal desorption unit, due to the heat and pressures generated and the auxiliary fuel required, would be given special consideration.

Implementation of the excavation, treatment and offsite disposal components are not expected to adversely impact either the surrounding community or the environment. However, during these activities measures such as spill prevention and containment, erosion and sedimentation control, and perimeter air monitoring would be taken to insure that impact remains acceptable.

Alternative 4 could be completed in approximately 7 months and would achieve the RAOs at completion.

Implementability

The excavation component of Alternative 4 would have the same two significant implementability concerns as discussed for Alternative 3, i.e., first, extensive shoring would be required and, second, a significant portion of the excavation would have to be performed under water, which would be a considerable hindrance to its effectiveness. Also, since complete post-excavation verification sampling would not be possible because of the presence of extensive sheet piling and water in most excavated areas, a very thorough pre-excavation sampling would have to be performed to accurately determine the extent of soil contamination.

Other than these concerns, the excavation component of this alternative could be performed with normal construction equipment and resources, equipment, and materials would be readily available for this purpose.

Resources, equipment, and materials for the construction and operation of the on site DW/WWT facility would be readily available.

For implementation of the on site treatment component, there are some uncertainties regarding availability and operation of a thermal desorption unit. Although this technology has been successfully used to for full-scale treatment of PCB contaminated materials, only a few thermal desorption contractors have had experience treating PCBs. Therefore, minor delays due to technical problems should be expected. Bench-scale treatability tests would be required to verify the site-specific effectiveness of thermal desorption and determine the optimum operating temperature and residence time. Natural gas, which would be the preferred fuel for a thermal desorption unit, is not available at the DRMO. Fuel oil would the alternative and is readily available. Other utilities (electricity and water) are available at the DRMO.

Chemical fixation-solidification would be simple to implement and a large number of qualified contractors offer this type of service for on site treatment of soil containing inorganic compounds. Bench-scale treatability tests would have to be performed to optimize the composition of the fixation-solidification mix.

Non hazardous waste landfill for the offsite disposal of the treated soil would be readily available.

Implementation of Alternative 4 would also require the completion of relatively numerous administrative procedures which, while requiring a significant effort, could readily be accomplished. On site remedial activities would have to meet the substantive requirements of a RCRA hazardous waste TSD facility. If any waste generated by the treatment of drainage water or thermal desorption offgas (e.g., spent GAC) are determined to be hazardous, disposal of these wastes would have to comply with all applicable RCRA regulations. Although no formal permits would be required for operation of the thermal desorption unit and discharge of the treated drainage water to the Thames River, the appropriate State agencies would have to be contacted to determine appropriate offgas and water treatment criteria. A Coastal Site Plan would have to be prepared and submitted to the local municipalities and some coordination would be required with the CTDEP Office of Long Island Sound Programs regarding a coastal zone consistency determination.

Cost

The estimated costs for this alternative are:

Estimated capital costs:	$16,128,927
Total estimated O&M costs over 30 years:	$0
Estimated present worth:	$16,128,927

Cost estimates of this alternative are based on a 7-month construction period. The details of the cost estimations are provided in Appendix C.

6.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the analyses that were presented for each of the remedial alternatives in Section 5.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

The following remedial alternatives, developed for the DRMO, are being compared in this section:

- Alternative 1: No Action
- Alternative 2: Institutional Controls and Monitoring
- Alternative 3: "Hot Spots" Excavation, Offsite Disposal, Institutional Controls, and Monitoring
- Alternative 4: Excavation, Onsite Treatment (thermal desorption & fixation-solidification), and Offsite Disposal

6.1 COMPARISON OF SOIL REMEDIATION ALTERNATIVES BY CATEGORY

6.1.1 Overall Protection of Health and Environment

Alternative 1 would provide some protection of human health and the environment because of the existing cap. However, since the cap would not be maintained, this protection would be limited. Also, since no monitoring would be performed, potential contaminant migration to groundwater and to the Thames River would not be detected in time for appropriate action.

Alternative 2 would be protective of human health and the environment. Institutional controls would be protective because the existing cap would be maintained, site access would be restricted, and the DRMO would be kept in its current industrial function, all of which would minimize human health and ecological risks from direct exposure to contaminated soil under the current land use scenario. Monitoring would be protective as it would detect potential migration of soil contaminants to the Thames River which could adversely impact ecological receptors in that river.

Alternative 3 would be more protective than Alternative 2 since, in addition to institutional controls and monitoring, soil "hot spots" (i.e., soil contaminated above industrial land use PRGs) would be removed from the site and disposed of at an offsite RCRA hazardous waste TSD facility. Although complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, this removal and disposal would virtually eliminate unacceptable human health risk from direct exposure to contaminated soil under the current industrial land use scenario. Removal and disposal of soil "hot spots" would also be protective of ecological receptors in the Thames River by significantly reducing the possibility that contaminants would migrate from the DRMO soil to that river.

Alternative 4 would be the most protective of human health and the environment. All soil contaminated above residential land use, ecological, and surface water protection PRGs would be excavated, treated on site to irreversibly remove and destroy organic COCs and immobilize inorganic COCs, and disposed of at an offsite solid waste disposal facility. Although the existing cap would be removed and not replaced and complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, these actions would virtually eliminate unacceptable risk to human and ecological receptors from direct exposure to soil under all scenarios. These actions would also be protective of ecological receptors in the Thames River since the sources of potential contaminant migration to that river from the DRMO soil would no longer exist.

6.1.2 Compliance with ARARs and TBCs

Alternative 1 would not comply with chemical-specific and location-specific ARARs. No action-specific ARARs or TBCs apply to this alternative.

Alternatives 2 , 3 and 4 would comply with chemical-specific, location-specific, and action-specific ARARs and TBCs. A comparative assessment of this compliance is provided on Tables 6-1, 6-2, and 6-3, respectively

6.1.3 Long-term Effectiveness and Permanence

Alternative 1 would have very limited long-term effectiveness and permanence because all contaminated soil would remain on site and the existing cap would not be maintained. Therefore, as the existing cap deteriorates over time, an unacceptable risk (HI > 1.0) could develop for site workers from direct exposure to contaminated soil. As there would be no institutional controls to limit site access or prevent residential development, the potential would also exist for unacceptable risk to develop for trespassers (HI > 1.0) and possible future resident (HI > 1.0 and ICR > 1E-4). Residential development of the DRMO could also result in unacceptable risk to a correspondingly increased population of ecological receptors from exposure to contaminated surface soil. Since there would be no monitoring, potential impact to the groundwater and to the Thames River from possible migration of contaminants from soil would not be detected in time for appropriate remedial action.

TABLE 6-1

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE WITH CHEMICAL-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status/Action to be Taken to Attain ARAR		
		Alternative 2: Institutional Controls & Monitoring	**Alternative 3:** Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	**Alternative 4:** Excavation, On Site Treatment, & Offsite Disposal
Cancer Slope Factors (CSFs)		Not a TBC.	TBC. "Hot spots" contaminated soil would be excavated and disposed offsite. Remaining contaminated soil would be recapped to minimize exposure to potential receptors.	TBC. Contaminated soil would be excavated, treated on site, and disposed offsite. Remaining soils would pose no hazard to potential receptors.
Reference Dose (RfDs)		Not a TBC.	TBC. "Hot spots" contaminated soil would be excavated and disposed offsite. Remaining contaminated soil would be recapped to minimize exposure to potential receptors.	TBC. Contaminated soil would be excavated, treated on site, and disposed offsite. Remaining soils would pose no hazard to potential receptors.

STATE OF CONNECTICUT

Requirement	Citation	Status/Action to be Taken to Attain ARAR		
		Alternative 2: Institutional Controls & Monitoring	**Alternative 3:** Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	**Alternative 4:** Excavation, On Site Treatment, & Offsite Disposal

There are no state chemical-specific ARARs

TABLE 6-2

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE TO LOCATION-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON GROTON, CONNECTICUT

FEDERAL

Requirement	*Citation*	Status/Action to be Taken to Attain ARAR		
		Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Executive Order 11988 RE: Floodplain Management	Executive Order 11988	Applicable. Installation and sampling of monitoring wells within the 100-year floodplain would be carried out in such a way as to minimize impacts to resources and would not take place during periods of potential flooding.	Applicable. Excavation of contaminated soil and installation and sampling of monitoring wells within the 100-year floodplain would be carried-out in such a way as to minimize impacts to resources and would not take place during periods of potential flooding.	Applicable. Excavation and on site treatment of contaminated soil within the 100-year floodplain would be carried-out in such a way as to minimize impacts to resources and would not take place during periods of potential flooding
Fish and Wildlife Cooperation Act	16 USC Part 661 *et seq.* - 40 CFR Section 6.302	Applicable. If monitoring wells are installed in the Thames River or its tidal zone, the U.S. Fish & Wildlife Service would be consulted as to measures required to protect fish and wildlife resources.	Applicable. If monitoring wells are installed in the Thames River or its tidal zone, the U.S. Fish & Wildlife Service would be consulted as to measures required to protect fish and wildlife resources.	Not an ARAR
Coastal Zone Management Act	16 USC Parts 1451 *et seq.*	Applicable. Coastal zone management requirements would be addressed.	Applicable. Coastal zone management requirements would be addressed.	Applicable. Coastal zone management requirements would be addressed.

STATE OF CONNECTICUT

Requirement	Citation	Status/Action to be Taken to Attain ARAR		
		Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Coastal Management Act	CGS 22a-90 to 112	Applicable. Installation and sampling of monitoring wells within the 100-year floodplain would be performed in a way which would not negatively impact floodplain resources.	Applicable. Installation and sampling of monitoring wells and excavation within the 100-year floodplain would be performed in a way which would not negatively impact floodplain resources.	Applicable. Excavation and on site treatment within the 100-year floodplain would be performed in a way which would not negatively impact floodplain resources.
Tidal Wetlands	RCSA 22a-30-1 through 17	Applicable. Installation and sampling of monitoring wells in the Thames River or its tidal zone, if needed, would be performed in a way which would not negatively impact tidal resources.	Applicable. Installation and sampling of monitoring wells in the Thames River or its tidal zone, if needed, would be performed in a way which would not negatively impact tidal resources. Wastewater from dewatering of excavated material would not be discharged to tidal wetlands	Applicable. Wastewater from dewatering of excavated material would not be discharged to tidal wetlands
Hazardous Waste Management - Floodplain	RCSA 22a-449 (c) 104	Not and ARAR.	Not and ARAR.	Applicable siting of the thermal desorption unit within the 100-year floodplain would be in accordance to this regulation.

TABLE 6-2

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE TO LOCATION-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON GROTON, CONNECTICUT

Requirement	Citation	Status/Action to be Taken to Attain ARAR		
		Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
CT Endangered Species Act	CGS 26-303 to 314	Relevant and Appropriate. Installation and sampling of monitoring wells in the Thames River or its tidal zone, if needed, would be performed in a way which would not negatively impact the Atlantic Sturgeon.	Relevant and Appropriate. Installation and sampling of monitoring wells in the Thames River or its tidal zone, if needed, would be performed in a way which would not negatively impact the Atlantic Sturgeon. Wastewater from dewatering of excavated material would be adequately treated prior to discharge to the river.	Relevant and Appropriate. Wastewater from dewatering of excavated material would be adequately treated prior to discharge to the Thames River.

TABLE 6-3

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE TO ACTION-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON, GROTON, CONNECTICUT

FEDERAL

Requirement	Citation	Status/Action to be Taken to Attain ARAR		
		Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Clean Water Act, National Pollution Discharge Elimination System (NPDES)	40 CFR Parts 122 to 125 and 131	Not an ARAR	Relevant and appropriate. The quality of the treated water from the on site DW/WWT facility would meet NPDES standards for discharge to the Thames River. No formal discharge permit would be required.	Relevant and appropriate. The quality of the treated water from the on site DW/WWT facility would meet NPDES standards for discharge to the Thames River. No formal discharge permit would be required.
Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Not an ARAR	Not an ARAR.	Applicable. Emissions of hazardous air pollutants would be minimized by fugitive dust controls and offgas treatment from the thermal desorption facility.
Resource Conservation and Recovery Act, Treatment Standards for Hazardous Debris - Thermal Desorption	40 CFR 268.45	Not an ARAR	Not an ARAR.	Applicable. Thermal desorption would be operated in compliance with treatment standards.
PCB Regulations under TSCA	40 CFR 761.60 to 761.71	Not an ARAR.	Relevant and appropriate. These regulations are not applicable because PCB levels at the site have been measured at no greater than 47.2 ppm. However, if PCBs are detected at greater than 50 ppm, any activities regarding storage, transportation, and disposal of such PCB-contaminated soil would be conducted in compliance with these standards.	Relevant and appropriate. These regulations are not applicable because PCB levels at the site have been measured at no greater than 47.2 ppm. However, if PCBs are detected at greater than 50 ppm, any activities regarding storage, transportation, and disposal of such PCB-contaminated soil would be conducted in compliance with these standards.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive 9355.4-01	TBC. This guidance would be considered in evaluating PCB issues as part of the remedial action. Low level of PCBs (47.2 ppm or less) are present within soils at the site.	TBC. This guidance would be considered in evaluating PCB issues as part of the remedial action. Low level of PCBs (47.2 ppm or less) are present within soils at the site.	TBC. Low levels of PCBs (47.2 ppm or less) are present within the soils at the site. This guidance document would be considered in evaluating PCB issues as part of the remedial action.
Air/Superfund National Technical Guidance	EPA Guidance. EPA/450/1-89/001 to EPA/450/1-89/004	Not a TBC.	Not a TBC.	TBC. This guidance would be considered when risks due to air releases from fugitive dust and thermal desorption are being evaluated.

TABLE 6-3

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE TO ACTION-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON, GROTON, CONNECTICUT

STATE OF CONNECTICUT

Requirement	Citation	Status/Action to be Taken		
		Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Solid Waste Management Regulations	RCSA 22a-209-1 through 13	Not an ARAR.	Applicable. After contaminated soil from the "hot spots" are removed, the existing cap would be replaced in accordance with these requirements.	Applicable. After contaminated soils are treated and removed from the site, the area would be closed in accordance with these requirements.
Hazardous Waste Management: Generator and Handler Requirements	RCSA 22a-449(c)100-101	Applicable. For any material generated during monitoring well installation, hazardous waste determinations would be performed and the wastes would be managed in accordance with the requirements of these regulations, if necessary.	Applicable. For all soil excavated from the "hot spots" and generated during monitoring well installation, hazardous waste determinations would be performed and the wastes would be managed in accordance with the requirements of these regulations, if necessary.	Applicable. For all soil excavated, hazardous waste determinations would be performed and the wastes would be managed in accordance with the requirements of these regulations, if necessary.
Hazardous Waste Management Generator Standards	RCSA 22a-449 (c) 102	Not an ARAR.	Applicable. Any hazardous waste generated through excavation, monitoring well installation, or other activities would be managed in accordance with the substantive requirements of these regulations.	Applicable. Any hazardous waste generated through excavation, treatment, or other activities would be managed in accordance with the substantive requirements of these regulations.
Hazardous Waste Management: TSDF Standards	RCSA 22a-449(c)104	Applicable. The remedy would comply with the post-closure requirements of this section through groundwater monitoring and institutional controls at the site.	Applicable. Any hazardous waste which is temporarily stored on this site as part of the "hot spot" excavation or monitoring well installation would be managed in accordance with the requirements of this section. The remedy would comply with the post-closure requirements of this section through groundwater monitoring and institutional controls at the site.	Applicable. Any hazardous waste which is treated or temporarily stored on this site as part of the remedy would be managed in accordance with the requirements of this section.
Hazardous Waste Management Facility Siting Regulations	CGS 22a-117-123 & RCSA 22a-116B-1 through 11	No an ARAR.	Not an ARAR.	Applicable. The requirements are applicable to this alternative's on site treatment of wastes through thermal desorption. The substantive requirements of these regulations would be met.

TABLE 6-3

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE TO ACTION-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status/Action to be Taken		
		Alternative 2: **Institutional Controls & Monitoring**	Alternative 3: **Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring**	Alternative 4: **Excavation, On Site Treatment, & Offsite Disposal**
Control of Noise Regulations	RCSA 22a-69-1 to 69-7.4	Applicable. Noise generated by installation of monitoring wells would meet these regulations. This alternative involves drilling and monitoring activities which are not anticipated to generate excessive noise.	Relevant and appropriate. Noise generated by any remedial actions other than construction would meet the standards of these regulations. This alternative involves excavation and monitoring activities which are not anticipated to generate excessive noise.	Applicable. . Noise generated by any remedial actions other than construction would meet the standards of these regulations. Noise generated by the thermal desorption unit would have to meet the standards in these regulations. Noise from excavation activities is not expected to exceed these standards
Air Pollution Control	RCSA 22a-174	Not an ARAR.	Applicable Emission standards for fugitive dust would be met with dust control measures during excavation, transportation and offsite disposal to comply with substantive requirements.	Applicable. The thermal desorption unit which produces an air discharge would be designed to meet the substantive requirements of these regulations. Emission standards for fugitive dust would be met through dust control measures during excavation, transportation, and offsite disposal to comply with substantive requirements.
Guidelines for Soil Erosion and Sediment Control	*The Connecticut* Council on Soil and Water Conservation	*TBC. Erosion and sedimentation* controls would be implemented during well installation.	*TBC. These guidelines would be* incorporated into any remedial design for this site. Erosion and sedimentation controls would be implemented during excavation, recapping, and well installation.	*TBC. These guidelines would be incorporated* into any remedial design for this site. Erosion and sedimentation controls would be implemented during excavation activities.
Water Pollution Control	RCSA 22a-430-1 to 8	Not an ARAR.	Applicable. No discharge to a POTW is proposed. The quality of the treated water from the on site DW/WWT facility would meet the requirements of this section for discharge to the Thames River. No formal discharge permit would be required.	Applicable. No discharge to a POTW is proposed. The quality of the treated water from the on site DW/WWT facility would meet the requirements of this section for discharge to the Thames River. No formal discharge permit would be required.

TABLE 6-3

DRMO FS
COMPARATIVE ASSESSMENT OF COMPLIANCE TO ACTION-SPECIFIC ARARs AND TBCs
ALTERNATIVES 2, 3, & 4
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status/Action to be Taken		
		Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Remediation Standard Regulations	RCSA 22a-133k-3	Relevant and appropriate. Although no groundwater plume has been identified at this site, the proposed groundwater monitoring would be conducted to determine if any contaminants of concern are migrating offsite at level above CTDEP surface water protection or volatilization standards for GB groundwater. Maintenance of the cap and institutional controls would satisfy the Remediation Standards Regulations for soil.	Relevant and appropriate. Although no groundwater plume has been identified at this site, the proposed groundwater monitoring would be conducted to determine if any contaminants of concern are migrating offsite at level above CTDEP surface water protection or volatilization standards for GB groundwater. Excavation of "hot spots", maintenance of the cap, and institutional controls would satisfy the Remediation Standards Regulations for soil.	Relevant and appropriate. Excavation, on site treatment, and offsite disposal of contaminated soil would satisfy the Remediation Standard Regulations for soil.
Water Quality Standards	CGS 22a-426	Relevant and appropriate. Standards would be used to evaluate monitoring results to determine if further remedial action is required to protect resources.	Applicable. Standards would be used to evaluate monitoring results to determine if further remedial action is required to protect resources. Remedial activities, including the treatment and discharge of wastewater from dewatering would be undertaken in a manner which is consistent with the antidegradation policy in the Water Quality Standards.	Applicable. Remedial activities would be undertaken in a manner which is consistent with the antidegradation policy in the Water Quality Standards.
Disposition of PCBs	CGS 22a-167	Not an ARAR.	Applicable. Low level s of PCBs (47.2 ppm or less) are present within soils at the site. Disposal of PCB-contaminated soil would be conducted in compliance with this statute.	Applicable. Low level s of PCBs (47.2 ppm or less) are present within soils at the site. Disposal of PCB-contaminated soil would be conducted in compliance with this statute.

Alternative 2 would be long-term effective and permanent. Institutional controls, including maintenance of the existing cap, limits to site access, and land use restrictions would effectively and permanently minimize risks from direct exposure of human and ecological receptors to contaminated soil. Long-term monitoring would be effective for the detection of potential migration of soil contaminants to the Thames River which could adversely impact ecological receptors in that river.

Alternative 3 would provide better long-term effectiveness and permanence than Alternative 2 since, in addition to institutional controls and monitoring, it would include removal and offsite disposal of soil "hot spots". Although complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, these remedial actions would effectively and permanently eliminate unacceptable human health risk from direct exposure to soil contaminated above industrial land use PRGs. These remedial actions would also effectively and permanently reduce the potential for soil contaminants to migrate to the Thames River, which could adversely impact ecological receptors in that river.

Alternative 4 would offer the best long-term effectiveness and permanence. All soil contaminated above residential land use, ecological, and surface water protection PRGs would be excavated, treated on site to irreversibly remove and destroy organic COCs and immobilize inorganic COCs, and disposed of at an offsite solid waste disposal facility. Although complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, these remedial actions would effectively and permanently eliminate unacceptable risks to human and ecological receptors from direct exposure to soil under all land use scenario. These remedial actions would also effectively and permanently eliminate the potential for soil contaminants to migrate to the Thames River, which could adversely impact ecological receptors in that river.

6.1.4 <u>Reduction of Toxicity, Mobility, or Volume through Treatment</u>

Alternatives 1 and 2 would not achieve any reduction of toxicity, mobility, or volume of contaminants through treatment. Both alternatives might achieve some reduction of contaminant toxicity and volume through natural attenuation. Alternative 2 would also achieve a slight reduction in contaminant mobility because maintenance of the existing cap would insure continued minimization of infiltration through contaminated soil in the vadose zone.

Alternative 3 would achieve a slight reduction in contaminant toxicity and volume through the on site treatment of the drainage water from the wet excavated soil by the GAC adsorption unit of the DW/WWT facility. Because the GAC would ultimately be either thermally regenerated or destroyed by incineration, the achieved reduction in contaminant toxicity and volume would be 100-percent irreversible. Alternative 3 would also achieve significant reduction of contaminant toxicity, mobility and volume because of excavation and transportation of soil "hot spots" to an offsite RCRA hazardous waste TSD facility. Finally, in the same way as Alternative 2, Alternative 3 would also achieve a slight reduction in contaminant mobility because maintenance of the existing cap would insure continued minimization of infiltration through contaminated soil in the vadose zone

Alternative 4 would significantly reduce contaminant toxicity, mobility, and volume through treatment. On site thermal desorption would remove 90 percent or more of organic COCs in a 100 percent irreversible way. Onsite chemical fixation-solidification would immobilize inorganic COCs in an almost completely irreversible way. However, chemical fixation-stabilization may also increase volume of treated soil by 10 to 15 percent. As Alternative 3, Alternative 4 would also achieve a slight, 100-percent irreversible, reduction in contaminant toxicity and volume through the on site treatment of the drainage water from the wet excavated soil by the GAC adsorption unit of the DW/WWT facility.

6.1.5 Short-term Effectiveness

Implementation of Alternative 1 would not result in risks to site workers or adversely impact the surrounding community or environment since no remedial activities would be performed. Alternative 1 would never achieve the RAOs.

Implementation of Alternative 2 would result in a slight possibility of exposing site workers to contaminated soil during the maintenance of the existing cap and fence and to contaminated soil and groundwater during the construction of new groundwater monitoring wells and the maintenance and sampling of the new and existing wells. However, these risks of exposure would be effectively controlled by wearing of appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternative 2 would not adversely impact the surrounding community and environment. Alternative 2 would immediately achieve the RAOs. However, continued achievement of the RAO for protection of ecological receptors in the Thames River would have to be regularly verified through monitoring.

Implementation of Alternatives 3 and 4 would result in a significant possibility of exposing construction workers to contaminated soil and groundwater during the excavation, dewatering, and offsite transportation activities. Implementation of Alternative 4 would also result in an added possibility of exposing construction workers to contaminated soil and offgas emissions during the thermal desorption and chemical fixation-solidification activities. However, all these risks of exposure would be effectively controlled by the implementation of engineering controls (e.g., dust suppression, offgas treatment), by the wearing of appropriate PPE, and by compliance with applicable OSHA regulations and proper site-specific health and safety procedures. Implementation of Alternative 3 could have some impact on the surrounding community and environment because of the potential for release of fugitive dust and spillage of contaminated soil during excavation and offsite transportation. However, this impact would be adequately controlled through the implementation of appropriate procedures, such as perimeter air monitoring, spill prevention, and erosion and sedimentation controls. Implementation of Alternative 4 could have a slightly greater impact than Alternative 3 on the surrounding community and environment because of the added risk of exposure to offgas from the thermal desorption unit. However, this possible incremental impact would also be adequately controlled through offgas treatment.. Alternative 3 would achieve the RAOs in 5 months but continued achievement of the RAO for protection of ecological receptors in the Thames River would have to be regularly verified through monitoring. Alternative 4 would achieve the RAOs in 7 months.

6.1.6 Implementability

Alternative 1 would be very simple to implement since there would be no remedial action to implement.

Alternative 2 would be simple to implement. Maintenance of the existing cap and fence, posting of notices, and institution of land use restrictions as part of the institutional controls component are all relatively simple tasks which could be readily accomplished. Installation of new wells, maintenance and sampling of new and existing wells, and performance of 5-year reviews as part of the monitoring component could also be readily accomplished. Resources, equipment and materials are available for all of these tasks. The administrative inplementability of institutional controls and monitoring would also be simple as long as the DRMO stays under the Navy control but, even in the unlikely event that this would change, adequate provisions could be relatively easily incorporated in any property transfer documents to insure continuation of these controls and monitoring under civilian ownership.

Alternative 3 would be significantly more difficult to implement than Alternative 2. This alternative would require excavation of non-cohesive soil (i.e., sand and gravel) to a depth of up to 10 feet bgs, which is well below the groundwater table. This would raise two significant implementability concerns. First, the excavated areas would have to be extensively shored with sheet piling and, second, water would have to be allowed to accumulate within the excavated areas, which would significantly hinder excavation efficiency. These concerns aside, excavation could be performed with normal construction equipment which is readily available. Installation and operation of a DW/WWT facility for the on site dewatering of wet soil and treatment of drainage water could be implemented with readily available resources, equipment, and material. Offsite disposal of excavated soil would be readily implementable since permitted RCRA hazardous waste TSD facilities with adequate capacity are available to receive this kind of waste material. The institutional controls and monitoring components of Alternative 3 would be identical to and as readily implementable as those of Alternative 2. The administrative implementability of Alternative 3 would be very similar to that of Alternative 2 with the difference that the proper State agencies would have to be consulted to determine treatment criteria for discharge of the drainage water to the Thames River and that offsite disposal of excavated soil would have to meet all applicable RCRA regulations, including manifesting of the shipments of excavated soil. Both of these additional administrative requirements could readily be accomplished.

Alternative 4 would be the most difficult to implement. The significant concerns about implementability of the excavation component of this alternative would be identical to those of the same component for Alternative 3. As with Alternative 3, on site dewatering of wet soil and treatment of the drainage water would be readily implementable. For the onsite treatment component, although thermal desorption services are readily available, the number of contractors with experience for treatment of PCB contaminated waste may be relatively limited. The balance of the on site treatment component would be easily implementable since experienced chemical fixation-solidification contractors are readily available. There would be no institutional controls and monitoring to implement. The administrative implementability of Alternative 4 would be comparable to that of Alternative 3 with the additional requirement that the appropriate State agencies would have to be contacted to determine acceptable air emissions for the thermal desorption unit, which could be accomplished relatively easily.

6.1.7 Cost

The capital, total operating and maintenance (O&M) cost over 30 years, and 30-year net present-worth (NPW) costs of the alternatives are presented in the following table and ranked according to the 30-year NPW cost.

Alternative	Capital ($)	30-year O&M ($)	30-year NPW ($)
1	0	0	0
2	90,814	617,580	708,394
3	4,363,156	617,580	4,980,736
4	16,128,927	0	16,128,927

The total operating costs shown for Alternatives 2 and 3 are for groundwater monitoring only and include a $20,000 lump sum amount at the end of the third year of monitoring for final site reviews and report preparation. The 30-year NPW costs for Alternatives 2 and 3 include the performance of 5-year reviews for 30 years.

6.2 SUMMARY OF COMPARATIVE ANALYSIS

Table 6-4 summarizes the comparative analysis of the 4 remedial alternatives.

TABLE 6-4

DRMO FS
SUMMARY OF COMPARATIVE EVALUATION OF ALTERNATIVES
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 4

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Threshold Criteria				
Overall Protection of Human Health and Environment	Would provide some protection of human health and the environment because the existing cap would reduce the risks from exposure to contaminated soil. However, since the cap would not be maintained and no monitoring would be performed, this protection would not be permanent and its effectiveness could not be evaluated.	Would be protective of human health and the environment by minimizing risks from exposure to contaminated soil by maintaining the existing cap, limiting site access, and restricting future land uses. Would also be protective of human health and the environment through monitoring to verify the continued absence of contaminant migration from soil to the groundwater and Thames River.	Would be more protective of human and the environment than Alternative 2 by providing the same protective components plus permanent elimination of risks from exposure to soil contaminated above PRGs for the current industrial land use through excavation and offsite disposal of that soil.	Would be most protective of human health and the environment by permanently eliminating risks of exposure to soil contaminated above the very conservative PRGs for future residential land use through excavation, on site treatment, and offsite disposal of that soil.
Compliance with ARARs & TBCs:				
Chemical-Specific	Would not comply	Would comply	Would comply	Would comply
Location-Specific	Would not comply	Would comply	Would comply	Would comply
Action-Specific	Not applicable	Would comply	Would comply	Would comply

TABLE 6-4

DRMO FS
SUMMARY OF COMPARATIVE EVALUATION OF ALTERNATIVES
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 4

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Primary Balancing Criteria				
Long-term Effectiveness and Permanence	Would not be long-term effective and permanent. The protection provided by the existing cap would not be permanent because the cap would not be maintained . The long-term effectiveness of the cap would be unknown because no monitoring would be performed.	Would be long-term effective and permanent. Institutional controls, including maintenance of the cap, would be effective in the long-term through permanent minimization of risks from exposure to contaminated soil. Monitoring would effectively and permanently reduce risks from potential migration of contaminants from soil to the groundwater and Thames River though monitoring which would detect this potential migration in time for corrective action to be taken, if necessary.	Would provide better long-term effectiveness and permanence. As in Alternative 2, all risks from exposure to contaminated soil and potential future contaminant migration would be effectively and permanently minimized through institutional controls and monitoring. In addition, risks from exposure to soil contaminated above PRGs for current industrial land use and from potential future migration of contaminants from that soil would be effectively and permanently eliminated through excavation and offsite disposal.	Would provide the best long-term effectiveness and permanence. Risks from exposure to soil contaminated above the very conservative PRGs for future residential land use and from potential future migration of contaminants from that soil would effectively and permanently be eliminated through excavation, on site treatment, and offsite disposal.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	No reduction of contaminant toxicity, mobility, or volume through treatment.	No reduction of contaminant toxicity, mobility, or volume through treatment.	Minimal reduction of contaminant toxicity, mobility, or volume through treatment of drainage water from dewatering operations	Near complete and 100% irreversible reduction of organic contaminant toxicity, mobility, and volume through on site thermal desorption. Near complete and irreversible reduction of inorganic contaminant mobility through on site chemical fixation-solidification.

TABLE 6-4

DRMO FS
SUMMARY OF COMPARATIVE EVALUATION OF ALTERNATIVES
NSB-NLON, GROTON, CONNECTICUT

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Short-term Effectiveness	Implementation of this alternative would not result in any short-term risks to workers or impacts to the community and environment since no remedial action would take place. The RAOs would never be met	Implementation of this alternative would result in minor short-term risks to workers involved in cap maintenance and installation of new monitoring wells due to potential exposure to contaminated soil. These risks would be minimized by wearing of PPE and complying with H&S procedures. There would be no short-term adverse impacts to community or environment. RAOs would be achieved immediately.	Implementation of this alternative would result in significant short-term risks to workers due to potential exposure to contaminated soil during excavation, dewaterng, and offsite transportation and disposal activities. Exposure would be minimized by implementation of engineering controls, wearing of PPE, and complying with H&S procedures. Some short-term impacts to the community and environment could result from fugitive dust from the site and spillage during transportation. These impacts would be minimized by implementation of engineering controls. RAOs would be achieved in 5 months.	Implementation of this alternative would result in the highest potential for short-term risks to workers and impacts to the community and environment. Risks to workers would be due to exposure to contaminated soil and offgas during excavation, dewatering, on site treatment, and offsite transportation an disposal activities. Exposure would be minimized by implementation of engineering controls, wearing of PPE, and complying with H&S procedures. Impacts to the community and environment could result from fugitive dust and thermal desorption offgas and from spillage during transportation. These impact swould be minimized by implementation of engineering controls. RAOs would be achieved in 7 months.
Implementability	Would be easily implemntable as there would be nothing to implement.	Would be easily implementable as long as the DRMO stays under military control. In case of transfer of the site to private ownership, continued implementation of institutional controls and monitoring would require special provisions in the property transfer documents.	Would be difficult to implement because depth of excavation would require shoring and water would accumulate in the excavation. This aside, excavation could be performed with normal construction equipment. RCRA TSDFs are available for disposal of excavated soil. Administratively, the substantive requirements of a RCRA TSDF and NPDES permit would have to be met for performance of on site remedial activities and surface discharge of the treated drainage water, respectively. RCRA regulations would also have to be met for offsite transportation of excavated soil.	Would be the most difficult to implement. Implementation of excavation would be subject to the same significant concerns as for Alternative 3. The number thermal desorption contractors with PCB removal experience would be limited. Experienced fixation-solidification contractors would be readily available. Solid waste landfills would be readily available for the disposal of treated soil. Administratively, the substantive requirements of a RCRA TSDF and NPDES permit would have to be met for performance of on site remedial activities and surface discharge of the treated drainage water, respectively. The substantive requirements of applicable air pollution controls regulations would also have to be met for the thermal desorption offgas.

TABLE 6-4

DRMO FS
SUMMARY OF COMPARATIVE EVALUATION OF ALTERNATIVES
NSB-NLON, GROTON, CONNECTICUT

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Institutional Controls & Monitoring	Alternative 3: Hot Spots Excavation, Offsite Disposal, Institutional Controls, & Monitoring	Alternative 4: Excavation, On Site Treatment, & Offsite Disposal
Costs:				
Capital	$0	$90,814	$4,363,156	$16,128,927
O&M For 30 Years	$0	$617,580	$617,580	$0
30-Year Net Present Worth	$0	$708,394	$4,980,736	$16,128,927

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APPENDIX A

PRG DEVELOPMENT

REVISED SELECTION OF SOIL COCS

FOR RISK ASSESSMENT

NEW SELECTION OF SOIL COCs FOR QUANTITATIVE RISK ASSESSMENT
DEFENSE REUTILIZATION AND MARKETING OFFICE
NSB-NLON, GROTON, CONNECTICUT

CHEMICAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION (mg/kg)	RISK-BASED SCREENING LEVEL* (mg/kg)	BACKGROUND (mg/kg)	COC?/RATIONALE
1,1-Dichloroethane	3/71	0.00625	780	NA	No/2
1,2-Dichloroethane	4/71	1.9	7	NA	No/2
1,1-Dichloroethene	1/71	0.013	1.1	NA	No/2
1,2-Dichloroethene (total)	2/29	16	70	NA	No/2
2-Butanone	7/71	0.0144	4700	NA	No/2
Acetone	31/71	1.63	780	NA	No/2
Benzene	3/71	0.007	22	NA	No/2
Carbon Disulfide	6/71	0.048	780	NA	No/2
Chloroethane	1/71	0.00155	3100	NA	No/2
Chloroform	1/71	0.014	100	NA	No/2
Ethylbenzene	4/71	0.044	780	NA	No/2
2-Hexanone	1/71	0.00303	NA	NA	No/1
Methylene Chloride	40/71	0.427	85	NA	No/2
4-Methyl-2-pentanone	1/71	0.00121	630	NA	No/2
4-Methylphenol	2/70	0.79	39	NA	No/2
Styrene	4/71	0.00259	1600	NA	No/2
1,1,2,2-Tetrachloroethane	2/71	6.4	3.2	NA	Yes/3
Tetrachloroethene	16/71	0.21	12	NA	No/2
Toluene	17/71	0.043	1600	NA	No/2
1,1,2-Trichloroethane	1/71	0.59	11	NA	No/2
Trichloroethene	32/71	7.1	58	NA	No/2
Vinyl chloride	2/71	1.3	0.34	NA	Yes/3
Xylenes, Total	11/71	0.34	16000	NA	No/2
1,3-Dichlorobenzene	1/70	1.06	700	NA	No/2
1,2,4-Trichlorobenzene	2/70	4.94	78	NA	No/2
2-Methylnaphthalene	11/70	8.36	NA	NA	No/1
Acenaphthene	8/70	13.7	470	NA	No/2
Acenaphthylene	12/70	5.6	NA	NA	No/1
Anthracene	34/70	29.3	2300	NA	No/2
Benzo(a)anthracene	44/70	43.7	0.88	NA	Yes/3
Benzo(a)pyrene	36/70	40.6	0.088	NA	Yes/3
Benzo(b)fluoranthtene	45/70	78.6	0.88	NA	Yes/3
Benzo(g,h,i)perylene	25/69	11	NA	NA	No/1
Benzo(k)fluoranthene	34/69	19.4	8.8	NA	Yes/3
Benzoic Acid	4/19	12	31000	NA	No/2
Bis(2-ethylhexyl)phthalate	39/70	12.5	46	NA	No/2
Butyl benzyl phthalate	1/70	0.423	1600	NA	No/2
Carbazole	9/53	14.2	32	NA	No/2

NEW SELECTION OF SOIL COCs FOR QUANTITATIVE RISK ASSESSMENT
DEFENSE REUTILIZATION AND MARKETING OFFICE
NSB-NLON, GROTON, CONNECTICUT

CHEMICAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION (mg/kg)	RISK-BASED SCREENING LEVEL* (mg/kg)	BACKGROUND (mg/kg)	COC?/RATIONALE
Chrysene	47/70	47.1	88	NA	No/2
Dibenzo(a,h)anthracene	2/69	1.16	0.088	NA	Yes/3
Dibenzofuran	6/70	14.3	31	NA	No/2
Fluoranthene	52/70	95.1	310	NA	No/2
Fluorene	11/70	19.2	310	NA	No/2
Indeno(1,2,3-cd)pyrene	25/69	9.29	0.88	NA	Yes/3
Naphthalene	7/70	23.7	310	NA	No/2
Phenanthrene	42/70	96.9	NA	NA	No/1
Pyrene	55/70	174	230	NA	No/2
Dioxins	1/1	0.0000098	0.0000041	NA	Yes/3
4,4'-DDD	3/71	0.227	2.7	NA	No/2
4,4'-DDE	4/71	0.0359	1.9	NA	No/2
4,4'-DDT	7/71	0.0634	1.9	NA	No/2
Aroclors (1254+1260)	39/71	51.5	0.319	NA	Yes/3
Hexachlorobiphenyl	1/1	3.16	0.319	NA	Yes/3
Delta-BHC	1/71	0.00509	NA	NA	No/1
Dieldrin	1/71	0.00468	0.04	NA	No/2
Endosulfan II ,	2/71	0.0254	47	NA	No/2
Endosulfane Sulfate	2/71	0.0379	NA	NA	No/1
Endrin	3/71	0.0125	23	NA	No/2
Endrin Aldehyde	6/54	0.00686	NA	NA	No/1
Endrin Ketone	3/71	0.0319	NA	NA	No/1
Gamma-Chlordane	3/71	0.0204	0.49	NA	No/2
Heptachlor Epoxide	5/71	0.0207	0.07	NA	No/2
Aluminum	71/71	18900	7800	17600	No/4
Antimony	38/50	134	3.1	2.05	Yes/3
Arsenic	70/71	16.4	0.43	3.6	Yes/3
Barium	71/71	934	550	57.2	Yes/3
Beryllium	68/71	24.9	0.15	0.72	Yes/3
Boron	3/12	60.2	700	3.1	No/2
Cadmium	65/71	126	3.9	0.24	Yes/3
Calcium	71/71	16300	NA	499	No/1
Chromium	69/71	1210	39 (Cr VI)	21.5	Yes/3
Cobalt	69/71	179	470	8	No/2
Copper	71/71	8730	310	25.6	No/4
Cyanide	28/68	7.68	160	NA	No/2
Iron	71/71	103000	2300	17200	N[illegible]
Lead	71/71	5980	400**	17.5	Ye[illegible]

NEW SELECTION OF SOIL COCs FOR QUANTITATIVE RISK ASSESSMENT
DEFENSE REUTILIZATION AND MARKETING OFFICE
NSB-NLON, GROTON, CONNECTICUT

CHEMICAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION (mg/kg)	RISK-BASED SCREENING LEVEL* (mg/kg)	BACKGROUND (mg/kg)	COC?/RATIONALE
Magnesium	71/71	7190	NA	3650	No/1
Manganese	71/71	1260	180	188	Yes/3
Mercury	63/70	20.7	2.3	0.05	Yes/3
Nickel	71/71	1250	160	5.95	Yes/3
Potassium	71/71	6520	NA	2580	No/1
Selenium	18/71	1	39	0.445	No/2
Silver	33/71	24.3	39	0.385	No/2
Sodium	67/71	5860	NA	20.5	No/1
Thallium	15/71	0.64	0.55 (oxide)	0.29	Yes/3
Vanadium	71/71	368	55	35.1	Yes/3
Zinc	71/71	28300	2300	31.3	Yes/3

* For residential use, based on a target hazard quotient of 0.1 or an incremental cancer risk of 1E-6 (USEPA, Region III, March 1997)
** OSWER soil screening level for residential land use (USEPA, July 14, 1994).

Rationale Designations:
1 = No toxicity criteria available.
2 = Maximum is less than the COC screening level.
3 = Maximum is greater than the COC screening level.
4 = USEPA Region I does not recommend evaluation.

REVISED HUMAN HEALTH

RISK ASSESSMENT

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL RME INGESTION
FULL TIME EMPLOYEE

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation		Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane					0.00E+00				0.00E+00
Vinyl Chloride					0.00E+00				0.00E+00
Benzo(a)anthracene	4.90E-07				4.90E-07	3.2	12.300		1.88E-06
Benzo(a)pyrene	6.12E-06				6.12E-06	4	8.810		1.35E-05
Benzo(b)fluoranthene	4.13E-07				4.13E-07	2.7	8.870		1.36E-06
Benzo(k)fluoranthene					0.00E+00		13.800		2.11E-07
Dibenzo(a,h)anthracene					0.00E+00				0.00E+00
Dibenzofuran					0.00E+00				0.00E+00
Indeno(1,2,3-cd)pyrene	5.51E-07				5.51E-07	3.6	3.600		5.51E-07
Aroclors	4.62E-06				4.62E-06	11	40.400		1.70E-05
1,2,3,4,6,7,8-HPCDD					0.00E+00				0.00E+00
Antimony					0.00E+00	19.2	134.000		0.00E+00
Arsenic	8.81E-07				8.81E-07	2.8	5.780		1.82E-06
Barium					0.00E+00		242.000		0.00E+00
Beryllium	5.50E-07				5.50E-07	0.61	1.730		1.56E-06
Cadmium					0.00E+00	4.1	22.800		0.00E+00
Chromium					0.00E+00	28.4	1210.000		0.00E+00
Manganese					0.00E+00	260	302.000		0.00E+00
Mercury					0.00E+00		1.730		0.00E+00
Nickel					0.00E+00		97.700		0.00E+00
Thallium					0.00E+00	0.64	0.640		0.00E+00
Vanadium					0.00E+00		88.400		0.00E+00
Zinc					0.00E+00	28300	9209.0		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	1.36E-05	0.00E+00	0.00E+00	Total:	1.36E-05			Total:	3.78E-05

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation		Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane					0.00E+00				0.00E+00
Vinyl Chloride					0.00E+00				0.00E+00
Benzo(a)anthracene					0.00E+00	3.2	12.300		0.00E+00
Benzo(a)pyrene					0.00E+00	4	8.810		0.00E+00
Benzo(b)fluoranthene					0.00E+00	2.7	8.870		0.00E+00
Benzo(k)fluoranthene					0.00E+00		13.800		0.00E+00
Dibenzo(a,h)anthracene					0.00E+00				0.00E+00
Dibenzofuran					0.00E+00				0.00E+00
Indeno(1,2,3-cd)pyrene					0.00E+00	3.6	3.600		0.00E+00
Aroclors	3.23E-01				3.23E-01	11	40.400		1.19E+00
1,2,3,4,6,7,8-HPCDD					0.00E+00				0.00E+00
Antimony	2.82E-02				2.82E-02	19.2	134.000		1.97E-01
Arsenic	5.48E-03				5.48E-03	2.8	5.780		1.13E-02
Barium					0.00E+00		242.000		2.03E-03
Beryllium	7.16E-05				7.16E-05	0.61	1.730		2.03E-04
Cadmium	4.81E-03				4.81E-03	4.1	22.800		2.67E-02
Chromium	3.33E-03				3.33E-03	28.4	1210.000		1.42E-01
Manganese	6.35E-03				6.35E-03	260	302.000		7.38E-03
Mercury					0.00E+00		1.730		3.39E-03
Nickel					0.00E+00		97.700		2.87E-03
Thallium	4.70E-03				4.70E-03	0.64	0.640		4.70E-03
Vanadium					0.00E+00		88.400		7.41E-03
Zinc	5.54E-02				5.54E-02	28300	9209.0		1.80E-02
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	4.31E-01	0.00E+00	0.00E+00	Total:	4.31E-01			Total:	1.61E+00

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL RME DERMAL
FULL TIME EMPLOYEE

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Aroclors		1.05E-05		1.05E-05	11	40.400	3.86E-05
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium				0.00E+00	4.1	22.800	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	1.05E-05	0.00E+00	Total: 1.05E-05			Total: 3.86E-05

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Aroclors		7.36E-01		7.36E-01	11	40.400	2.70E+00
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		3.66E-02		3.66E-02	4.1	22.800	2.04E-01
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	7.73E-01	0.00E+00	Total: 7.73E-01			Total: 2.91E+00

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL RME INGESTION
CONSTRUCTION WORKER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	4.12E-08			4.12E-08	6.4	0.074	4.75E-10
Vinyl Chloride	7.95E-08			7.95E-08	1.3	0.060	3.68E-09
Benzo(a)anthracene	7.52E-08			7.52E-08	3.2	9.132	2.15E-07
Benzo(a)pyrene	9.40E-07			9.40E-07	4	10.487	2.46E-06
Benzo(b)fluoranthene	6.35E-08			6.35E-08	2.7	12.523	2.95E-07
Benzo(k)fluoranthene	5.88E-08			5.88E-08	25	12.683	2.98E-08
Dibenzo(a,h)anthracene	3.06E-08			3.06E-08	0.13	1.160	2.73E-07
Indeno(1,2,3-cd)pyrene	8.46E-08			8.46E-08	3.6	9.290	2.18E-07
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	8.00E-07			8.00E-07	12.4	3.160	2.04E-07
Aroclors (1254 + 1260)	8.00E-07			8.00E-07	12.4	13.124	8.47E-07
Dioxins (HPCDD + OCDD)	3.37E-08			3.37E-08	0.00067	0.00098	4.91E-08
Antimony	0.00E+00			0.00E+00	19.2	70.700	0.00E+00
Arsenic	1.64E-07			1.64E-07	3.4	4.900	2.36E-07
Barium	0.00E+00			0.00E+00		216.400	0.00E+00
Beryllium	9.14E-08			9.14E-08	0.66	2.700	3.74E-07
Cadmium	0.00E+00			0.00E+00	6.7	12.600	0.00E+00
Chromium	0.00E+00			0.00E+00	30	59.000	0.00E+00
Manganese	0.00E+00			0.00E+00	284	335.100	0.00E+00
Mercury	0.00E+00			0.00E+00		1.060	0.00E+00
Nickel	0.00E+00			0.00E+00		113.600	0.00E+00
Thallium	0.00E+00			0.00E+00	0.64	0.640	0.00E+00
Vanadium	0.00E+00			0.00E+00	34.6	70.000	0.00E+00
Zinc	0.00E+00			0.00E+00	28300	8421.0	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	3.26E-06	0.00E+00	0.00E+00	Total: 3.26E-06			Total: 5.21E-06

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	0.00E+00			0.00E+00	6.4	0.074	0.00E+00
Vinyl Chloride	0.00E+00			0.00E+00	1.3	0.060	0.00E+00
Benzo(a)anthracene	0.00E+00			0.00E+00	3.2	9.132	0.00E+00
Benzo(a)pyrene	0.00E+00			0.00E+00	4	10.487	0.00E+00
Benzo(b)fluoranthene	0.00E+00			0.00E+00	2.7	12.523	0.00E+00
Benzo(k)fluoranthene	0.00E+00			0.00E+00		12.683	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00			0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00			0.00E+00	3.6	9.290	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	1.40E+00			1.40E+00	12.4	3.160	3.57E-01
Aroclors (1254 + 1260)	1.40E+00			1.40E+00	12.4	13.124	1.48E+00
Dioxins (HPCDD + OCDD)	0.00E+00			0.00E+00	0.00067	0.00098	0.00E+00
Antimony	1.08E-01			1.08E-01	19.2	70.700	3.98E-01
Arsenic	2.55E-02			2.55E-02	3.4	4.900	3.68E-02
Barium	5.89E-03			5.89E-03	183	216.400	6.97E-03
Beryllium	2.98E-04			2.98E-04	0.66	2.700	1.22E-03
Cadmium	3.02E-02			3.02E-02	6.7	12.600	5.68E-02
Chromium	1.35E-02			1.35E-02	30	59.000	2.66E-02
Manganese	2.67E-02			2.67E-02	284	335.100	3.15E-02
Mercury	2.44E-02			2.44E-02	3.25	1.060	7.96E-03
Nickel	4.22E-02			4.22E-02	374	113.600	1.28E-02
Thallium	1.80E-02			1.80E-02	0.64	0.640	1.80E-02
Vanadium	1.11E-02			1.11E-02	34.6	70.000	2.25E-02
Zinc	2.13E-01			2.13E-01	28300	8421.0	6.34E-02
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	3.32E+00	0.00E+00	0.00E+00	Total: 3.32E+00			Total: 2.52E+00

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL RME DERMAL
CONSTRUCTION WORKER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		3.79E-07		3.79E-07	12.4	3.160	9.66E-08
Aroclors (1254 + 1260)		3.79E-07		3.79E-07	12.4	13.124	4.01E-07
Dioxins (HPCDD + OCDD)		8.86E-09		8.86E-09	0.00067	0.00098	1.30E-08
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium				0.00E+00	6.7	12.600	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	7.67E-07	0.00E+00	Total: 7.67E-07			Total: 5.11E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		6.64E-01		6.64E-01	12.4	3.160	1.69E-01
Aroclors (1254 + 1260)		6.64E-01		6.64E-01	12.4	13.124	7.03E-01
Dioxins (HPCDD + OCDD)				0.00E+00	0.00067	0.00098	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		4.78E-02		4.78E-02	6.7	12.600	8.99E-02
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	1.38E+00	0.00E+00	Total: 1.38E+00			Total: 9.62E-01

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL RME INHALATION
CONSTRUCTION WORKER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation		Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane			2.45E-10		2.45E-10	6.4	0.074		2.83E-12
Vinyl Chloride			7.35E-11		7.35E-11	1.3	0.060		3.40E-12
Benzo(a)anthracene					0.00E+00	3.2	9.132		0.00E+00
Benzo(a)pyrene					0.00E+00	4	10.487		0.00E+00
Benzo(b)fluoranthene					0.00E+00	2.7	12.523		0.00E+00
Benzo(k)fluoranthene			2.87E-10		2.87E-10	25	12.683		1.46E-10
Dibenzo(a,h)anthracene					0.00E+00	0.13	1.160		0.00E+00
Indeno(1,2,3-cd)pyrene					0.00E+00	3.6	9.290		0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl					0.00E+00		3.160		0.00E+00
Aroclors (1254 + 1260)					0.00E+00	12.4	13.124		0.00E+00
Dioxins (HPCDD + OCDD)					0.00E+00	0.00067	0.00098		0.00E+00
Antimony					0.00E+00	19.2	70.700		0.00E+00
Arsenic			9.67E-09		9.67E-09	3.4	4.900		1.39E-08
Barium			0		0.00E+00		216.400		0.00E+00
Beryllium			1.04E-09		1.04E-09	0.66	2.700		4.25E-09
Cadmium			7.95E-09		7.95E-09	6.7	12.600		1.50E-08
Chromium			2.37E-07		2.37E-07	30	59.000		4.66E-07
Manganese					0.00E+00	284	335.100		0.00E+00
Mercury			0		0.00E+00		1.060		0.00E+00
Nickel			0		0.00E+00		113.600		0.00E+00
Thallium					0.00E+00	0.64	0.640		0.00E+00
Vanadium					0.00E+00	34.6	70.000		0.00E+00
Zinc					0.00E+00	28300	8421.0		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	0.00E+00	0.00E+00	2.56E-07	Total:	2.56E-07			Total:	4.99E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation		Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane					0.00E+00	6.4	0.074		0.00E+00
Vinyl Chloride					0.00E+00	1.3	0.060		0.00E+00
Benzo(a)anthracene					0.00E+00	3.2	9.132		0.00E+00
Benzo(a)pyrene					0.00E+00	4	10.487		0.00E+00
Benzo(b)fluoranthene					0.00E+00	2.7	12.523		0.00E+00
Benzo(k)fluoranthene			0		0.00E+00		12.683		0.00E+00
Dibenzo(a,h)anthracene					0.00E+00	0.13	1.160		0.00E+00
Indeno(1,2,3-cd)pyrene					0.00E+00	3.6	9.290		0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl					0.00E+00		3.160		0.00E+00
Aroclors (1254 + 1260)					0.00E+00	12.4	13.124		0.00E+00
Dioxins (HPCDD + OCDD)					0.00E+00	0.00067	0.00098		0.00E+00
Antimony					0.00E+00	19.2	70.700		0.00E+00
Arsenic					0.00E+00	3.4	4.900		0.00E+00
Barium			1.69E-02		1.69E-02	183	216.400		2.00E-02
Beryllium					0.00E+00	0.66	2.700		
Cadmium			1.55E-03		1.55E-03	6.7	12.600		2.91E-03
Chromium					0.00E+00	30	59.000		0.00E+00
Manganese					0.00E+00	284	335.100		0.00E+00
Mercury			4.90E-04		4.90E-04	3.25	1.060		1.60E-04
Nickel			0		0.00E+00		113.600		0.00E+00
Thallium					0.00E+00	0.64	0.640		0.00E+00
Vanadium					0.00E+00	34.6	70.000		0.00E+00
Zinc					0.00E+00	28300	8421.0		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	0.00E+00	0.00E+00	1.89E-02	Total:	1.89E-02			Total:	2.31E-02

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL RME INGESTION
OLDER CHILD TRESPASSER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane				0.00E+00			0.00E+00
Vinyl Chloride				0.00E+00			0.00E+00
Benzo(a)anthracene	2.55E-07			2.55E-07	3.2	12.300	9.80E-07
Benzo(a)pyrene	3.19E-06			3.19E-06	4	8.810	7.03E-06
Benzo(b)fluoranthene	2.15E-07			2.15E-07	2.7	8.870	7.06E-07
Benzo(k)fluoranthene	0.00E+00			0.00E+00		13.800	1.10E-07
Dibenzo(a,h)anthracene				0.00E+00			0.00E+00
Dibenzofuran				0.00E+00			0.00E+00
Indeno(1,2,3-cd)pyrene	2.87E-07			2.87E-07	3.6	3.600	2.87E-07
Aroclors	2.40E-06			2.40E-06	11	40.400	8.81E-06
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
Antimony				0.00E+00	19.2	134.000	0.00E+00
Arsenic	4.59E-07			4.59E-07	2.8	5.780	9.48E-07
Barium	0.00E+00			0.00E+00		242.000	0.00E+00
Beryllium	2.86E-07			2.86E-07	0.61	1.730	8.11E-07
Cadmium				0.00E+00	4.1	22.800	0.00E+00
Chromium				0.00E+00	28.4	1210.000	0.00E+00
Manganese				0.00E+00	260	302.000	0.00E+00
Mercury	0.00E+00			0.00E+00		1.730	0.00E+00
Nickel	0.00E+00			0.00E+00		97.700	0.00E+00
Thallium				0.00E+00	0.64	0.640	0.00E+00
Vanadium	0.00E+00			0.00E+00		88.400	0.00E+00
Zinc				0.00E+00	28300	9209.0	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	7.09E-06	0.00E+00	0.00E+00	Total: 7.09E-06			Total: 1.97E-05

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane				0.00E+00			0.00E+00
Vinyl Chloride				0.00E+00			0.00E+00
Benzo(a)anthracene				0.00E+00	3.2	12.300	0.00E+00
Benzo(a)pyrene				0.00E+00	4	8.810	0.00E+00
Benzo(b)fluoranthene				0.00E+00	2.7	8.870	0.00E+00
Benzo(k)fluoranthene	0.00E+00			0.00E+00		13.800	0.00E+00
Dibenzo(a,h)anthracene				0.00E+00			0.00E+00
Dibenzofuran				0.00E+00			0.00E+00
Indeno(1,2,3-cd)pyrene				0.00E+00	3.6	3.600	0.00E+00
Aroclors	4.21E-01			4.21E-01	11	40.400	1.55E+00
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
Antimony	3.67E-02			3.67E-02	19.2	134.000	2.56E-01
Arsenic	7.14E-03			7.14E-03	2.8	5.780	1.47E-02
Barium	0.00E+00			0.00E+00		242.000	2.64E-03
Beryllium	9.33E-05			9.33E-05	0.61	1.730	2.65E-04
Cadmium	6.27E-03			6.27E-03	4.1	22.800	3.49E-02
Chromium	4.34E-03			4.34E-03	28.4	1210.000	1.85E-01
Manganese	8.29E-03			8.29E-03	260	302.000	9.63E-03
Mercury	0.00E+00			0.00E+00		1.730	4.41E-03
Nickel	0.00E+00			0.00E+00		97.700	3.73E-03
Thallium	6.12E-03			6.12E-03	0.64	0.640	6.12E-03
Vanadium	0.00E+00			0.00E+00		88.400	9.66E-03
Zinc	7.21E-02			7.21E-02	28300	9209.0	2.35E-02
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	5.62E-01	0.00E+00	0.00E+00	Total: 5.62E-01			Total: 2.10E+00

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL RME DERMAL
OLDER CHILD TRESPASSER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation		Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Aroclors		4.55E-06			4.55E-06	11	40.400		1.67E-05
1,2,3,4,6,7,8-HPCDD					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Cadmium					0.00E+00	4.1	22.800		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	0.00E+00	4.55E-06	0.00E+00	Total:	4.55E-06			Total:	1.67E-05

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation		Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Aroclors		7.95E-01			7.95E-01	11	40.400		2.92E+00
1,2,3,4,6,7,8-HPCDD					0.00E+00		0.00067		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Cadmium		3.95E-02			3.95E-02	4.1	22.800		2.20E-01
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	0.00E+00	8.35E-01	0.00E+00	Total:	8.35E-01			Total:	3.14E+00

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL RME INGESTION
FUTURE RESIDENT (ADULT/CHD)

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	8.59E-07			8.59E-07	6.4	0.074	9.91E-09
Vinyl Chloride	1.66E-06			1.66E-06	1.3	0.060	7.67E-08
Benzo(a)anthracene	1.57E-06			1.57E-06	3.2	9.132	4.48E-06
Benzo(a)pyrene	1.96E-05			1.96E-05	4	10.487	5.14E-05
Benzo(b)fluoranthene	1.32E-06			1.32E-06	2.7	12.523	6.12E-06
Benzo(k)fluoranthene	1.22E-06			1.22E-06	25	12.683	6.19E-07
Dibenzo(a,h)anthracene	6.37E-07			6.37E-07	0.13	1.160	5.68E-06
Indeno(1,2,3-cd)pyrene	1.76E-06			1.76E-06	3.6	9.290	4.54E-06
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	1.66E-05			1.66E-05	12.4	3.160	4.23E-06
Aroclors (1254 + 1260)	1.66E-05			1.66E-05	12.4	13.124	1.76E-05
Dioxins (HPCDD + OCDD)	7.01E-07			7.01E-07	0.00067	0.00098	1.02E-06
Antimony	0.00E+00			0.00E+00	19.2	70.700	0.00E+00
Arsenic	3.42E-06			3.42E-06	3.4	4.900	4.93E-06
Barium	0.00E+00			0.00E+00		216.400	0.00E+00
Beryllium	1.90E-06			1.90E-06	0.66	2.700	7.77E-06
Cadmium	0.00E+00			0.00E+00	6.7	12.600	0.00E+00
Chromium	0.00E+00			0.00E+00	30	59.000	0.00E+00
Manganese	0.00E+00			0.00E+00	284	335.100	0.00E+00
Mercury	0.00E+00			0.00E+00		1.060	0.00E+00
Nickel	0.00E+00			0.00E+00		113.600	0.00E+00
Thallium	0.00E+00			0.00E+00	0.64	0.640	0.00E+00
Vanadium	0.00E+00			0.00E+00	34.6	70.000	0.00E+00
Zinc	0.00E+00			0.00E+00	28300	8421.0	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	6.78E-05	0.00E+00	0.00E+00	Total: 6.78E-05			Total: 1.08E-04

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	0.00E+00			0.00E+00	6.4	0.074	0.00E+00
Vinyl Chloride	0.00E+00			0.00E+00	1.3	0.060	0.00E+00
Benzo(a)anthracene	0.00E+00			0.00E+00	3.2	9.132	0.00E+00
Benzo(a)pyrene	0.00E+00			0.00E+00	4	10.487	0.00E+00
Benzo(b)fluoranthene	0.00E+00			0.00E+00	2.7	12.523	0.00E+00
Benzo(k)fluoranthene	0.00E+00			0.00E+00		12.683	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00			0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00			0.00E+00	3.6	9.290	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	9.71E-01			9.71E-01	12.4	3.160	2.47E-01
Aroclors (1254 + 1260)	9.71E-01			9.71E-01	12.4	13.124	1.03E+00
Dioxins (HPCDD + OCDD)	0.00E+00			0.00E+00	0.00067	0.00098	0.00E+00
Antimony	7.51E-02			7.51E-02	19.2	70.700	2.77E-01
Arsenic	1.77E-02			1.77E-02	3.4	4.900	2.55E-02
Barium	4.09E-03			4.09E-03	183	216.400	4.84E-03
Beryllium	2.07E-04			2.07E-04	0.66	2.700	8.47E-04
Cadmium	2.10E-02			2.10E-02	6.7	12.600	3.95E-02
Chromium	9.39E-03			9.39E-03	30	59.000	1.85E-02
Manganese	1.85E-02			1.85E-02	284	335.100	2.18E-02
Mercury	1.70E-02			1.70E-02	3.25	1.060	5.54E-03
Nickel	2.93E-02			2.93E-02	374	113.600	8.90E-03
Thallium	1.25E-02			1.25E-02	0.64	0.640	1.25E-02
Vanadium	7.74E-03			7.74E-03	34.6	70.000	1.57E-02
Zinc	1.48E-01			1.48E-01	28300	8421.0	4.40E-02
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	2.30E+00	0.00E+00	0.00E+00	Total: 2.30E+00			Total: 1.75E+00

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RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL RME DERMAL
FUTURE RESIDENT (ADULT/CHD)

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		1.87E-05		1.87E-05	12.4	3.160	4.77E-06
Aroclors (1254 + 1260)		1.87E-05		1.87E-05	12.4	13.124	1.98E-05
Dioxins (HPCDD + OCDD)		4.38E-07		4.38E-07	0.00067	0.00098	6.41E-07
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium				0.00E+00	6.7	12.600	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	3.78E-05	0.00E+00	Total: 3.78E-05			Total: 2.52E-05

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		1.09E+00		1.09E+00	12.4	3.160	2.78E-01
Aroclors (1254 + 1260)		1.09E+00		1.09E+00	12.4	13.124	1.15E+00
Dioxins (HPCDD + OCDD)				0.00E+00	0.00067	0.00098	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		7.86E-02		7.86E-02	6.7	12.600	1.48E-01
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	2.26E+00	0.00E+00	Total: 2.26E+00			Total: 1.58E+00

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL RME INHALATION
FUTURE RESIDENT (ADULT/CHD)

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane			2.74E-09	2.74E-09	6.4	0.074	3.16E-11
Vinyl Chloride			8.24E-10	8.24E-10	1.3	0.060	3.81E-11
Benzo(a)anthracene			0	0.00E+00	3.2	9.132	0.00E+00
Benzo(a)pyrene			0	0.00E+00	4	10.487	0.00E+00
Benzo(b)fluoranthene			0	0.00E+00	2.7	12.523	0.00E+00
Benzo(k)fluoranthene			1.61E-08	1.61E-08	25	12.683	8.17E-09
Dibenzo(a,h)anthracene			0	0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene			0	0.00E+00	3.6	9.290	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl			0	0.00E+00		3.160	0.00E+00
Aroclors (1254 + 1260)			0	0.00E+00	12.4	13.124	0.00E+00
Dioxins (HPCDD + OCDD)			0	0.00E+00	0.00067	0.00098	0.00E+00
Antimony			0	0.00E+00	19.2	70.700	0.00E+00
Arsenic			1.08E-07	1.08E-07	3.4	4.900	1.56E-07
Barium			0	0.00E+00		216.400	0.00E+00
Beryllium			1.17E-08	1.17E-08	0.66	2.700	4.79E-08
Cadmium			8.92E-08	8.92E-08	6.7	12.600	1.68E-07
Chromium			2.66E-06	2.66E-06	30	59.000	5.23E-06
Manganese			0	0.00E+00	284	335.100	0.00E+00
Mercury			0	0.00E+00		1.060	0.00E+00
Nickel			0	0.00E+00		113.600	0.00E+00
Thallium			0	0.00E+00	0.64	0.640	0.00E+00
Vanadium			0	0.00E+00	34.6	70.000	0.00E+00
Zinc			0	0.00E+00	28300	8421.0	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	0.00E+00	2.89E-06	Total: 2.89E-06			Total: 5.61E-06

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane				0.00E+00	6.4	0.074	0.00E+00
Vinyl Chloride				0.00E+00	1.3	0.060	0.00E+00
Benzo(a)anthracene				0.00E+00	3.2	9.132	0.00E+00
Benzo(a)pyrene				0.00E+00	4	10.487	0.00E+00
Benzo(b)fluoranthene				0.00E+00	2.7	12.523	0.00E+00
Benzo(k)fluoranthene			0	0.00E+00		12.683	0.00E+00
Dibenzo(a,h)anthracene				0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene				0.00E+00	3.6	9.290	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl				0.00E+00		3.160	0.00E+00
Aroclors (1254 + 1260)				0.00E+00	12.4	13.124	0.00E+00
Dioxins (HPCDD + OCDD)				0.00E+00	0.00067	0.00098	0.00E+00
Antimony				0.00E+00	19.2	70.700	0.00E+00
Arsenic				0.00E+00	3.4	4.900	0.00E+00
Barium			3.15E-02	3.15E-02	183	216.400	3.72E-02
Beryllium				0.00E+00	0.66	2.700	0.00E+00
Cadmium			5.78E-04	5.78E-04	6.7	12.600	1.09E-03
Chromium				0.00E+00	30	59.000	0.00E+00
Manganese				0.00E+00	284	335.100	0.00E+00
Mercury			9.15E-04	9.15E-04	3.25	1.060	2.98E-04
Nickel			0	0.00E+00		113.600	0.00E+00
Thallium				0.00E+00	0.64	0.640	0.00E+00
Vanadium				0.00E+00	34.6	70.000	0.00E+00
Zinc				0.00E+00	28300	8421.0	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	0.00E+00	3.30E-02	Total: 3.30E-02			Total: 3.86E-02

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL CTE INGESTION
FULL TIME EMPLOYEE

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane				0.00E+00			0.00E+00
Vinyl Chloride				0.00E+00			0.00E+00
Benzo(a)anthracene	2.95E-08			2.95E-08	3.2	4.209	3.88E-08
Benzo(a)pyrene	1.93E-07			1.93E-07	2.1	4.651	4.27E-07
Benzo(b)fluoranthene	2.49E-08			2.49E-08	2.7	4.385	4.04E-08
Benzo(k)fluoranthene				0.00E+00		4.867	4.47E-09
Dibenzo(a,h)anthracene				0.00E+00			0.00E+00
Dibenzofuran				0.00E+00			0.00E+00
Indeno(1,2,3-cd)pyrene	1.84E-08			1.84E-08	2	3.600	3.31E-08
Aroclors	1.89E-08			1.89E-08	1.5	5.116	6.45E-08
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
Antimony				0.00E+00	7.7	26.689	0.00E+00
Arsenic	5.30E-08			5.30E-08	2.8	4.141	7.84E-08
Barium				0.00E+00		159.005	0.00E+00
Beryllium	3.31E-08			3.31E-08	0.61	1.261	6.84E-08
Cadmium				0.00E+00	4.1	8.881	0.00E+00
Chromium				0.00E+00	28.4	65.049	0.00E+00
Manganese				0.00E+00	260	247.757	0.00E+00
Mercury				0.00E+00		0.521	0.00E+00
Nickel				0.00E+00		53.005	0.00E+00
Thallium				0.00E+00	0.31	0.461	0.00E+00
Vanadium				0.00E+00		58.820	0.00E+00
Zinc				0.00E+00	2250	2022.4	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	3.71E-07	0.00E+00	0.00E+00	Total: 3.71E-07			Total: 7.56E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane				0.00E+00			0.00E+00
Vinyl Chloride				0.00E+00			0.00E+00
Benzo(a)anthracene				0.00E+00	3.2	4.209	0.00E+00
Benzo(a)pyrene				0.00E+00	2.1	4.651	0.00E+00
Benzo(b)fluoranthene				0.00E+00	2.7	4.385	0.00E+00
Benzo(k)fluoranthene				0.00E+00		4.867	0.00E+00
Dibenzo(a,h)anthracene				0.00E+00			0.00E+00
Dibenzofuran				0.00E+00			0.00E+00
Indeno(1,2,3-cd)pyrene				0.00E+00	2	3.600	0.00E+00
Aroclors	1.10E-02			1.10E-02	1.5	5.116	3.75E-02
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
Antimony	2.83E-03			2.83E-03	7.7	26.689	9.81E-03
Arsenic	1.37E-03			1.37E-03	2.8	4.141	2.03E-03
Barium	1.79E-05			1.79E-05		159.005	3.33E-04
Beryllium				0.00E+00	0.61	1.261	0.00E+00
Cadmium	1.20E-03			1.20E-03	4.1	8.881	2.60E-03
Chromium	8.34E-04			8.34E-04	28.4	65.049	1.91E-03
Manganese	1.59E-03			1.59E-03	260	247.757	1.52E-03
Mercury				0.00E+00		0.521	2.55E-04
Nickel				0.00E+00		53.005	3.89E-04
Thallium	5.69E-04			5.69E-04	0.31	0.461	8.47E-04
Vanadium				0.00E+00		58.820	1.23E-03
Zinc	1.10E-03			1.10E-03	2250	2022.4	9.89E-04
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	2.05E-02	0.00E+00	0.00E+00	Total: 2.05E-02			Total: 5.94E-02

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL CTE DERMAL
FULL TIME EMPLOYEE

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Aroclors		1.72E-08		1.72E-08	1.5	5.116	5.87E-08
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium				0.00E+00	4.1	8.881	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	1.72E-08	0.00E+00	Total: 1.72E-08			Total: 5.87E-08

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Aroclors		1.00E-02		1.00E-02	1.5	5.116	3.41E-02
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		3.66E-03		3.66E-03	4.1	8.881	7.93E-03
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	1.37E-02	0.00E+00	Total: 1.37E-02			Total: 4.20E-02

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL CTE INGESTION
CONSTRUCTION WORKER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	2.46E-10			2.46E-10	0.23	0.139	1.49E-10
Vinyl Chloride	5.30E-09			5.30E-09	0.52	0.067	6.87E-10
Benzo(a)anthracene	5.49E-09			5.49E-09	1.4	4.207	1.65E-08
Benzo(a)pyrene	6.27E-08			6.27E-08	1.6	4.650	1.82E-07
Benzo(b)fluoranthene	1.06E-08			1.06E-08	2.7	5.335	2.09E-08
Benzo(k)fluoranthene	1.67E-09			1.67E-09	4.256	4.199	1.65E-09
Dibenzo(a,h)anthracene	5.09E-09			5.09E-09	0.13	1.160	4.54E-08
Indeno(1,2,3-cd)pyrene	6.27E-09			6.27E-09	1.6	3.865	1.51E-08
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	1.02E-08			1.02E-08	1.9	3.160	1.70E-08
Aroclors (1254 + 1260)	1.02E-08			1.02E-08	1.9	4.509	2.42E-08
Dioxins (HPCDD + OCDD)	5.61E-09			5.61E-09	0.00067	0.00098	8.21E-09
Antimony	0.00E+00			0.00E+00	5.5	18.031	0.00E+00
Arsenic	2.74E-08			2.74E-08	3.4	3.797	3.06E-08
Barium	0.00E+00			0.00E+00		166.678	0.00E+00
Beryllium	1.52E-08			1.52E-08	0.66	2.208	5.09E-08
Cadmium	0.00E+00			0.00E+00	2.7	7.730	0.00E+00
Chromium	0.00E+00			0.00E+00	30	54.378	0.00E+00
Manganese	0.00E+00			0.00E+00	284	293.225	0.00E+00
Mercury	0.00E+00			0.00E+00		0.792	0.00E+00
Nickel	0.00E+00			0.00E+00		80.030	0.00E+00
Thallium	0.00E+00			0.00E+00	0.36	0.372	0.00E+00
Vanadium	0.00E+00			0.00E+00	34.6	57.881	0.00E+00
Zinc	0.00E+00			0.00E+00	1260	2580.5	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	1.66E-07	0.00E+00	0.00E+00	Total: 1.66E-07			Total: 4.14E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	0.00E+00			0.00E+00	0.23	0.139	0.00E+00
Vinyl Chloride	0.00E+00			0.00E+00	0.52	0.067	0.00E+00
Benzo(a)anthracene	0.00E+00			0.00E+00	1.4	4.207	0.00E+00
Benzo(a)pyrene	0.00E+00			0.00E+00	1.6	4.650	0.00E+00
Benzo(b)fluoranthene	0.00E+00			0.00E+00	2.7	5.335	0.00E+00
Benzo(k)fluoranthene	0.00E+00			0.00E+00		4.199	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00			0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00			0.00E+00	1.6	3.865	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	3.57E-02			3.57E-02	1.9	3.160	5.94E-02
Aroclors (1254 + 1260)	3.57E-02			3.57E-02	1.9	4.509	8.47E-02
Dioxins (HPCDD + OCDD)	0.00E+00			0.00E+00	0.00067	0.00098	0.00E+00
Antimony	5.17E-03			5.17E-03	5.5	18.031	1.69E-02
Arsenic	4.26E-03			4.26E-03	3.4	3.797	4.76E-03
Barium	7.43E-04			7.43E-04	138.474	166.678	8.94E-04
Beryllium	4.96E-05			4.96E-05	0.66	2.208	1.66E-04
Cadmium	2.03E-03			2.03E-03	2.7	7.730	5.81E-03
Chromium	2.25E-03			2.25E-03	30	54.378	4.08E-03
Manganese	4.44E-03			4.44E-03	284	293.225	4.58E-03
Mercury	5.39E-04			5.39E-04	0.4296	0.792	9.93E-04
Nickel	9.34E-04			9.34E-04	49.717	80.030	1.50E-03
Thallium	1.69E-03			1.69E-03	0.36	0.372	1.74E-03
Vanadium	1.86E-03			1.86E-03	34.6	57.881	3.11E-03
Zinc	1.58E-03			1.58E-03	1260	2580.5	3.24E-03
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	9.69E-02	0.00E+00	0.00E+00	Total: 9.69E-02			Total: 1.92E-01

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL CTE INHALATION
CONSTRUCTION WORKER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation		Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane			5.86E-12		5.86E-12	0.23	0.139		3.54E-12
Vinyl Chloride			1.96E-11		1.96E-11	0.52	0.067		2.54E-12
Benzo(a)anthracene					0.00E+00	1.4	4.207		0.00E+00
Benzo(a)pyrene					0.00E+00	1.6	4.650		0.00E+00
Benzo(b)fluoranthene					0.00E+00	2.7	5.335		0.00E+00
Benzo(k)fluoranthene			3.26E-11		3.26E-11	4.256	4.199		3.22E-11
Dibenzo(a,h)anthracene					0.00E+00	0.13	1.160		0.00E+00
Indeno(1,2,3-cd)pyrene					0.00E+00	1.6	3.865		0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl					0.00E+00		3.160		0.00E+00
Aroclors (1254 + 1260)					0.00E+00	1.9	4.509		0.00E+00
Dioxins (HPCDD + OCDD)					0.00E+00	0.00067	0.00098		0.00E+00
Antimony					0.00E+00	5.5	18.031		0.00E+00
Arsenic			6.45E-09		6.45E-09	3.4	3.797		7.20E-09
Barium					0.00E+00		166.678		0.00E+00
Beryllium			6.96E-10		6.96E-10	0.66	2.208		2.33E-09
Cadmium			2.14E-09		2.14E-09	2.7	7.730		6.13E-09
Chromium			1.58E-07		1.58E-07	30	54.378		2.86E-07
Manganese					0.00E+00	284	293.225		0.00E+00
Mercury					0.00E+00		0.792		0.00E+00
Nickel					0.00E+00		80.030		0.00E+00
Thallium					0.00E+00	0.36	0.372		0.00E+00
Vanadium					0.00E+00	34.6	57.881		0.00E+00
Zinc					0.00E+00	1260	2580.5		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	0.00E+00	0.00E+00	1.67E-07	Total:	1.67E-07			Total:	3.02E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation		Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane					0.00E+00	0.23	0.139		0.00E+00
Vinyl Chloride					0.00E+00	0.52	0.067		0.00E+00
Benzo(a)anthracene					0.00E+00	1.4	4.207		0.00E+00
Benzo(a)pyrene					0.00E+00	1.6	4.650		0.00E+00
Benzo(b)fluoranthene					0.00E+00	2.7	5.335		0.00E+00
Benzo(k)fluoranthene					0.00E+00		4.199		0.00E+00
Dibenzo(a,h)anthracene					0.00E+00	0.13	1.160		0.00E+00
Indeno(1,2,3-cd)pyrene					0.00E+00		3.865		0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl					0.00E+00	1.6	3.160		0.00E+00
Aroclors (1254 + 1260)					0.00E+00	1.9	4.509		0.00E+00
Dioxins (HPCDD + OCDD)					0.00E+00	0.00067	0.00098		0.00E+00
Antimony					0.00E+00	5.5	18.031		0.00E+00
Arsenic					0.00E+00	3.4	3.797		0.00E+00
Barium			8.51E-03		8.51E-03	138.474	166.678		1.02E-02
Beryllium					0.00E+00	0.66	2.208		0.00E+00
Cadmium			4.16E-04		4.16E-04	2.7	7.730		1.19E-03
Chromium					0.00E+00	30	54.378		0.00E+00
Manganese					0.00E+00	284	293.225		0.00E+00
Mercury			4.32E-05		4.32E-05	0.4296	0.792		7.96E-05
Nickel					0.00E+00		80.030		0.00E+00
Thallium					0.00E+00	0.36	0.372		0.00E+00
Vanadium					0.00E+00	34.6	57.881		0.00E+00
Zinc					0.00E+00	1260	2580.5		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	0.00E+00	0.00E+00	8.97E-03	Total:	8.97E-03			Total:	1.15E-02

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL CTE INGESTION
OLDER CHILD TRESPASSER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation		Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane					0.00E+00				0.00E+00
Vinyl Chloride					0.00E+00				0.00E+00
Benzo(a)anthracene	8.29E-09				8.29E-09	3.2	4.209		1.09E-08
Benzo(a)pyrene	5.44E-08				5.44E-08	2.1	4.651		1.20E-07
Benzo(b)fluoranthene	7.00E-09				7.00E-09	2.7	4.385		1.14E-08
Benzo(k)fluoranthene					0.00E+00		4.867		1.26E-09
Dibenzo(a,h)anthracene					0.00E+00				0.00E+00
Dibenzofuran					0.00E+00				0.00E+00
Indeno(1,2,3-cd)pyrene	5.18E-09				5.18E-09	2	3.600		9.32E-09
Aroclors	5.32E-09				5.32E-09	1.5	5.116		1.81E-08
1,2,3,4,6,7,8-HPCDD					0.00E+00				0.00E+00
Antimony					0.00E+00	7.7	26.689		0.00E+00
Arsenic	1.49E-08				1.49E-08	2.8	4.141		2.20E-08
Barium					0.00E+00		159.005		0.00E+00
Beryllium	9.31E-09				9.31E-09	0.61	1.261		1.92E-08
Cadmium					0.00E+00	4.1	8.881		0.00E+00
Chromium					0.00E+00	28.4	65.049		0.00E+00
Manganese					0.00E+00	260	247.757		0.00E+00
Mercury					0.00E+00		0.521		0.00E+00
Nickel					0.00E+00		53.005		0.00E+00
Thallium					0.00E+00	0.31	0.461		0.00E+00
Vanadium					0.00E+00		58.820		0.00E+00
Zinc					0.00E+00	2250	2022.4		0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	1.04E-07	0.00E+00	0.00E+00	Total:	1.04E-07			Total:	2.13E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation		Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)		Risk at New Con
1,1,2,2-Tetrachloroethane					0.00E+00				0.00E+00
Vinyl Chloride					0.00E+00				0.00E+00
Benzo(a)anthracene					0.00E+00	3.2	4.209		0.00E+00
Benzo(a)pyrene					0.00E+00	2.1	4.651		0.00E+00
Benzo(b)fluoranthene					0.00E+00	2.7	4.385		0.00E+00
Benzo(k)fluoranthene					0.00E+00		4.867		0.00E+00
Dibenzo(a,h)anthracene					0.00E+00				0.00E+00
Dibenzofuran					0.00E+00				0.00E+00
Indeno(1,2,3-cd)pyrene					0.00E+00	2	3.600		0.00E+00
Aroclors	6.21E-03				6.21E-03	1.5	5.116		2.12E-02
1,2,3,4,6,7,8-HPCDD					0.00E+00				0.00E+00
Antimony	1.59E-03				1.59E-03	7.7	26.689		5.51E-03
Arsenic	7.73E-04				7.73E-04	2.8	4.141		1.14E-03
Barium					0.00E+00		159.005		1.88E-04
Beryllium	1.01E-05				1.01E-05	0.61	1.261		2.09E-05
Cadmium	6.79E-04				6.79E-04	4.1	8.881		1.47E-03
Chromium	4.70E-04				4.70E-04	28.4	65.049		1.08E-03
Manganese	8.98E-04				8.98E-04	260	247.757		8.56E-04
Mercury					0.00E+00		0.521		1.44E-04
Nickel					0.00E+00		53.005		2.20E-04
Thallium	3.21E-04				3.21E-04	0.31	0.461		4.78E-04
Vanadium					0.00E+00		58.820		6.96E-04
Zinc	6.21E-04				6.21E-04	2250	2022.4		5.58E-04
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
					0.00E+00				0.00E+00
Totals:	1.16E-02	0.00E+00	0.00E+00	Total:	1.16E-02			Total:	3.35E-02

RISKS WITH PHASE II DATA
NSB-NLON
SURFACE SOIL CTE DERMAL
OLDER CHILD TRESPASSER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Aroclors		4.03E-09		4.03E-09	1.5	5.116	1.37E-08
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium				0.00E+00	4.1	8.881	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	4.03E-09	0.00E+00	Total: 4.03E-09			Total: 1.37E-08

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Aroclors		4.70E-03		4.70E-03	1.5	5.116	1.60E-02
1,2,3,4,6,7,8-HPCDD				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		1.71E-03		1.71E-03	4.1	8.881	3.70E-03
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	6.41E-03	0.00E+00	Total: 6.41E-03			Total: 1.97E-02

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL CTE INGESTION
FUTURE RESIDENT (ADULT/CHD)

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	2.48E-09			2.48E-09	0.23	0.139	1.50E-09
Vinyl Chloride	5.32E-08			5.32E-08	0.52	0.067	6.90E-09
Benzo(a)anthracene	5.50E-08			5.50E-08	1.4	4.207	1.65E-07
Benzo(a)pyrene	6.29E-07			6.29E-07	1.6	4.650	1.83E-06
Benzo(b)fluoranthene	1.06E-07			1.06E-07	2.7	5.335	2.09E-07
Benzo(k)fluoranthene	1.67E-08			1.67E-08	4.256	4.199	1.65E-08
Dibenzo(a,h)anthracene	5.11E-08			5.11E-08	0.13	1.160	4.56E-07
Indeno(1,2,3-cd)pyrene	6.29E-08			6.29E-08	1.6	3.865	1.52E-07
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	1.02E-07			1.02E-07	1.9	3.160	1.70E-07
Aroclors (1254 + 1260)	1.02E-07			1.02E-07	1.9	4.509	2.42E-07
Dioxins (HPCDD + OCDD)	5.62E-08			5.62E-08	0.00067	0.00098	8.22E-08
Antimony	0.00E+00			0.00E+00	5.5	18.031	0.00E+00
Arsenic	2.74E-07			2.74E-07	3.4	3.797	3.06E-07
Barium	0.00E+00			0.00E+00		166.678	0.00E+00
Beryllium	1.53E-07			1.53E-07	0.66	2.208	5.12E-07
Cadmium	0.00E+00			0.00E+00	2.7	7.730	0.00E+00
Chromium	0.00E+00			0.00E+00	30	54.378	0.00E+00
Manganese	0.00E+00			0.00E+00	284	293.225	0.00E+00
Mercury	0.00E+00			0.00E+00		0.792	0.00E+00
Nickel	0.00E+00			0.00E+00		80.030	0.00E+00
Thallium	0.00E+00			0.00E+00	0.36	0.372	0.00E+00
Vanadium	0.00E+00			0.00E+00	34.6	57.881	0.00E+00
Zinc	0.00E+00			0.00E+00	1260	2580.5	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	1.66E-06	0.00E+00	0.00E+00	Total: 1.66E-06			Total: 4.15E-06

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane	0.00E+00			0.00E+00	0.23	0.139	0.00E+00
Vinyl Chloride	0.00E+00			0.00E+00	0.52	0.067	0.00E+00
Benzo(a)anthracene	0.00E+00			0.00E+00	1.4	4.207	0.00E+00
Benzo(a)pyrene	0.00E+00			0.00E+00	1.6	4.650	0.00E+00
Benzo(b)fluoranthene	0.00E+00			0.00E+00	2.7	5.335	0.00E+00
Benzo(k)fluoranthene	0.00E+00			0.00E+00		4.199	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00			0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00			0.00E+00	1.6	3.865	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl	3.98E-02			3.98E-02	1.9	3.160	6.62E-02
Aroclors (1254 + 1260)	3.98E-02			3.98E-02	1.9	4.509	9.45E-02
Dioxins (HPCDD + OCDD)	0.00E+00			0.00E+00	0.00067	0.00098	0.00E+00
Antimony	5.76E-03			5.76E-03	5.5	18.031	1.89E-02
Arsenic	4.74E-03			4.74E-03	3.4	3.797	5.29E-03
Barium	8.28E-04			8.28E-04	138.474	166.678	9.97E-04
Beryllium	5.53E-05			5.53E-05	0.66	2.208	1.85E-04
Cadmium	2.26E-03			2.26E-03	2.7	7.730	6.47E-03
Chromium	2.51E-03			2.51E-03	30	54.378	4.55E-03
Manganese	4.96E-03			4.96E-03	284	293.225	5.12E-03
Mercury	6.00E-04			6.00E-04	0.43	0.792	1.10E-03
Nickel	1.04E-03			1.04E-03	49.717	80.030	1.67E-03
Thallium	1.88E-03			1.88E-03	0.36	0.372	1.94E-03
Vanadium	2.07E-03			2.07E-03	34.6	57.881	3.46E-03
Zinc	1.76E-03			1.76E-03	1260	2580.5	3.60E-03
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	1.08E-01	0.00E+00	0.00E+00	Total: 1.08E-01			Total: 2.14E-01

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL CTE DERMAL
FUTURE RESIDENT (ADULT/CHD)

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		4.41E-08		4.41E-08	1.9	3.160	7.33E-08
Aroclors (1254 + 1260)		4.41E-08		4.41E-08	1.9	4.509	1.05E-07
Dioxins (HPCDD + OCDD)		1.35E-08		1.35E-08	0.00067	0.00098	1.97E-08
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		0.00E+00		0.00E+00	2.7	7.730	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	1.02E-07	0.00E+00	Total: 1.02E-07			Total: 1.98E-07

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		1.72E-02		1.72E-02	1.9	3.160	2.86E-02
Aroclors (1254 + 1260)		1.72E-02		1.72E-02	1.9	4.509	4.08E-02
Dioxins (HPCDD + OCDD)		0.00E+00		0.00E+00	0.00067	0.00098	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		3.25E-03		3.25E-03	2.7	7.730	9.30E-03
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	3.77E-02	0.00E+00	Total: 3.77E-02			Total: 7.87E-02

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL CTE INHALATION
FUTURE RESIDENT (ADULT/CHD)

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane			1.98E-11	1.98E-11	0.23	0.139	1.20E-11
Vinyl Chloride			6.61E-11	6.61E-11	0.52	0.067	8.57E-12
Benzo(a)anthracene				0.00E+00	1.4	4.207	0.00E+00
Benzo(a)pyrene				0.00E+00	1.6	4.650	0.00E+00
Benzo(b)fluoranthene				0.00E+00	2.7	5.335	0.00E+00
Benzo(k)fluoranthene			5.50E-10	5.50E-10	4.256	4.199	5.43E-10
Dibenzo(a,h)anthracene				0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene				0.00E+00	1.6	3.865	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl				0.00E+00		3.160	0.00E+00
Aroclors (1254 + 1260)				0.00E+00	1.9	4.509	0.00E+00
Dioxins (HPCDD + OCDD)				0.00E+00	0.00067	0.00098	0.00E+00
Antimony				0.00E+00	5.5	18.031	0.00E+00
Arsenic			2.18E-08	2.18E-08	3.4	3.797	2.43E-08
Barium				0.00E+00		166.678	0.00E+00
Beryllium			2.35E-09	2.35E-09	0.66	2.208	7.86E-09
Cadmium			7.21E-09	7.21E-09	2.7	7.730	2.06E-08
Chromium			5.34E-07	5.34E-07	30	54.378	9.68E-07
Manganese				0.00E+00	284	293.225	0.00E+00
Mercury				0.00E+00		0.792	0.00E+00
Nickel			0	0.00E+00		80.030	0.00E+00
Thallium			0	0.00E+00	0.36	0.372	0.00E+00
Vanadium				0.00E+00	34.6	57.881	0.00E+00
Zinc				0.00E+00	1260	2580.5	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	0.00E+00	5.66E-07	Total: 5.66E-07			Total: 1.02E-06

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
1,1,2,2-Tetrachloroethane				0.00E+00	0.23	0.139	0.00E+00
Vinyl Chloride				0.00E+00	0.52	0.067	0.00E+00
Benzo(a)anthracene				0.00E+00	1.4	4.207	0.00E+00
Benzo(a)pyrene				0.00E+00	1.6	4.650	0.00E+00
Benzo(b)fluoranthene				0.00E+00	2.7	5.335	0.00E+00
Benzo(k)fluoranthene			0	0.00E+00		4.199	0.00E+00
Dibenzo(a,h)anthracene				0.00E+00	0.13	1.160	0.00E+00
Indeno(1,2,3-cd)pyrene				0.00E+00	1.6	3.865	0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl				0.00E+00		3.160	0.00E+00
Aroclors (1254 + 1260)				0.00E+00	1.9	4.509	0.00E+00
Dioxins (HPCDD + OCDD)				0.00E+00	0.00067	0.00098	0.00E+00
Antimony				0.00E+00	5.5	18.031	0.00E+00
Arsenic				0.00E+00	3.4	3.797	0.00E+00
Barium			1.60E-02	1.60E-02	138.474	166.678	1.93E-02
Beryllium				0.00E+00	0.66	2.208	0.00E+00
Cadmium			1.56E-04	1.56E-04	2.7	7.730	4.47E-04
Chromium				0.00E+00	30	54.378	0.00E+00
Manganese				0.00E+00	284	293.225	0.00E+00
Mercury			8.10E-05	8.10E-05	0.4296	0.792	1.49E-04
Nickel			0	0.00E+00		80.030	0.00E+00
Thallium				0.00E+00	0.36	0.372	0.00E+00
Vanadium				0.00E+00	34.6	57.881	0.00E+00
Zinc				0.00E+00	1260	2580.5	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	0.00E+00	1.62E-02	Total: 1.62E-02			Total: 1.99E-02

RISKS WITH PHASE II DATA
NSB-NLON
ALL SOIL **CTE DERMAL**
CONSTRUCTION WORKER

Chemical of Concern	Previous Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		1.94E-09		1.94E-09	1.9	3.160	3.23E-09
Aroclors (1254 + 1260)		1.94E-09		1.94E-09	1.9	4.509	4.60E-09
Dioxins (HPCDD + OCDD)		5.92E-10		5.92E-10	0.00067	0.00098	8.66E-10
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium				0.00E+00	2.7	7.730	0.00E+00
		0.00E+00		0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	4.47E-09	0.00E+00	Total: 4.47E-09			Total: 8.70E-09

Chemical of Concern	Previous Non-Cancer Risks Ingestion	Dermal	Inhalation	Total Risk (HI)	Previous Conc (mg/kg)	New Conc (mg/kg)	Risk at New Con
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
2,3,3',4,5,6-Hexachloro-1,1'-biphenyl		6.78E-03		6.78E-03	1.9	3.160	1.13E-02
Aroclors (1254 + 1260)		6.78E-03		6.78E-03	1.9	4.509	1.61E-02
Dioxins (HPCDD + OCDD)		0.00E+00		0.00E+00	0.00067	0.00098	0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Cadmium		1.28E-03		1.28E-03	2.7	7.730	3.66E-03
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
				0.00E+00			0.00E+00
Totals:	0.00E+00	1.48E-02	0.00E+00	Total: 1.48E-02			Total: 3.10E-02

PRG CALCULATIONS

PHASE II PREL. REM. GOALS*	
NSB NLON	SITE 6 (DRMO)
RECEPTOR:	FULL-TIME EMPL.
MEDIUM:	SURF. SOIL (RME)

Chemical of Concern	Route -Specific Cancer Risks Ingestion	Dermal	Inhalation		Total Risk	Exposure Conc (mg/kg)	Preliminary Remediation Goals (mg/kg) 1.00E-07	1.00E-06	5.00E-07
					0.00E+00		0.000	0.00	0.00
					0.00E+00		0.000	0.00	0.00
					0.00E+00		0.000	0.00	0.00
					0.00E+00		0.000	0.00	0.00
					0.00E+00		0.000	0.00	0.00
					0.00E+00		0.000	0.00	0.00
Totals				Total	0.00E+00				

Chemical of Concern	Route -Specific Hazard Index Ingestion	Dermal	Inhalation		Total HI	Exposure Conc (mg/kg)	Preliminary Remediation Goals (mg/kg) 0.1	0.2	1
Aroclors (1254 + 1260)	1.19E+00	2.70E+00			3.89E+00	40.4	1.04	2.08	**10.39**
Antimony	1.97E-01				1.97E-01	134	68.02	136.04	680.20
Cadmium	2.67E-02	2.04E-01			2.31E-01	22.8	9.9	19.77	98.83
Chromium	1.42E-01				1.42E-01	1210	852.1	1704.23	8521.13
					0.00E+00		0.00	0.00	0.00
					0.00E+00		0.00	0.00	0.00
					0.00E+00		0.00	0.00	0.00
Totals	1.56E+00	2.90E+00	0.00E+00	Total	4.46E+00				

*For ICR>E-04 and HI>1.0 (major contributors to risk and recommended PRGs in bold print).

PHASE II PREL. REM. GOALS*
NSB NLON SITE 6 (DRMO)
RECEPTOR: CONST. WORKER
MEDIUM: ALL SOIL (RME)

Chemical of Concern	Route -Specific Cancer Risks Ingestion	Dermal	Inhalation	Total Risk	Exposure Conc (mg/kg)	Preliminary Remediation Goals (mg/kg) 1.00E-07	1.00E-06	5.00E-07
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00000	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00		0.00
				0.00E+00		0.00	0.00	0.00
Totals	0.00E+00	0.00E+00	0.00E+00	Total 0.00E+00				0.00

Chemical of Concern	Route -Specific Hazard Index Ingestion	Dermal	Inhalation	Total HI	Exposure Conc (mg/kg)	Preliminary Remediation Goals (mg/kg) 0.1	0.2	1
Hexachlorobiphenyl	3.57E-01	1.69E-01		5.26E-01	3.16	0.60	1.20	**6.01**
Aroclors (1254 + 1260)	1.48E+00	7.03E-01		2.18E+00	13.124	0.60	1.20	**6.01**
Antimony	3.98E-01			3.98E-01	70.7	17.76	35.53	**177.64**
Cadmium	5.68E-02	8.99E-02	2.91E-03	1.50E-01	12.6	8.4	16.84	**84.22**
Chromium				0.00E+00	59	0.0	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
				0.00E+00		0.00	0.00	0.00
Totals	2.29E+00	9.62E-01	2.91E-03	Total 3.26E+00				

*For ICR>E-04 and HI>1.0 (major contributors to risk and recommended PRGs in bold print).

PHASE II PREL. REM. GOALS*	
NSB NLON	SITE 6 (DRMO)
RECEPTOR:	CHILD TRESP.
MEDIUM:	SURF. SOIL (RME)

		Route -Specific Cancer Risks					Exposure	Preliminary Remediation Goals (mg/kg)		
Chemical of Concern		Ingestion	Dermal	Inhalation		Total Risk	Conc (mg/kg)	1.00E-07	1.00E-06	5.00E-07
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.000	0.00	0.00
	Totals	0.00E+00	0.00E+00	0.00E+00	Total	0.00E+00				

		Route -Specific Hazard Index					Exposure	Preliminary Remediation Goals (mg/kg)		
		Ingestion	Dermal	Inhalation		Total HI	Conc (mg/kg)	0.1	0.2	1
Aroclors (1254 + 1260)		1.55E+00	2.92E+00			4.47E+00	40.4	0.90	1.81	**9.04**
Antimony		2.56E-01				2.56E-01	134	52.34	104.69	523.44
Cadmium		3.49E-02	2.20E-01			2.55E-01	22.8	8.9	17.89	89.45
Chromium		1.85E-01				1.85E-01	1210	654.1	1308.11	6540.54
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
	Totals	2.03E+00	3.14E+00	0.00E+00	Total	5.17E+00				

*For ICR>E-04 and HI>1.0 (major contributors to risk and recommended PRGs in bold print).A16

PHASE II PREL. REM. GOALS*	
NSB NLON	SITE 6 (DRMO)
RECEPTOR:	CHILD/ADULT RESID.
MEDIUM:	ALL SOIL (RME)

		Route -Specific Cancer Risks					Exposure	Preliminary Remediation Goals (mg/kg)		
Chemical of Concern		Ingestion	Dermal	Inhalation		Total Risk	Conc (mg/kg)	1.00E-07	1.00E-06	5.00E-07
Benzo(a)anthracene		4.48E-06				4.48E-06	9.132	0.204	**2.04**	1.02
Benzo(a)pyrene		5.14E-05				5.14E-05	10.487	0.020	**0.20**	0.10
Benzo(b)fluoranthene		6.12E-06				6.12E-06	12.523	0.205	**2.05**	1.02
Dibenzo(a,h)anthracene		5.68E-06				5.68E-06	1.16	0.020	**0.20**	0.10
Indeno(1,2,3-cd)pyrene		4.54E-06				4.54E-06	9.29	0.205	**2.05**	1.02
Hexachlorobiphenyl		4.23E-06	4.77E-06			9.00E-06	3.16	0.035	**0.35**	0.18
Aroclors (1254 + 1260)		1.76E-05	1.98E-05			3.74E-05	13.124	0.035	**0.35**	0.18
Dioxins (HPCDD + OCDD)		1.02E-06	6.41E-07			1.66E-06	0.00098	0.000059	**0.00059**	0.00030
Arsenic		4.93E-06		1.56E-07		5.09E-06	4.9	0.096	**0.96**	0.48
Beryllium		7.77E-06		4.79E-08		7.82E-06	2.7	0.035	**0.35**	0.17
Cadmium				1.68E-07		1.68E-07	12.6	7.500	75.00	37.50
Chromium				5.23E-06		5.23E-06	59	1.128	**11.28**	5.64
	Totals	1.08E-04	2.52E-05	5.60E-06	Total	1.39E-04				

		Route -Specific Hazard Index					Exposure	Preliminary Remediation Goals (mg/kg)		
		Ingestion	Dermal	Inhalation		Total HI	Conc (mg/kg)	0.1	0.2	1
Hexachlorobiphenyl		2.47E-01	2.78E-01			5.25E-01	3.16	0.60	1.20	**6.02**
Aroclors (1254 + 1260)		1.03E+00	1.15E+00			2.18E+00	13.124	0.60	1.20	**6.02**
Antimony		2.77E-01				2.77E-01	70.7	25.52	51.05	255.23
Cadmium		3.95E-02	1.48E-01	1.09E-03		1.89E-01	12.6	6.7	13.36	**66.81**
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
						0.00E+00		0.00	0.00	0.00
	Totals	1.59E+00	1.58E+00	1.09E-03	Total	3.17E+00				

*For ICR>E-04 and HI>1.0 (major contributors to risk and recommended PRGs in bold print).

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APPENDIX B

ESTIMATION OF CONTAMINATED MEDIA VOLUME

Industrial Land Use Scenario
PCBs in Excess Soil PRG

nsample	sample	para	PRG	result	units	validated
100490-6TB2(0-2)	6TB2(0-2)	AROCLOR-1260	6000	11000 J	UG/KG	Y
100490-6TB2(2-4)	6TB2(2-4)	AROCLOR-1260	6000	12000 J	UG/KG	Y
16144-35	16144-35	AROCLOR-1254	6000	18100	UG/KG	N
16144-35	16144-35	AROCLOR-1260	6000	29100	UG/KG	N
16144-51	16144-51	AROCLOR-1254	6000	6130	UG/KG	N
16144-51	16144-51	AROCLOR-1260	6000	13800	UG/KG	N
16144-62	16144-62	AROCLOR-1260	6000	13900	UG/KG	N
16144-63-MAX	16144-63MAX	AROCLOR-1254	6000	11200	UG/KG	N
16144-63-MAX	16144-63MAX	AROCLOR-1260	6000	18000	UG/KG	N
16144-66	16144-66	AROCLOR-1260	6000	6560	UG/KG	N
16144-67	16144-67	AROCLOR-1254	6000	8860	UG/KG	N
16144-67	16144-67	AROCLOR-1260	6000	8790	UG/KG	N
16144-70	16144-70	AROCLOR-1254	6000	9250	UG/KG	N
16144-71	16144-71	AROCLOR-1254	6000	10800	UG/KG	N
16144-72	16144-72	AROCLOR-1254	6000	22400	UG/KG	N

Industrial Land Use Scenario
Cadmium in Excess Soil PRG

nsample	***sample***	***para***	***PRG***	***result***	***units***	***method***	***validated***
16144-40-MAX	16144-40MAX	CADMIUM	84	126.000	MG/KG	ME20	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	*sample*	*para*	*PRG*	*result*	*units*	*validated*
6TB20 (4-6)	6TB20 (4-6)	1,2,3,4,6,7,8-HPCDD	0.59	0.67	UG/KG	N
16144-74-MAX	16144-74MAX	4,4'-DDD	80	227	UG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	ALUMINUM	50	7030	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	ALUMINUM	50	8400	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	ALUMINUM	50	7050	MG/KG	Y
100490-6TB2(2-4)	6TB2(2-4)	ALUMINUM	50	5840	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	ALUMINUM	50	6430	MG/KG	Y
100490-6TB3(6-8)	6TB3(6-8)	ALUMINUM	50	5470	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	ALUMINUM	50	11700	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	ALUMINUM	50	9030	MG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	ALUMINUM	50	10700	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	ALUMINUM	50	9740	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	ALUMINUM	50	9630	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	ALUMINUM	50	14500	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	ALUMINUM	50	10800	MG/KG	Y
101590-6MW5S(0-2)	6MW5S(0-2)	ALUMINUM	50	12800	MG/KG	Y
101590-6MW5S(8-10)	6MW5S(8-10)	ALUMINUM	50	4880	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	ALUMINUM	50	14600	MG/KG	Y
112790-6SS4	6SS4	ALUMINUM	50	5610	MG/KG	Y
16144-35	16144-35	ALUMINUM	50	5790	MG/KG	N
16144-36	16144-36	ALUMINUM	50	7020	MG/KG	N
16144-37	16144-37	ALUMINUM	50	6420	MG/KG	N
16144-38	16144-38	ALUMINUM	50	4730	MG/KG	N
16144-39	16144-39	ALUMINUM	50	7390	MG/KG	N
16144-40-MAX	16144-40MAX	ALUMINUM	50	15400	MG/KG	N
16144-42	16144-42	ALUMINUM	50	11100	MG/KG	N
16144-43	16144-43	ALUMINUM	50	7720	MG/KG	N
16144-44	16144-44	ALUMINUM	50	7150	MG/KG	N
16144-45	16144-45	ALUMINUM	50	8380	MG/KG	N
16144-46	16144-46	ALUMINUM	50	18900	MG/KG	N
16144-47	16144-47	ALUMINUM	50	7650	MG/KG	N
16144-48	16144-48	ALUMINUM	50	12100	MG/KG	N
16144-49	16144-49	ALUMINUM	50	6700	MG/KG	N
16144-50	16144-50	ALUMINUM	50	5850	MG/KG	N
16144-51	16144-51	ALUMINUM	50	4680	MG/KG	N
16144-52	16144-52	ALUMINUM	50	8380	MG/KG	N
16144-53	16144-53	ALUMINUM	50	4500	MG/KG	N
16144-54	16144-54	ALUMINUM	50	9140	MG/KG	N
16144-55	16144-55	ALUMINUM	50	7060	MG/KG	N
16144-56-MAX	16144-56MAX	ALUMINUM	50	6820	MG/KG	N
16144-60	16144-60	ALUMINUM	50	4430	MG/KG	N
16144-61	16144-61	ALUMINUM	50	4770	MG/KG	N
16144-62	16144-62	ALUMINUM	50	6570	MG/KG	N
16144-63-MAX	16144-63MAX	ALUMINUM	50	6460	MG/KG	N
16144-65	16144-65	ALUMINUM	50	8330	MG/KG	N
16144-66	16144-66	ALUMINUM	50	6560	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-67	16144-67	ALUMINUM	50	13600	MG/KG	N
16144-68	16144-68	ALUMINUM	50	3670	MG/KG	N
16144-69	16144-69	ALUMINUM	50	3450	MG/KG	N
16144-70	16144-70	ALUMINUM	50	4920	MG/KG	N
16144-71	16144-71	ALUMINUM	50	8560	MG/KG	N
16144-72	16144-72	ALUMINUM	50	5070	MG/KG	N
16144-73	16144-73	ALUMINUM	50	5260	MG/KG	N
16144-74-MAX	16144-74MAX	ALUMINUM	50	6460	MG/KG	N
16144-75	16144-75	ALUMINUM	50	8480	MG/KG	N
16144-76	16144-76	ALUMINUM	50	4470	MG/KG	N
16144-77	16144-77	ALUMINUM	50	3860	MG/KG	N
16144-78	16144-78	ALUMINUM	50	9320	MG/KG	N
16144-79	16144-79	ALUMINUM	50	2430	MG/KG	N
16144-80	16144-80	ALUMINUM	50	3510	MG/KG	N
16144-81	16144-81	ALUMINUM	50	3570	MG/KG	N
6MW2D0406	6MW2D0406	ALUMINUM	50	8060	MG/KG	N
6MW3D-0406	6MW3D-0406	ALUMINUM	50	9800	MG/KG	N
6MW7S-0709	6MW7S-0709	ALUMINUM	50	10100	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	ALUMINUM	50	6080	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	ALUMINUM	50	5060	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	ALUMINUM	50	4990	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	ALUMINUM	50	4490 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	ALUMINUM	50	8960 J	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	ALUMINUM	50	7020	MG/KG	N
6TB8 (0-1)	6TB8 (0-1)	ALUMINUM	50	5650	MG/KG	N
6TB8 (4-6)	6TB8 (4-6)	ALUMINUM	50	6980	MG/KG	N
6TB9 (2-4)	6TB9 (2-4)	ALUMINUM	50	5340	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	ANTIMONY	5	19.2 J	MG/KG	Y
16144-35	16144-35	ANTIMONY	5	18.5	MG/KG	N
16144-37	16144-37	ANTIMONY	5	17.2	MG/KG	N
16144-38	16144-38	ANTIMONY	5	9.32	MG/KG	N
16144-39	16144-39	ANTIMONY	5	9.12	MG/KG	N
16144-40-MAX	16144-40MAX	ANTIMONY	5	95.1	MG/KG	N
16144-43	16144-43	ANTIMONY	5	35.0	MG/KG	N
16144-48	16144-48	ANTIMONY	5	36.5	MG/KG	N
16144-49	16144-49	ANTIMONY	5	25.0	MG/KG	N
16144-50	16144-50	ANTIMONY	5	5.32	MG/KG	N
16144-51	16144-51	ANTIMONY	5	5.62	MG/KG	N
16144-52	16144-52	ANTIMONY	5	8.61	MG/KG	N
16144-62	16144-62	ANTIMONY	5	10.1	MG/KG	N
16144-63-MAX	16144-63MAX	ANTIMONY	5	134	MG/KG	N
16144-65	16144-65	ANTIMONY	5	53.1	MG/KG	N
16144-66	16144-66	ANTIMONY	5	126	MG/KG	N
16144-67	16144-67	ANTIMONY	5	55.3	MG/KG	N
16144-68	16144-68	ANTIMONY	5	17.2	MG/KG	N
16144-69	16144-69	ANTIMONY	5	7.37	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-70	16144-70	ANTIMONY	5	75.3	MG/KG	N
16144-71	16144-71	ANTIMONY	5	12.4	MG/KG	N
16144-72	16144-72	ANTIMONY	5	28.7	MG/KG	N
16144-74-MAX	16144-74MAX	ANTIMONY	5	11.4	MG/KG	N
16144-78	16144-78	ANTIMONY	5	33	MG/KG	N
6MW3D-0406	6MW3D-0406	ANTIMONY	5	7.0 J	MG/KG	N
16144-35	16144-35	AROCLOR-1254	350	18100	UG/KG	N
16144-36	16144-36	AROCLOR-1254	350	392 J	UG/KG	N
16144-37	16144-37	AROCLOR-1254	350	659	UG/KG	N
16144-38	16144-38	AROCLOR-1254	350	765	UG/KG	N
16144-39	16144-39	AROCLOR-1254	350	4130	UG/KG	N
16144-40-MAX	16144-40MAX	AROCLOR-1254	350	3750	UG/KG	N
16144-43	16144-43	AROCLOR-1254	350	674 J	UG/KG	N
16144-45	16144-45	AROCLOR-1254	350	359 J	UG/KG	N
16144-46	16144-46	AROCLOR-1254	350	628	UG/KG	N
16144-47	16144-47	AROCLOR-1254	350	698	UG/KG	N
16144-48	16144-48	AROCLOR-1254	350	903 J	UG/KG	N
16144-49	16144-49	AROCLOR-1254	350	2530	UG/KG	N
16144-50	16144-50	AROCLOR-1254	350	1260	UG/KG	N
16144-51	16144-51	AROCLOR-1254	350	6130	UG/KG	N
16144-52	16144-52	AROCLOR-1254	350	2810	UG/KG	N
16144-53	16144-53	AROCLOR-1254	350	2300	UG/KG	N
16144-54	16144-54	AROCLOR-1254	350	986	UG/KG	N
16144-55	16144-55	AROCLOR-1254	350	1930	UG/KG	N
16144-56-MAX	16144-56MAX	AROCLOR-1254	350	968	UG/KG	N
16144-62	16144-62	AROCLOR-1254	350	5870	UG/KG	N
16144-63-MAX	16144-63MAX	AROCLOR-1254	350	11200	UG/KG	N
16144-65	16144-65	AROCLOR-1254	350	5300	UG/KG	N
16144-66	16144-66	AROCLOR-1254	350	4790	UG/KG	N
16144-67	16144-67	AROCLOR-1254	350	8860	UG/KG	N
16144-68	16144-68	AROCLOR-1254	350	5970	UG/KG	N
16144-69	16144-69	AROCLOR-1254	350	5440	UG/KG	N
16144-70	16144-70	AROCLOR-1254	350	9250	UG/KG	N
16144-71	16144-71	AROCLOR-1254	350	10800	UG/KG	N
16144-72	16144-72	AROCLOR-1254	350	22400	UG/KG	N
16144-74-MAX	16144-74MAX	AROCLOR-1254	350	684	UG/KG	N
16144-75	16144-75	AROCLOR-1254	350	741	UG/KG	N
16144-78	16144-78	AROCLOR-1254	350	1930	UG/KG	N
6TB20 (4-6)	6TB20 (4-6)	AROCLOR-1254	350	440	UG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	AROCLOR-1260	350	2400	UG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	AROCLOR-1260	350	2900	UG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	AROCLOR-1260	350	11000 J	UG/KG	Y
100490-6TB2(2-4)	6TB2(2-4)	AROCLOR-1260	350	12000 J	UG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	AROCLOR-1260	350	3200 J	UG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	AROCLOR-1260	350	450 J	UG/KG	Y
112790-6SS3-MAX	6SS3MAX	AROCLOR-1260	350	1400 J	UG/KG	Y

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
112790-6SS4	6SS4	AROCLOR-1260	350	3100 J	UG/KG	Y
16144-35	16144-35	AROCLOR-1260	350	29100	UG/KG	N
16144-36	16144-36	AROCLOR-1260	350	763	UG/KG	N
16144-38	16144-38	AROCLOR-1260	350	579	UG/KG	N
16144-39	16144-39	AROCLOR-1260	350	2220	UG/KG	N
16144-40-MAX	16144-40MAX	AROCLOR-1260	350	1790	UG/KG	N
16144-42	16144-42	AROCLOR-1260	350	371	UG/KG	N
16144-43	16144-43	AROCLOR-1260	350	1490	UG/KG	N
16144-45	16144-45	AROCLOR-1260	350	749 J	UG/KG	N
16144-46	16144-46	AROCLOR-1260	350	499	UG/KG	N
16144-47	16144-47	AROCLOR-1260	350	380	UG/KG	N
16144-49	16144-49	AROCLOR-1260	350	1500	UG/KG	N
16144-50	16144-50	AROCLOR-1260	350	680 J	UG/KG	N
16144-51	16144-51	AROCLOR-1260	350	13800	UG/KG	N
16144-52	16144-52	AROCLOR-1260	350	1680	UG/KG	N
16144-53	16144-53	AROCLOR-1260	350	2230	UG/KG	N
16144-54	16144-54	AROCLOR-1260	350	1270	UG/KG	N
16144-55	16144-55	AROCLOR-1260	350	1900	UG/KG	N
16144-56-MAX	16144-56MAX	AROCLOR-1260	350	1570	UG/KG	N
16144-62	16144-62	AROCLOR-1260	350	13900	UG/KG	N
16144-63-MAX	16144-63MAX	AROCLOR-1260	350	18000	UG/KG	N
16144-65	16144-65	AROCLOR-1260	350	1870	UG/KG	N
16144-66	16144-66	AROCLOR-1260	350	6560	UG/KG	N
16144-67	16144-67	AROCLOR-1260	350	8790	UG/KG	N
16144-69	16144-69	AROCLOR-1260	350	2740	UG/KG	N
16144-74-MAX	16144-74MAX	AROCLOR-1260	350	1610	UG/KG	N
16144-75	16144-75	AROCLOR-1260	350	1590	UG/KG	N
6TB20 (4-6)	6TB20 (4-6)	AROCLOR-1260	350	1100 PJ	UG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	ARSENIC	0.96	2.3	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	ARSENIC	0.96	2.6	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	ARSENIC	0.96	2.4	MG/KG	Y
100490-6TB2(2-4)	6TB2(2-4)	ARSENIC	0.96	3.3	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	ARSENIC	0.96	2.0	MG/KG	Y
100490-6TB3(6-8)	6TB3(6-8)	ARSENIC	0.96	1.1	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	ARSENIC	0.96	6.5	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	ARSENIC	0.96	3.4 J	MG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	ARSENIC	0.96	1.5 J	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	ARSENIC	0.96	3.4 J	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	ARSENIC	0.96	7.5 J	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	ARSENIC	0.96	1.5 J	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	ARSENIC	0.96	1.6 J	MG/KG	Y
101590-6MW5S(0-2)	6MW5S(0-2)	ARSENIC	0.96	1.2 J	MG/KG	Y
101590-6MW5S(8-10)	6MW5S(8-10)	ARSENIC	0.96	1.9 J	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	ARSENIC	0.96	2.3 J	MG/KG	Y
112790-6SS4	6SS4	ARSENIC	0.96	1.5 J	MG/KG	Y
16144-35	16144-35	ARSENIC	0.96	2.84	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-36	16144-36	ARSENIC	0.96	2.07	MG/KG	N
16144-37	16144-37	ARSENIC	0.96	4.48	MG/KG	N
16144-38	16144-38	ARSENIC	0.96	1.87	MG/KG	N
16144-39	16144-39	ARSENIC	0.96	4.43	MG/KG	N
16144-40-MAX	16144-40MAX	ARSENIC	0.96	12.0	MG/KG	N
16144-42	16144-42	ARSENIC	0.96	3.49	MG/KG	N
16144-43	16144-43	ARSENIC	0.96	10.2	MG/KG	N
16144-44	16144-44	ARSENIC	0.96	2.0	MG/KG	N
16144-45	16144-45	ARSENIC	0.96	5.08	MG/KG	N
16144-47	16144-47	ARSENIC	0.96	3.05	MG/KG	N
16144-48	16144-48	ARSENIC	0.96	10.6	MG/KG	N
16144-49	16144-49	ARSENIC	0.96	8.32	MG/KG	N
16144-50	16144-50	ARSENIC	0.96	4.9	MG/KG	N
16144-51	16144-51	ARSENIC	0.96	1.31	MG/KG	N
16144-52	16144-52	ARSENIC	0.96	10.0	MG/KG	N
16144-54	16144-54	ARSENIC	0.96	1.62	MG/KG	N
16144-55	16144-55	ARSENIC	0.96	2.35	MG/KG	N
16144-56-MAX	16144-56MAX	ARSENIC	0.96	17.0	MG/KG	N
16144-60	16144-60	ARSENIC	0.96	1.35	MG/KG	N
16144-61	16144-61	ARSENIC	0.96	2.1	MG/KG	N
16144-62	16144-62	ARSENIC	0.96	3.29	MG/KG	N
16144-63-MAX	16144-63MAX	ARSENIC	0.96	5.51	MG/KG	N
16144-65	16144-65	ARSENIC	0.96	4.06	MG/KG	N
16144-66	16144-66	ARSENIC	0.96	8.93	MG/KG	N
16144-67	16144-67	ARSENIC	0.96	2.5	MG/KG	N
16144-68	16144-68	ARSENIC	0.96	1.7	MG/KG	N
16144-69	16144-69	ARSENIC	0.96	1.12	MG/KG	N
16144-70	16144-70	ARSENIC	0.96	2.23	MG/KG	N
16144-71	16144-71	ARSENIC	0.96	5.08	MG/KG	N
16144-72	16144-72	ARSENIC	0.96	12	MG/KG	N
16144-73	16144-73	ARSENIC	0.96	1.68	MG/KG	N
16144-74-MAX	16144-74MAX	ARSENIC	0.96	5.65	MG/KG	N
16144-75	16144-75	ARSENIC	0.96	16.4	MG/KG	N
16144-76	16144-76	ARSENIC	0.96	4.74	MG/KG	N
16144-77	16144-77	ARSENIC	0.96	3.89	MG/KG	N
16144-78	16144-78	ARSENIC	0.96	7.89	MG/KG	N
16144-80	16144-80	ARSENIC	0.96	1.73	MG/KG	N
6MW2D0406	6MW2D0406	ARSENIC	0.96	2.3	MG/KG	N
6MW3D-0406	6MW3D-0406	ARSENIC	0.96	5.4	MG/KG	N
6MW7S-0709	6MW7S-0709	ARSENIC	0.96	5.2	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	ARSENIC	0.96	2.3	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	ARSENIC	0.96	2.0	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	ARSENIC	0.96	3.4	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	ARSENIC	0.96	1.1	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	ARSENIC	0.96	5.2	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	ARSENIC	0.96	2.1	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
6TB8 (0-1)	6TB8 (0-1)	ARSENIC	0.96	2.9	MG/KG	N
6TB8 (4-6)	6TB8 (4-6)	ARSENIC	0.96	1.7	MG/KG	N
6TB9 (2-4)	6TB9 (2-4)	ARSENIC	0.96	1.8	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	BARIUM	160	174	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	BARIUM	160	170	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	BARIUM	160	163	MG/KG	Y
16144-35	16144-35	BARIUM	160	162	MG/KG	N
16144-36	16144-36	BARIUM	160	166	MG/KG	N
16144-37	16144-37	BARIUM	160	791	MG/KG	N
16144-39	16144-39	BARIUM	160	185	MG/KG	N
16144-40-MAX	16144-40MAX	BARIUM	160	934	MG/KG	N
16144-42	16144-42	BARIUM	160	403	MG/KG	N
16144-43	16144-43	BARIUM	160	270	MG/KG	N
16144-46	16144-46	BARIUM	160	305	MG/KG	N
16144-48	16144-48	BARIUM	160	471	MG/KG	N
16144-49	16144-49	BARIUM	160	429	MG/KG	N
16144-50	16144-50	BARIUM	160	228	MG/KG	N
16144-51	16144-51	BARIUM	160	163	MG/KG	N
16144-52	16144-52	BARIUM	160	371	MG/KG	N
16144-54	16144-54	BARIUM	160	175	MG/KG	N
16144-61	16144-61	BARIUM	160	236	MG/KG	N
16144-62	16144-62	BARIUM	160	169	MG/KG	N
16144-63-MAX	16144-63MAX	BARIUM	160	332	MG/KG	N
16144-65	16144-65	BARIUM	160	300	MG/KG	N
16144-66	16144-66	BARIUM	160	328	MG/KG	N
16144-67	16144-67	BARIUM	160	334	MG/KG	N
16144-68	16144-68	BARIUM	160	170	MG/KG	N
16144-70	16144-70	BARIUM	160	236	MG/KG	N
16144-71	16144-71	BARIUM	160	182	MG/KG	N
16144-77	16144-77	BARIUM	160	282	MG/KG	N
16144-78	16144-78	BARIUM	160	459	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	BARIUM	160	181 J	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	BENZO(A)ANTHRACENE	2000	3200	UG/KG	Y
16144-37	16144-37	BENZO(A)ANTHRACENE	2000	9320	UG/KG	N
16144-43	16144-43	BENZO(A)ANTHRACENE	2000	17100	UG/KG	N
16144-45	16144-45	BENZO(A)ANTHRACENE	2000	43700	UG/KG	N
16144-48	16144-48	BENZO(A)ANTHRACENE	2000	5950 J	UG/KG	N
16144-51	16144-51	BENZO(A)ANTHRACENE	2000	3620 J	UG/KG	N
16144-53	16144-53	BENZO(A)ANTHRACENE	2000	2450	UG/KG	N
16144-54	16144-54	BENZO(A)ANTHRACENE	2000	2500	UG/KG	N
16144-55	16144-55	BENZO(A)ANTHRACENE	2000	3240 J	UG/KG	N
16144-63-MAX	16144-63MAX	BENZO(A)ANTHRACENE	2000	9920	UG/KG	N
16144-71	16144-71	BENZO(A)ANTHRACENE	2000	3670 J	UG/KG	N
16144-72	16144-72	BENZO(A)ANTHRACENE	2000	9320	UG/KG	N
16144-77	16144-77	BENZO(A)ANTHRACENE	2000	4890	UG/KG	N
16144-81	16144-81	BENZO(A)ANTHRACENE	2000	12300	UG/KG	N

6TB17 (10'-12')
Ba: 188 mg/kg > PRG = 160 mg/kg
for sw. protection

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
092790-6MW4(0-2)	6MW4(0-2)	BENZO(A)PYRENE	200	4000	UG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	BENZO(A)PYRENE	200	1800 J	UG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	BENZO(A)PYRENE	200	680 J	UG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	BENZO(A)PYRENE	200	780	UG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	BENZO(A)PYRENE	200	320 J	UG/KG	Y
16144-35	16144-35	BENZO(A)PYRENE	200	453 J	UG/KG	N
16144-37	16144-37	BENZO(A)PYRENE	200	10900	UG/KG	N
16144-38	16144-38	BENZO(A)PYRENE	200	2030 J	UG/KG	N
16144-43	16144-43	BENZO(A)PYRENE	200	20000	UG/KG	N
16144-44	16144-44	BENZO(A)PYRENE	200	366 J	UG/KG	N
16144-45	16144-45	BENZO(A)PYRENE	200	40600	UG/KG	N
16144-46	16144-46	BENZO(A)PYRENE	200	2020 J	UG/KG	N
16144-47	16144-47	BENZO(A)PYRENE	200	803 J	UG/KG	N
16144-48	16144-48	BENZO(A)PYRENE	200	7830 J	UG/KG	N
16144-50	16144-50	BENZO(A)PYRENE	200	2380 J	UG/KG	N
16144-51	16144-51	BENZO(A)PYRENE	200	5070 J	UG/KG	N
16144-52	16144-52	BENZO(A)PYRENE	200	2020 J	UG/KG	N
16144-53	16144-53	BENZO(A)PYRENE	200	4930	UG/KG	N
16144-54	16144-54	BENZO(A)PYRENE	200	3930	UG/KG	N
16144-55	16144-55	BENZO(A)PYRENE	200	4980 J	UG/KG	N
16144-60	16144-60	BENZO(A)PYRENE	200	276 J	UG/KG	N
16144-61	16144-61	BENZO(A)PYRENE	200	1130	UG/KG	N
16144-62	16144-62	BENZO(A)PYRENE	200	1810 J	UG/KG	N
16144-63-MAX	16144-63MAX	BENZO(A)PYRENE	200	6350	UG/KG	N
16144-65	16144-65	BENZO(A)PYRENE	200	888 J	UG/KG	N
16144-72	16144-72	BENZO(A)PYRENE	200	6920 J	UG/KG	N
16144-73	16144-73	BENZO(A)PYRENE	200	401	UG/KG	N
16144-74-MAX	16144-74MAX	BENZO(A)PYRENE	200	684	UG/KG	N
16144-75	16144-75	BENZO(A)PYRENE	200	298 J	UG/KG	N
16144-77	16144-77	BENZO(A)PYRENE	200	3570	UG/KG	N
16144-78	16144-78	BENZO(A)PYRENE	200	767 J	UG/KG	N
16144-81	16144-81	BENZO(A)PYRENE	200	8810	UG/KG	N
6TB10 (4-6)	6TB10 (4-6)	BENZO(A)PYRENE	200	280 J	UG/KG	N
6TB8 (0-1)	6TB8 (0-1)	BENZO(A)PYRENE	200	240 J	UG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	BENZO(B)FLUORANTHENE	2000	2700	UG/KG	Y
16144-37	16144-37	BENZO(B)FLUORANTHENE	2000	11200	UG/KG	N
16144-43	16144-43	BENZO(B)FLUORANTHENE	2000	20800	UG/KG	N
16144-45	16144-45	BENZO(B)FLUORANTHENE	2000	78600	UG/KG	N
16144-46	16144-46	BENZO(B)FLUORANTHENE	2000	2270 J	UG/KG	N
16144-48	16144-48	BENZO(B)FLUORANTHENE	2000	18400	UG/KG	N
16144-49	16144-49	BENZO(B)FLUORANTHENE	2000	2990 J	UG/KG	N
16144-50	16144-50	BENZO(B)FLUORANTHENE	2000	2910 J	UG/KG	N
16144-51	16144-51	BENZO(B)FLUORANTHENE	2000	10700	UG/KG	N
16144-52	16144-52	BENZO(B)FLUORANTHENE	2000	3910	UG/KG	N
16144-53	16144-53	BENZO(B)FLUORANTHENE	2000	4750	UG/KG	N
16144-54	16144-54	BENZO(B)FLUORANTHENE	2000	6000	UG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-55	16144-55	BENZO(B)FLUORANTHENE	2000	9890 J	UG/KG	N
16144-62	16144-62	BENZO(B)FLUORANTHENE	2000	2660 J	UG/KG	N
16144-63-MAX	16144-63MAX	BENZO(B)FLUORANTHENE	2000	6480	UG/KG	N
16144-65	16144-65	BENZO(B)FLUORANTHENE	2000	2030 J	UG/KG	N
16144-71	16144-71	BENZO(B)FLUORANTHENE	2000	6930 J	UG/KG	N
16144-72	16144-72	BENZO(B)FLUORANTHENE	2000	8050	UG/KG	N
16144-77	16144-77	BENZO(B)FLUORANTHENE	2000	4070	UG/KG	N
16144-81	16144-81	BENZO(B)FLUORANTHENE	2000	8870	UG/KG	N
112790-6SS3-MAX	6SS3MAX	BENZOIC ACID	8400	12000 J	UG/KG	Y
112790-6SS4	6SS4	BENZOIC ACID	8400	9300 J	UG/KG	Y
092790-6MW4(0-2)	6MW4(0-2)	BERYLLIUM	0.35	0.79	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	BERYLLIUM	0.35	0.54	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	BERYLLIUM	0.35	0.87	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	BERYLLIUM	0.35	0.52	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	BERYLLIUM	0.35	0.58	MG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	BERYLLIUM	0.35	0.54	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	BERYLLIUM	0.35	0.38	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	BERYLLIUM	0.35	0.37	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	BERYLLIUM	0.35	0.39	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	BERYLLIUM	0.35	1.8	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	BERYLLIUM	0.35	0.54	MG/KG	Y
16144-35	16144-35	BERYLLIUM	0.35	1.76	MG/KG	N
16144-36	16144-36	BERYLLIUM	0.35	24.9	MG/KG	N
16144-37	16144-37	BERYLLIUM	0.35	0.582	MG/KG	N
16144-38	16144-38	BERYLLIUM	0.35	1.21	MG/KG	N
16144-39	16144-39	BERYLLIUM	0.35	0.806	MG/KG	N
16144-40-MAX	16144-40MAX	BERYLLIUM	0.35	3.250	MG/KG	N
16144-42	16144-42	BERYLLIUM	0.35	16.7	MG/KG	N
16144-43	16144-43	BERYLLIUM	0.35	2.38	MG/KG	N
16144-45	16144-45	BERYLLIUM	0.35	0.614	MG/KG	N
16144-46	16144-46	BERYLLIUM	0.35	4.12	MG/KG	N
16144-47	16144-47	BERYLLIUM	0.35	7.88	MG/KG	N
16144-48	16144-48	BERYLLIUM	0.35	20.0	MG/KG	N
16144-49	16144-49	BERYLLIUM	0.35	5.92	MG/KG	N
16144-50	16144-50	BERYLLIUM	0.35	1.83	MG/KG	N
16144-51	16144-51	BERYLLIUM	0.35	0.934	MG/KG	N
16144-53	16144-53	BERYLLIUM	0.35	0.467	MG/KG	N
16144-54	16144-54	BERYLLIUM	0.35	8.54	MG/KG	N
16144-55	16144-55	BERYLLIUM	0.35	2.62	MG/KG	N
16144-56-MAX	16144-56MAX	BERYLLIUM	0.35	1.7	MG/KG	N
16144-62	16144-62	BERYLLIUM	0.35	7.22	MG/KG	N
16144-63-MAX	16144-63MAX	BERYLLIUM	0.35	0.722	MG/KG	N
16144-65	16144-65	BERYLLIUM	0.35	1.51	MG/KG	N
16144-66	16144-66	BERYLLIUM	0.35	0.979	MG/KG	N
16144-67	16144-67	BERYLLIUM	0.35	0.889	MG/KG	N
16144-68	16144-68	BERYLLIUM	0.35	0.883	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-69	16144-69	BERYLLIUM	0.35	0.684	MG/KG	N
16144-70	16144-70	BERYLLIUM	0.35	1.77	MG/KG	N
16144-71	16144-71	BERYLLIUM	0.35	1.27	MG/KG	N
16144-72	16144-72	BERYLLIUM	0.35	2.19	MG/KG	N
16144-74-MAX	16144-74MAX	BERYLLIUM	0.35	1.120	MG/KG	N
16144-75	16144-75	BERYLLIUM	0.35	0.585	MG/KG	N
16144-78	16144-78	BERYLLIUM	0.35	14.3	MG/KG	N
6MW3D-0406	6MW3D-0406	BERYLLIUM	0.35	0.4 J	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	BERYLLIUM	0.35	0.35 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	BERYLLIUM	0.35	2.2	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	BERYLLIUM	0.35	0.9 J	MG/KG	N
6MW2D0406	6MW2D0406	BORON	0.5	15.6 J	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	BORON	0.5	2.9	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	BORON	0.5	60.2	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	CADMIUM	3	6.7	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	CADMIUM	3	6.4	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	CADMIUM	3	4.9 J	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	CADMIUM	3	5.6	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	CADMIUM	3	3.6	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	CADMIUM	3	4.1	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	CADMIUM	3	3.9	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	CADMIUM	3	6.6	MG/KG	Y
16144-35	16144-35	CADMIUM	3	75.9	MG/KG	N
16144-37	16144-37	CADMIUM	3	8.05	MG/KG	N
16144-39	16144-39	CADMIUM	3	4.33	MG/KG	N
16144-40-MAX	16144-40MAX	CADMIUM	3	126	MG/KG	N
16144-42	16144-42	CADMIUM	3	3.8	MG/KG	N
16144-43	16144-43	CADMIUM	3	4.22	MG/KG	N
16144-46	16144-46	CADMIUM	3	6.51	MG/KG	N
16144-48	16144-48	CADMIUM	3	6.35	MG/KG	N
16144-49	16144-49	CADMIUM	3	13.2	MG/KG	N
16144-50	16144-50	CADMIUM	3	14.9	MG/KG	N
16144-51	16144-51	CADMIUM	3	4.33	MG/KG	N
16144-52	16144-52	CADMIUM	3	10.7	MG/KG	N
16144-55	16144-55	CADMIUM	3	23.5	MG/KG	N
16144-56-MAX	16144-56MAX	CADMIUM	3	3.07	MG/KG	N
16144-62	16144-62	CADMIUM	3	4.07	MG/KG	N
16144-63-MAX	16144-63MAX	CADMIUM	3	8.99	MG/KG	N
16144-65	16144-65	CADMIUM	3	9.51	MG/KG	N
16144-66	16144-66	CADMIUM	3	9.04	MG/KG	N
16144-67	16144-67	CADMIUM	3	15.3	MG/KG	N
16144-68	16144-68	CADMIUM	3	10.3	MG/KG	N
16144-69	16144-69	CADMIUM	3	13.1	MG/KG	N
16144-70	16144-70	CADMIUM	3	4.4	MG/KG	N
16144-71	16144-71	CADMIUM	3	12.2	MG/KG	N
16144-72	16144-72	CADMIUM	3	36.4	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-74-MAX	16144-74MAX	CADMIUM	3	3.87	MG/KG	N
16144-77	16144-77	CADMIUM	3	5.15	MG/KG	N
16144-78	16144-78	CADMIUM	3	19.1	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	CADMIUM	3	4.3	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	CHROMIUM	0.4	55.0 J	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	CHROMIUM	0.4	139 J	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	CHROMIUM	0.4	15.2	MG/KG	Y
100490-6TB2(2-4)	6TB2(2-4)	CHROMIUM	0.4	11.0	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	CHROMIUM	0.4	13.1	MG/KG	Y
100490-6TB3(6-8)	6TB3(6-8)	CHROMIUM	0.4	16.1	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	CHROMIUM	0.4	29.0	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	CHROMIUM	0.4	18.3 J	MG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	CHROMIUM	0.4	14.5 J	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	CHROMIUM	0.4	15.2	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	CHROMIUM	0.4	19.7	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	CHROMIUM	0.4	35.0	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	CHROMIUM	0.4	29.6	MG/KG	Y
101590-6MW5S(0-2)	6MW5S(0-2)	CHROMIUM	0.4	20.7	MG/KG	Y
101590-6MW5S(8-10)	6MW5S(8-10)	CHROMIUM	0.4	6.2	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	CHROMIUM	0.4	41.3	MG/KG	Y
112790-6SS4	6SS4	CHROMIUM	0.4	12.6	MG/KG	Y
16144-35	16144-35	CHROMIUM	0.4	29.9	MG/KG	N
16144-36	16144-36	CHROMIUM	0.4	61.6	MG/KG	N
16144-37	16144-37	CHROMIUM	0.4	31.6	MG/KG	N
16144-38	16144-38	CHROMIUM	0.4	18.3	MG/KG	N
16144-39	16144-39	CHROMIUM	0.4	29.9	MG/KG	N
16144-40-MAX	16144-40MAX	CHROMIUM	0.4	114	MG/KG	N
16144-42	16144-42	CHROMIUM	0.4	95.6	MG/KG	N
16144-43	16144-43	CHROMIUM	0.4	54.2	MG/KG	N
16144-44	16144-44	CHROMIUM	0.4	10.0	MG/KG	N
16144-45	16144-45	CHROMIUM	0.4	27.3	MG/KG	N
16144-46	16144-46	CHROMIUM	0.4	155	MG/KG	N
16144-47	16144-47	CHROMIUM	0.4	64.2	MG/KG	N
16144-48	16144-48	CHROMIUM	0.4	179	MG/KG	N
16144-49	16144-49	CHROMIUM	0.4	86.1	MG/KG	N
16144-50	16144-50	CHROMIUM	0.4	24.7	MG/KG	N
16144-51	16144-51	CHROMIUM	0.4	23.2	MG/KG	N
16144-52	16144-52	CHROMIUM	0.4	32.3	MG/KG	N
16144-53	16144-53	CHROMIUM	0.4	71.4	MG/KG	N
16144-54	16144-54	CHROMIUM	0.4	54.2	MG/KG	N
16144-55	16144-55	CHROMIUM	0.4	43.6	MG/KG	N
16144-56-MAX	16144-56MAX	CHROMIUM	0.4	24.8	MG/KG	N
16144-60	16144-60	CHROMIUM	0.4	6.87	MG/KG	N
16144-61	16144-61	CHROMIUM	0.4	18.1	MG/KG	N
16144-62	16144-62	CHROMIUM	0.4	55.6	MG/KG	N
16144-63-MAX	16144-63MAX	CHROMIUM	0.4	1210	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-65	16144-65	CHROMIUM	0.4	134	MG/KG	N
16144-66	16144-66	CHROMIUM	0.4	50.8	MG/KG	N
16144-67	16144-67	CHROMIUM	0.4	91.3	MG/KG	N
16144-68	16144-68	CHROMIUM	0.4	22.5	MG/KG	N
16144-69	16144-69	CHROMIUM	0.4	19.3	MG/KG	N
16144-70	16144-70	CHROMIUM	0.4	28.5	MG/KG	N
16144-71	16144-71	CHROMIUM	0.4	33.2	MG/KG	N
16144-72	16144-72	CHROMIUM	0.4	72.8	MG/KG	N
16144-73	16144-73	CHROMIUM	0.4	13.6	MG/KG	N
16144-74-MAX	16144-74MAX	CHROMIUM	0.4	24.2	MG/KG	N
16144-75	16144-75	CHROMIUM	0.4	93	MG/KG	N
16144-76	16144-76	CHROMIUM	0.4	7.62	MG/KG	N
16144-77	16144-77	CHROMIUM	0.4	9.61	MG/KG	N
16144-78	16144-78	CHROMIUM	0.4	69	MG/KG	N
16144-79	16144-79	CHROMIUM	0.4	4.42	MG/KG	N
16144-80	16144-80	CHROMIUM	0.4	5.99	MG/KG	N
16144-81	16144-81	CHROMIUM	0.4	5.71	MG/KG	N
6MW2D0406	6MW2D0406	CHROMIUM	0.4	11.4	MG/KG	N
6MW3D-0406	6MW3D-0406	CHROMIUM	0.4	13.8	MG/KG	N
6MW7S-0709	6MW7S-0709	CHROMIUM	0.4	17.7	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	CHROMIUM	0.4	20.1 J	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	CHROMIUM	0.4	13.9 J	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	CHROMIUM	0.4	8.9 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	CHROMIUM	0.4	36.4 J	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	CHROMIUM	0.4	10.0 J	MG/KG	N
6TB8 (0-1)	6TB8 (0-1)	CHROMIUM	0.4	12.6 J	MG/KG	N
6TB8 (4-6)	6TB8 (4-6)	CHROMIUM	0.4	12.7 J	MG/KG	N
16144-36	16144-36	COBALT	20	97.4	MG/KG	N
16144-40-MAX	16144-40MAX	COBALT	20	39.4	MG/KG	N
16144-42	16144-42	COBALT	20	142	MG/KG	N
16144-43	16144-43	COBALT	20	38.2	MG/KG	N
16144-46	16144-46	COBALT	20	31.1	MG/KG	N
16144-47	16144-47	COBALT	20	41.0	MG/KG	N
16144-48	16144-48	COBALT	20	179	MG/KG	N
16144-49	16144-49	COBALT	20	60.1	MG/KG	N
16144-54	16144-54	COBALT	20	76.7	MG/KG	N
16144-55	16144-55	COBALT	20	24.4	MG/KG	N
16144-62	16144-62	COBALT	20	40.7	MG/KG	N
16144-70	16144-70	COBALT	20	21.5	MG/KG	N
16144-78	16144-78	COBALT	20	83.3	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	COBALT	20	29.0	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	COPPER	50	513	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	COPPER	50	380	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	COPPER	50	65.6 J	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	COPPER	50	67.5 J	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	COPPER	50	59.7	MG/KG	Y

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
101190-6TB1(2-4)	6TB1(2-4)	COPPER	50	227	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	COPPER	50	362	MG/KG	Y
112790-6SS4	6SS4	COPPER	50	258	MG/KG	Y
16144-35	16144-35	COPPER	50	4380	MG/KG	N
16144-36	16144-36	COPPER	50	1960	MG/KG	N
16144-37	16144-37	COPPER	50	4700	MG/KG	N
16144-38	16144-38	COPPER	50	373	MG/KG	N
16144-39	16144-39	COPPER	50	1100	MG/KG	N
16144-40-MAX	16144-40MAX	COPPER	50	7170	MG/KG	N
16144-42	16144-42	COPPER	50	4470	MG/KG	N
16144-43	16144-43	COPPER	50	1050	MG/KG	N
16144-45	16144-45	COPPER	50	144	MG/KG	N
16144-46	16144-46	COPPER	50	5060	MG/KG	N
16144-47	16144-47	COPPER	50	835	MG/KG	N
16144-48	16144-48	COPPER	50	5710	MG/KG	N
16144-49	16144-49	COPPER	50	8730	MG/KG	N
16144-50	16144-50	COPPER	50	7830	MG/KG	N
16144-51	16144-51	COPPER	50	954	MG/KG	N
16144-52	16144-52	COPPER	50	821	MG/KG	N
16144-53	16144-53	COPPER	50	175	MG/KG	N
16144-54	16144-54	COPPER	50	2220	MG/KG	N
16144-55	16144-55	COPPER	50	1600	MG/KG	N
16144-56-MAX	16144-56MAX	COPPER	50	412	MG/KG	N
16144-61	16144-61	COPPER	50	115	MG/KG	N
16144-62	16144-62	COPPER	50	1580	MG/KG	N
16144-63-MAX	16144-63MAX	COPPER	50	3030	MG/KG	N
16144-65	16144-65	COPPER	50	1540	MG/KG	N
16144-66	16144-66	COPPER	50	2540	MG/KG	N
16144-67	16144-67	COPPER	50	2680	MG/KG	N
16144-68	16144-68	COPPER	50	677	MG/KG	N
16144-69	16144-69	COPPER	50	758	MG/KG	N
16144-70	16144-70	COPPER	50	4460	MG/KG	N
16144-71	16144-71	COPPER	50	851	MG/KG	N
16144-72	16144-72	COPPER	50	1710	MG/KG	N
16144-74-MAX	16144-74MAX	COPPER	50	551	MG/KG	N
16144-75	16144-75	COPPER	50	415	MG/KG	N
16144-77	16144-77	COPPER	50	515	MG/KG	N
16144-78	16144-78	COPPER	50	3780	MG/KG	N
6MW3D-0406	6MW3D-0406	COPPER	50	50.6 J	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	COPPER	50	132 J	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	COPPER	50	69.5 J	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	COPPER	50	58.3 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	COPPER	50	467 J	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	COPPER	50	199 J	MG/KG	N
6TB9 (2-4)	6TB9 (2-4)	COPPER	50	87.4 J	MG/KG	N
16144-37	16144-37	DIBENZO(A,H)ANTHRACENE	200	1160 J	UG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
092790-6MW4(0-2)	6MW4(0-2)	LEAD	50	390	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	LEAD	50	245	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	LEAD	50	63.4 J	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	LEAD	50	459	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	LEAD	50	51.3	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	LEAD	50	168 J	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	LEAD	50	308	MG/KG	Y
16144-35	16144-35	LEAD	50	2900	MG/KG	N
16144-36	16144-36	LEAD	50	1400	MG/KG	N
16144-37	16144-37	LEAD	50	650	MG/KG	N
16144-38	16144-38	LEAD	50	365	MG/KG	N
16144-39	16144-39	LEAD	50	727	MG/KG	N
16144-40-MAX	16144-40MAX	LEAD	50	3530	MG/KG	N
16144-42	16144-42	LEAD	50	3100	MG/KG	N
16144-43	16144-43	LEAD	50	824	MG/KG	N
16144-45	16144-45	LEAD	50	416	MG/KG	N
16144-46	16144-46	LEAD	50	854	MG/KG	N
16144-47	16144-47	LEAD	50	325	MG/KG	N
16144-48	16144-48	LEAD	50	3180	MG/KG	N
16144-49	16144-49	LEAD	50	2700	MG/KG	N
16144-50	16144-50	LEAD	50	909	MG/KG	N
16144-51	16144-51	LEAD	50	844	MG/KG	N
16144-52	16144-52	LEAD	50	1040	MG/KG	N
16144-53	16144-53	LEAD	50	255	MG/KG	N
16144-54	16144-54	LEAD	50	1220	MG/KG	N
16144-55	16144-55	LEAD	50	802	MG/KG	N
16144-56-MAX	16144-56MAX	LEAD	50	1450	MG/KG	N
16144-61	16144-61	LEAD	50	93.2	MG/KG	N
16144-62	16144-62	LEAD	50	2390	MG/KG	N
16144-63-MAX	16144-63MAX	LEAD	50	3350	MG/KG	N
16144-65	16144-65	LEAD	50	777	MG/KG	N
16144-66	16144-66	LEAD	50	901	MG/KG	N
16144-67	16144-67	LEAD	50	1600	MG/KG	N
16144-68	16144-68	LEAD	50	1400	MG/KG	N
16144-69	16144-69	LEAD	50	482	MG/KG	N
16144-70	16144-70	LEAD	50	5520	MG/KG	N
16144-71	16144-71	LEAD	50	1230	MG/KG	N
16144-72	16144-72	LEAD	50	1100	MG/KG	N
16144-73	16144-73	LEAD	50	212	MG/KG	N
16144-74-MAX	16144-74MAX	LEAD	50	1030	MG/KG	N
16144-75	16144-75	LEAD	50	273	MG/KG	N
16144-77	16144-77	LEAD	50	5980	MG/KG	N
16144-78	16144-78	LEAD	50	4830	MG/KG	N
6MW7S-0709	6MW7S-0709	LEAD	50	50.7	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	LEAD	50	55.4	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	LEAD	50	119 J	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	*sample*	*para*	*PRG*	*result*	*units*	*validated*
6TB12 (0-2)	6TB12 (0-2)	LEAD	50	94.3	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	LEAD	50	174 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	LEAD	50	337 J	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	LEAD	50	413	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	MERCURY	0.128	0.35	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	MERCURY	0.128	0.31	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	MERCURY	0.128	0.14 J	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	MERCURY	0.128	1.9 J	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	MERCURY	0.128	0.14	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	MERCURY	0.128	0.15 J	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	MERCURY	0.128	0.14 J	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	MERCURY	0.128	0.19 J	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	MERCURY	0.128	0.24 J	MG/KG	Y
112790-6SS4	6SS4	MERCURY	0.128	0.68 J	MG/KG	Y
16144-35	16144-35	MERCURY	0.128	0.173	MG/KG	N
16144-36	16144-36	MERCURY	0.128	0.281	MG/KG	N
16144-38	16144-38	MERCURY	0.128	0.254	MG/KG	N
16144-40-MAX	16144-40MAX	MERCURY	0.128	0.427	MG/KG	N
16144-42	16144-42	MERCURY	0.128	0.147	MG/KG	N
16144-43	16144-43	MERCURY	0.128	0.57	MG/KG	N
16144-45	16144-45	MERCURY	0.128	0.524	MG/KG	N
16144-46	16144-46	MERCURY	0.128	20.7	MG/KG	N
16144-48	16144-48	MERCURY	0.128	8.59	MG/KG	N
16144-49	16144-49	MERCURY	0.128	0.644	MG/KG	N
16144-50	16144-50	MERCURY	0.128	0.24	MG/KG	N
16144-51	16144-51	MERCURY	0.128	0.286	MG/KG	N
16144-53	16144-53	MERCURY	0.128	0.469	MG/KG	N
16144-54	16144-54	MERCURY	0.128	0.175	MG/KG	N
16144-55	16144-55	MERCURY	0.128	0.168	MG/KG	N
16144-62	16144-62	MERCURY	0.128	0.783	MG/KG	N
16144-63-MAX	16144-63MAX	MERCURY	0.128	0.366	MG/KG	N
16144-65	16144-65	MERCURY	0.128	0.542	MG/KG	N
16144-66	16144-66	MERCURY	0.128	0.533	MG/KG	N
16144-67	16144-67	MERCURY	0.128	1.27	MG/KG	N
16144-68	16144-68	MERCURY	0.128	0.507	MG/KG	N
16144-69	16144-69	MERCURY	0.128	0.513	MG/KG	N
16144-70	16144-70	MERCURY	0.128	0.448	MG/KG	N
16144-71	16144-71	MERCURY	0.128	0.963	MG/KG	N
16144-72	16144-72	MERCURY	0.128	3.25	MG/KG	N
16144-74-MAX	16144-74MAX	MERCURY	0.128	1.120	MG/KG	N
16144-75	16144-75	MERCURY	0.128	1.47	MG/KG	N
16144-77	16144-77	MERCURY	0.128	0.134	MG/KG	N
16144-78	16144-78	MERCURY	0.128	1.1	MG/KG	N
6MW2D0406	6MW2D0406	MERCURY	0.128	0.14	MG/KG	N
6MW3D-0406	6MW3D-0406	MERCURY	0.128	0.15 J	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	MERCURY	0.128	0.16 J	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
6TB11 (0-2)	6TB11 (0-2)	MERCURY	0.128	0.42	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	MERCURY	0.128	0.2 J	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	MERCURY	0.128	0.19	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	MERCURY	0.128	0.78	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	MERCURY	0.128	0.9 J	MG/KG	N
6TB9 (2-4)	6TB9 (2-4)	MERCURY	0.128	0.28 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	OCDD	0.59	3.07	UG/KG	N
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	SILVER	2	6.2 J	MG/KG	Y
16144-35	16144-35	SILVER	2	2.95	MG/KG	N
16144-39	16144-39	SILVER	2	5.87	MG/KG	N
16144-40-MAX	16144-40MAX	SILVER	2	14.4	MG/KG	N
16144-49	16144-49	SILVER	2	2.28	MG/KG	N
16144-51	16144-51	SILVER	2	2.2	MG/KG	N
16144-63-MAX	16144-63MAX	SILVER	2	24.3	MG/KG	N
16144-66	16144-66	SILVER	2	4.51	MG/KG	N
16144-67	16144-67	SILVER	2	10.1	MG/KG	N
16144-70	16144-70	SILVER	2	2.55	MG/KG	N
16144-78	16144-78	SILVER	2	3.12	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	VANADIUM	2	39.9	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	VANADIUM	2	63.8	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	VANADIUM	2	18.5	MG/KG	Y
100490-6TB2(2-4)	6TB2(2-4)	VANADIUM	2	11.8	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	VANADIUM	2	16.1	MG/KG	Y
100490-6TB3(6-8)	6TB3(6-8)	VANADIUM	2	19.3	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	VANADIUM	2	32.5	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	VANADIUM	2	26.9	MG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	VANADIUM	2	37.9	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	VANADIUM	2	22.6	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	VANADIUM	2	32.8	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	VANADIUM	2	45.6	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	VANADIUM	2	33.6	MG/KG	Y
101590-6MW5S(0-2)	6MW5S(0-2)	VANADIUM	2	35.5	MG/KG	Y
101590-6MW5S(8-10)	6MW5S(8-10)	VANADIUM	2	9.0	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	VANADIUM	2	53.2	MG/KG	Y
112790-6SS4	6SS4	VANADIUM	2	15.9	MG/KG	Y
16144-35	16144-35	VANADIUM	2	22.9	MG/KG	N
16144-36	16144-36	VANADIUM	2	19.0	MG/KG	N
16144-37	16144-37	VANADIUM	2	51.2	MG/KG	N
16144-38	16144-38	VANADIUM	2	24.1	MG/KG	N
16144-39	16144-39	VANADIUM	2	56.0	MG/KG	N
16144-40-MAX	16144-40MAX	VANADIUM	2	331	MG/KG	N
16144-42	16144-42	VANADIUM	2	31.9	MG/KG	N
16144-43	16144-43	VANADIUM	2	31.8	MG/KG	N
16144-44	16144-44	VANADIUM	2	25.6	MG/KG	N
16144-45	16144-45	VANADIUM	2	18.2	MG/KG	N
16144-46	16144-46	VANADIUM	2	77.9	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-47	16144-47	VANADIUM	2	328	MG/KG	N
16144-48	16144-48	VANADIUM	2	76.5	MG/KG	N
16144-49	16144-49	VANADIUM	2	126	MG/KG	N
16144-50	16144-50	VANADIUM	2	42.1	MG/KG	N
16144-51	16144-51	VANADIUM	2	46.3	MG/KG	N
16144-52	16144-52	VANADIUM	2	368	MG/KG	N
16144-53	16144-53	VANADIUM	2	14.9	MG/KG	N
16144-54	16144-54	VANADIUM	2	73.9	MG/KG	N
16144-55	16144-55	VANADIUM	2	39.5	MG/KG	N
16144-56-MAX	16144-56MAX	VANADIUM	2	25.4	MG/KG	N
16144-60	16144-60	VANADIUM	2	9.21	MG/KG	N
16144-61	16144-61	VANADIUM	2	11.2	MG/KG	N
16144-62	16144-62	VANADIUM	2	41.3	MG/KG	N
16144-63-MAX	16144-63MAX	VANADIUM	2	287	MG/KG	N
16144-65	16144-65	VANADIUM	2	73.1	MG/KG	N
16144-66	16144-66	VANADIUM	2	50	MG/KG	N
16144-67	16144-67	VANADIUM	2	190	MG/KG	N
16144-68	16144-68	VANADIUM	2	214	MG/KG	N
16144-69	16144-69	VANADIUM	2	94.2	MG/KG	N
16144-70	16144-70	VANADIUM	2	79.9	MG/KG	N
16144-71	16144-71	VANADIUM	2	119	MG/KG	N
16144-72	16144-72	VANADIUM	2	121	MG/KG	N
16144-73	16144-73	VANADIUM	2	17.1	MG/KG	N
16144-74-MAX	16144-74MAX	VANADIUM	2	51.4	MG/KG	N
16144-75	16144-75	VANADIUM	2	25.4	MG/KG	N
16144-76	16144-76	VANADIUM	2	8.74	MG/KG	N
16144-77	16144-77	VANADIUM	2	12.4	MG/KG	N
16144-78	16144-78	VANADIUM	2	36.7	MG/KG	N
16144-79	16144-79	VANADIUM	2	6.26	MG/KG	N
16144-80	16144-80	VANADIUM	2	6.68	MG/KG	N
16144-81	16144-81	VANADIUM	2	7.45	MG/KG	N
6MW2D0406	6MW2D0406	VANADIUM	2	22.2	MG/KG	N
6MW3D-0406	6MW3D-0406	VANADIUM	2	27.4	MG/KG	N
6MW7S-0709	6MW7S-0709	VANADIUM	2	39.8	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	VANADIUM	2	31.7	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	VANADIUM	2	16.4	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	VANADIUM	2	14.6	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	VANADIUM	2	11.5	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	VANADIUM	2	53.9	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	VANADIUM	2	26.9	MG/KG	N
6TB8 (0-1)	6TB8 (0-1)	VANADIUM	2	14.3	MG/KG	N
6TB8 (4-6)	6TB8 (4-6)	VANADIUM	2	27.7	MG/KG	N
6TB9 (2-4)	6TB9 (2-4)	VANADIUM	2	16.0	MG/KG	N
092790-6MW4(0-2)	6MW4(0-2)	ZINC	50	893 J	MG/KG	Y
092790-6MW4(2-4)	6MW4(2-4)	ZINC	50	573 J	MG/KG	Y
100490-6TB2(0-2)	6TB2(0-2)	ZINC	50	28300 J	MG/KG	Y

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
100490-6TB2(2-4)	6TB2(2-4)	ZINC	50	87.1 J	MG/KG	Y
100490-6TB3(0-2)	6TB3(0-2)	ZINC	50	136 J	MG/KG	Y
100490-6TB3(6-8)	6TB3(6-8)	ZINC	50	73.1 J	MG/KG	Y
100490-6TB4(6-8)	6TB4(6-8)	ZINC	50	58.5 J	MG/KG	Y
100990-6MW2(0-2)-MAX	6MW2(0-2)MAX	ZINC	50	68.1 J	MG/KG	Y
100990-6MW2(2-4)	6MW2(2-4)	ZINC	50	101 J	MG/KG	Y
101190-6MW1(0-2)	6MW1(0-2)	ZINC	50	133 J	MG/KG	Y
101190-6MW1(4-6)-MAX	6MW1(4-6)MAX	ZINC	50	117 J	MG/KG	Y
101190-6TB1(0-2)	6TB1(0-2)	ZINC	50	59.1 J	MG/KG	Y
101190-6TB1(2-4)	6TB1(2-4)	ZINC	50	676	MG/KG	Y
112790-6SS3-MAX	6SS3MAX	ZINC	50	415	MG/KG	Y
112790-6SS4	6SS4	ZINC	50	83.3 J	MG/KG	Y
16144-35	16144-35	ZINC	50	3860	MG/KG	N
16144-36	16144-36	ZINC	50	9400	MG/KG	N
16144-37	16144-37	ZINC	50	5040	MG/KG	N
16144-38	16144-38	ZINC	50	849	MG/KG	N
16144-39	16144-39	ZINC	50	979	MG/KG	N
16144-40-MAX	16144-40MAX	ZINC	50	7590	MG/KG	N
16144-42	16144-42	ZINC	50	21300	MG/KG	N
16144-43	16144-43	ZINC	50	2570	MG/KG	N
16144-44	16144-44	ZINC	50	140	MG/KG	N
16144-45	16144-45	ZINC	50	896	MG/KG	N
16144-46	16144-46	ZINC	50	3520	MG/KG	N
16144-47	16144-47	ZINC	50	2100	MG/KG	N
16144-48	16144-48	ZINC	50	16800	MG/KG	N
16144-49	16144-49	ZINC	50	20300	MG/KG	N
16144-50	16144-50	ZINC	50	2220	MG/KG	N
16144-51	16144-51	ZINC	50	1320	MG/KG	N
16144-52	16144-52	ZINC	50	1780	MG/KG	N
16144-53	16144-53	ZINC	50	642	MG/KG	N
16144-54	16144-54	ZINC	50	7380	MG/KG	N
16144-55	16144-55	ZINC	50	3370	MG/KG	N
16144-56-MAX	16144-56MAX	ZINC	50	1300	MG/KG	N
16144-61	16144-61	ZINC	50	105	MG/KG	N
16144-62	16144-62	ZINC	50	4440	MG/KG	N
16144-63-MAX	16144-63MAX	ZINC	50	1940	MG/KG	N
16144-65	16144-65	ZINC	50	1880	MG/KG	N
16144-66	16144-66	ZINC	50	1790	MG/KG	N
16144-67	16144-67	ZINC	50	3500	MG/KG	N
16144-68	16144-68	ZINC	50	1150	MG/KG	N
16144-69	16144-69	ZINC	50	1080	MG/KG	N
16144-70	16144-70	ZINC	50	2380	MG/KG	N
16144-71	16144-71	ZINC	50	1500	MG/KG	N
16144-72	16144-72	ZINC	50	2600	MG/KG	N
16144-73	16144-73	ZINC	50	304	MG/KG	N
16144-74-MAX	16144-74MAX	ZINC	50	1260	MG/KG	N

Residential Land Use Scenario
Exceedances of PRGs

nsample	sample	para	PRG	result	units	validated
16144-75	16144-75	ZINC	50	402	MG/KG	N
16144-77	16144-77	ZINC	50	1050	MG/KG	N
16144-78	16144-78	ZINC	50	8980	MG/KG	N
6MW2D0406	6MW2D0406	ZINC	50	79.4	MG/KG	N
6MW3D-0406	6MW3D-0406	ZINC	50	61.3 J	MG/KG	N
6MW7S-0709	6MW7S-0709	ZINC	50	88.1 J	MG/KG	N
6TB10 (4-6)	6TB10 (4-6)	ZINC	50	60.7	MG/KG	N
6TB11 (0-2)	6TB11 (0-2)	ZINC	50	236 J	MG/KG	N
6TB12 (0-2)	6TB12 (0-2)	ZINC	50	147	MG/KG	N
6TB20 (0-1)	6TB20 (0-1)	ZINC	50	241 J	MG/KG	N
6TB20 (4-6)	6TB20 (4-6)	ZINC	50	1820 J	MG/KG	N
6TB23 (0-1)	6TB23 (0-1)	ZINC	50	669	MG/KG	N
6TB9 (2-4)	6TB9 (2-4)	ZINC	50	69.0	MG/KG	N

CLIENT: US NAVY NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: CURRENT INDUSTRIAL LAND USE VOLUME CALCULATIONS	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		2-20-97

CADMIUM HITS AT: DRMO 35 } ACCOUNTED FOR IN AROCHLOR EXCAVATION
DRMO 72 }
DRMO 40 : NEW EXCAVATION AREA

DRMO 40 ~ 30 ft x 30 ft (EXCAVATION DEPTH = 6 ft)
AREA = 900 ft^2
SHEET PILE PERIMETER = 90 ft (3 SIDES w BORDERING EXC.)

NEW TOTAL VOLUME FOR THE SITE 79,608 ft^3
5,400 ft^3
85,008 ft^3 = 3,148 CY

NEW SURFACE AREA TOTALS FOR THE SITE 10,328 ft^2
900 ft^2
11,228 ft^2 = 1,248 SY

VOLUME OF CRUSHED ROCK = TOTAL AREA x 1 ft
= 11,228 ft^3 ≅ 416 CY

SHEET PILING AREA 6,470 ft^2
+ (90 ft)(6 ft)
7,010 ft^2

WT OF EXCAVATED SOIL (ASSUME 100 lbs/ft^3)
= (85,008 ft^3)(100 lbs/ft^3)(1 TON/2,000 lbs)
= 4,250 TONS

WT OF ASPHALT (ASSUME ASPHALT IS 110 lbs/ft^3 AND 3 IN THICK)
= (11,228 ft^2)(0.25 ft)(110 lbs/ft^3)(1 TON/2,000 lbs)
= 154 TONS

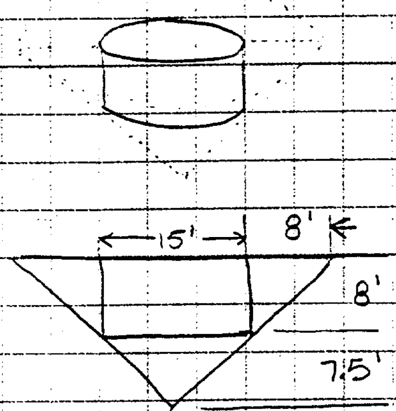
VOLUME OF ASPHALT = (11,228 ft^2)(0.25 ft)(1 CY/27 ft^3) ≅ 104 CY

CALCULATION WORKSHEET Order No. 19118 (01-91)

CLIENT: US NAVY – NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: CURRENT INDUSTRIAL LAND USE VOLUME CALCULATIONS	
BASED ON:	DRAWING NUMBER:
BY: HRR	CHECKED BY: TJR
APPROVED BY:	DATE: 5 FEB 97

6TB2 HOT SPOT (15 ft DIA × 8 ft DEEP)

AREA EXC. APPROXIAMATED BY CONE WITH THE TOP CUT OFF



VOL OF A CONE $= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi (15.5 ft)^2 (15.5 ft)$

$= 3900 ft^3$

VOL OF EXCAVATION = VOL OF CONE – TOP

$= 3900 ft^3 - \frac{1}{3}\pi (7.5 ft)^2 (7.5 ft)$

$= 3458 ft^3$

AREA $= \pi r^2 = \pi (15.5 ft)^2$

$\approx 755 ft^2$

DRMO 39 – 6TB19 (130 ft × 30 ft × 6 ft DEEP)

AREA = 3,900 ft^2

PERIMETER = 320 ft

VOLUME = 3900 ft^2 (6 ft) = 23,400 ft^3

DRMO 57–72 (10 ft DEEP)

AREA (USING PLANIMETER) = 3,683 ft^2

PERIMETER = 235 ft

VOLUME = 3683 ft^2 (10 ft) = 36,830 ft^3

DRMO 51–65 (8 ft DEEP)

AREA (USING PLANIMETER) = 1990 ft^2

PERIMETER = 275 ft

VOLUME = 1990 ft^2 (8 ft) = 15,920 ft^3

CLIENT US NAVY - NORTHDIV CTO 267	JOB NUMBER 7363
SUBJECT CURRENT INDUSTRIAL LAND USE VOLUME CALCULATIONS	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		5 FEB 97

VOLUME TOTALS FOR SITE:

3,458 ft^3
23,400 ft^3
36,830 ft^3
15,920 ft^3
79,608 ft^3 = 2,948 CY

SURFACE AREA TOTALS FOR SITE:

755 ft^2
3,900 ft^2
3,683 ft^2
1,990 ft^2
10,328 ft^2 = 1,148 SY

VOLUME OF CRUSHED ROCK = TOTAL AREA × 1 ft
= 10,328 ft^3 = 383 CY

VOLUME OF CONTAMINATED SOIL = 79,608 ft^3 ≅ 2950 CY

SHEET PILING AREAS

DRMO 39 - 6TB19 PERIMETER = 320 ft DEPTH = 6 ft
AREA = 1920 ft^2

DRMO 57-72 PERIMETER = 235 ft DEPTH = 10 ft
AREA = 2,350 ft^2

DRMO 51-65 PERIMETER = 275 ft DEPTH = 8 ft
AREA = 2,200 ft^2

TOTAL AREA = 6,470 ft^2

CLIENT	JOB NUMBER
US NAVY – NORTHDIV CTO 267	7363

FUTURE RESIDENTIAL LAND USE VOLUME CALCULATION

BASED ON	DRAWING NUMBER

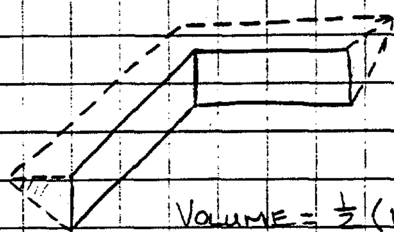
BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		12 FEB 97

MAIN ECO AREA EXCAVATION (EXCAVATE TO 3 ft)

AREA = 82,926 ft^2 (USING PLANIMETER)

PERIMETER = 1,410 ft

OVEREXCAVATION (ASSUME 1 TO 1 SLOPE)



Approximate as a triangular rod with a length = perimeter

Volume = $\frac{1}{2}$ (1,410 ft)(3 ft)(3 ft) = 6,345 ft^3

AREA = (3 ft)(1,410 ft) = 4,230 ft^2

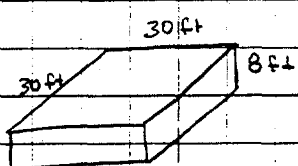
VOLUME = AREA (3 ft)

= (82,926 ft^2)(3 ft)

= 248,778 ft^3

HOT SPOT AT 6MW15 (30 ft × 30 ft × 8 ft DEEP)

USE SHEET PILE – NO OVEREXCAVATION



AREA = (30 ft)(30 ft) = 900 ft^3

PERIMETER = 4 (30 ft) = 120 ft

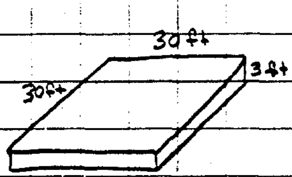
VOLUME = AREA (DEPTH)

= 900 ft^2 (8 ft)

= 7200 ft^3

HOT SPOT AT 6TB2 (30 ft × 30 ft × 6 ft)

USE SHEET PILE – NO OVEREXCAVATION



DEPTH OF EXC. = 6 ft – 3 ft (ALREADY EXC.) = 3 ft

AREA = (30 ft)(30 ft) = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (3 ft)

= 2,700 ft^3

CLIENT	JOB NUMBER		
US NAVY – NORTHDIV CTO 267	7363		
FUTURE RESIDENTIAL LAND USE VOLUME CALCULATION			
BASED ON	DRAWING NUMBER		
BY: JRR	CHECKED BY: TJR	APPROVED BY	DATE: 12 FEB 97

DRMO 51-65 (DEPTH OF EXC. = 8 ft (BELOW SURFACE) – 3 ft (ALREADY EXC.) = 5 ft)

USE SHEET PILE – NO OVEREXCAVATION

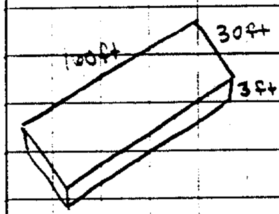
AREA = 1,990 ft^2 (USING PLANIMETER)

PERIMETER = 275 ft

VOLUME = $(1{,}990\ ft^2)(5\ ft)$

$= 9{,}950\ ft^3$

DRMO 40-71 (DEPTH OF EXC. = 6 ft (BELOW SURFACE) – 3 ft (ALREADY EXC.) = 3 ft)



USE SHEET PILE – NO OVEREXCAVATION

AREA = 160 ft (30 ft) = 4,800 ft^2

PERIMETER = 380 ft

VOLUME = $(4800\ ft^2)(3\ ft)$

$= 14{,}400\ ft^3$

DRMO 57-72 (DEPTH OF EXC. = 10 ft (BELOW SURFACE) – 3 ft (ALREADY EXC.) = 7 ft)

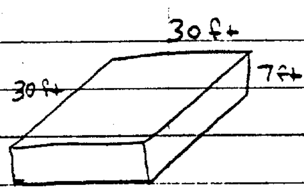
USE SHEET PILE – NO OVEREXCAVATION

AREA = 3,683 ft^2 (USING PLANIMETER)

PERIMETER = 235 ft

VOLUME = $(3{,}683\ ft^2)(7\ ft) = 25{,}781\ ft^3$

DRMO 45 (30 ft x 30 ft x 10 ft)



USE SHEET PILE – NO OVEREXCAVATION

DEPTH OF EXC. = 10 ft (BELOW SURFACE) – 3 ft (ALREADY EXC.) = 7 ft

AREA = $(30\ ft)(30\ ft) = 900\ ft^2$

PERIMETER = 120 ft

VOLUME = $900\ ft^2\ (7\ ft)$

$= 6{,}300\ ft^3$

CLIENT: US NAVY - NORTHDIV CTO 267

JOB NUMBER: 7363

SUBJ: FUTURE RESIDENTIAL LAND USE VOLUME CALCULATION

BASED ON:

DRAWING NUMBER:

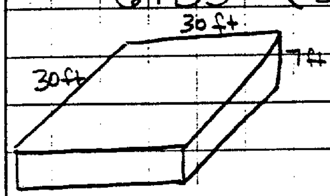
BY: JRR

CHECKED BY: TJR

APPROVED BY:

DATE: 12 FEB 97

6TB3 (30 ft x 30 ft x 10 ft DEEP)



USE SHEET PILE - NO OVEREXCAVATION

DEPTH OF EXCAVATION = 10 ft (BELOW SURFACE) - 3 ft (ALREADY EXC.) = 7 ft

AREA = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (7 ft)

= 6,300 ft^3

6TB10 - 6MW2

USE SHEET PILE - NO OVEREXCAVATION

DEPTH OF EXCAVATION = 8 ft (BELOW SURFACE) - 3 ft (ALREADY EXC.) = 5 ft

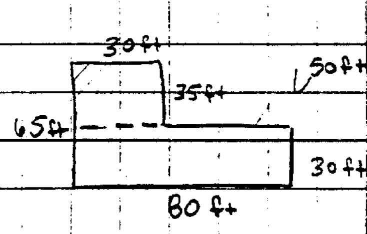
AREA = 30 ft (35 ft) + 30 ft (80 ft)

= 1,050 ft^2 + 2,400 ft^2

= 3,450 ft^2

PERIMETER = 30 ft + 35 ft + 50 ft + 30 ft + 80 ft + 65 ft

= 290 ft



VOLUME = 3,450 ft^2 (5 ft) + 25 ft (30 ft)(3 ft)

(25 ft (30 ft)(3 ft): AREA NOT WITHIN MAIN 3 ft EXC.)

= 19,500 ft^3

CALCULATION WORKSHEET Order No. 19116 (01-91)

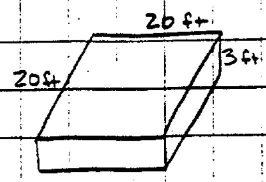
CLIENT	JOB NUMBER
US NAVY - NORTHDIV CTO 267	7363

SUB:
FUTURE RESIDENTIAL LAND USE VOLUME CALCULATION

BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		12 FEB 97

6MW4S (20ft x 20ft x 6ft DEEP)



USE SHEET PILE - NO OVEREXCAVATION

DEPTH OF EXC = 6ft (BELOW SURFACE) - 3ft (ALREADY EXC) = 3ft

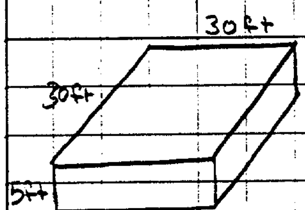
AREA = (20ft)(20ft) = 400 ft^2

PERIMETER = 80ft

VOLUME = 400 ft^2 (3ft)

= 1200 ft^3

6TB20 (30 ft x 30 ft x 8ft DEEP)



USE SHEET PILE - NO OVEREXCAVATION

DEPTH OF EXC = 8ft (BELOW SURFACE) - 3ft (ALREADY EXC) = 5ft

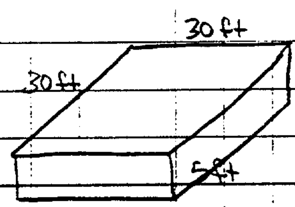
AREA = (30ft)(30ft) = 900 ft^2

PERIMETER = 4(30 ft) = 120 ft

VOLUME = (900 ft^2)(5ft)

= 4,500 ft^3

6MW3D (30ft x 30ft x 8ft DEEP)



USE SHEET PILE - NO OVEREXCAVATION

DEPTH OF EXC. = 8ft (BELOW SURFACE) - 3ft (ALREADY EXC) = 5ft

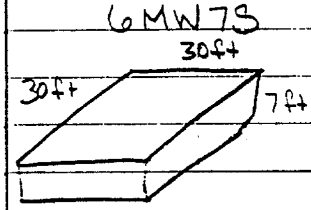
AREA = 900 ft^2

PERIMETER = 120ft

VOLUME = 900 ft^2 (5ft)

= 4,500 ft^3

6MW7S (30 ft x 30ft x 10 ft)



USE SHEET PILE - NO OVEREXCAVATION

DEPTH OF EXC. = 10 ft (ASSUME ENTIRE AREA OUTSIDE OF ECO EXC.)

AREA = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (10ft) = 9,000 ft^3

CLIENT US NAVY - NORTHDIV CTO 267

JOB NUMBER 7363

SUB: FUTURE RESIDENTIAL LAND USE VOLUME CALCULATION

BASED ON

DRAWING NUMBER

BY JRR

CHECKED BY TJR

APPROVED BY

DATE 12 FEB 97

TOTAL VOLUMES:

248,778	ft^3	MAIN ECO AREA
7,200	ft^3	6MW1S
2,700	ft^3	6TB2
9,950	ft^3	DRMO 51-65
14,400	ft^3	DRMO 40-71
25,781	ft^3	DRMO 57-72
6,300	ft^3	DRMO 45
1,200	ft^3	6MW4S
4,500	ft^3	6TB20
4,500	ft^3	6MW3D
9,000	ft^3	6MW7S
6,300	ft^3	6TB3
19,500	ft^3	6TB10-6MW2
16,345	ft^3	OVEREXCAVATION
366,454	ft^3	
≈ 13,575	CY	

TOTAL WEIGHT (ASSUMING 100 lb/ft^3)

$= (366{,}454\ ft^3)(100\ lb/ft^3)(1\ TON/2{,}000\ lb)$

= 18,322.7 TONS

≈ 18,325 TONS

TOTAL SURFACE AREA OF SITE:

87,156	ft^2	MAIN ECO AREA + OVEREXCAVATION
900	ft^2	6MW1S
900	ft^2	6MW7S
750	ft^2	6MW2 (30ft x 25ft AREA OUTSIDE OF MAIN ECO EXC.)
89,706	ft^2	

= 9,967.3 SY

≈ 9,970 SY

CALCULATION WORKSHEET Order No. 19116 (01-81)

CLIENT: U.S. NAVY - NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: FUTURE RESIDENTIAL LAND USE VOLUME CALCULATION	
BASED ON:	DRAWING NUMBER:
BY: JRR	CHECKED BY: TJR
APPROVED BY:	DATE: 12 FEB 97

SHEET PILING AREAS (ESTIMATE USING PERIMETER X EXCAVATION NEEDED)

6MW1S (PERIMETER)(EXC NEEDED) =	(120 ft)(8 ft) =	960 ft²
6TB2	(120 ft)(3 ft) =	360 ft²
DRMO 51-65	(275 ft)(5 ft) =	1,375 ft²
DRMO 40-71	(380 ft)(3 ft) =	1,140 ft²
DRMO 57-72	(235 ft)(7 ft) =	1,645 ft²
DRMO 45	(120 ft)(7 ft) =	840 ft²
6MW4S (ONLY NEED HALF OF THE PERIMETER SHEET PILED BECAUSE OF BORDERING EXC.)	(40 ft)(3 ft) =	120 ft²
6TB20	(120 ft)(5 ft) =	600 ft²
6MW3D	(120 ft)(5 ft) =	600 ft²
6MW7S	(120 ft)(10 ft) =	1,200 ft²
6TB3 (SUBTRACT 30 ft FROM PERIMETER BECAUSE OF BORDERING EXCAVATION)	(90 ft)(7 ft) =	630 ft²
6TB10 - 6MW2 (")	(260 ft)(5 ft) =	1,300 ft²
		10,770 ft²

TOPSOIL VOLUME = TOTAL SURFACE AREA X DEPTH (ASSUME A 6 IN LAYER)

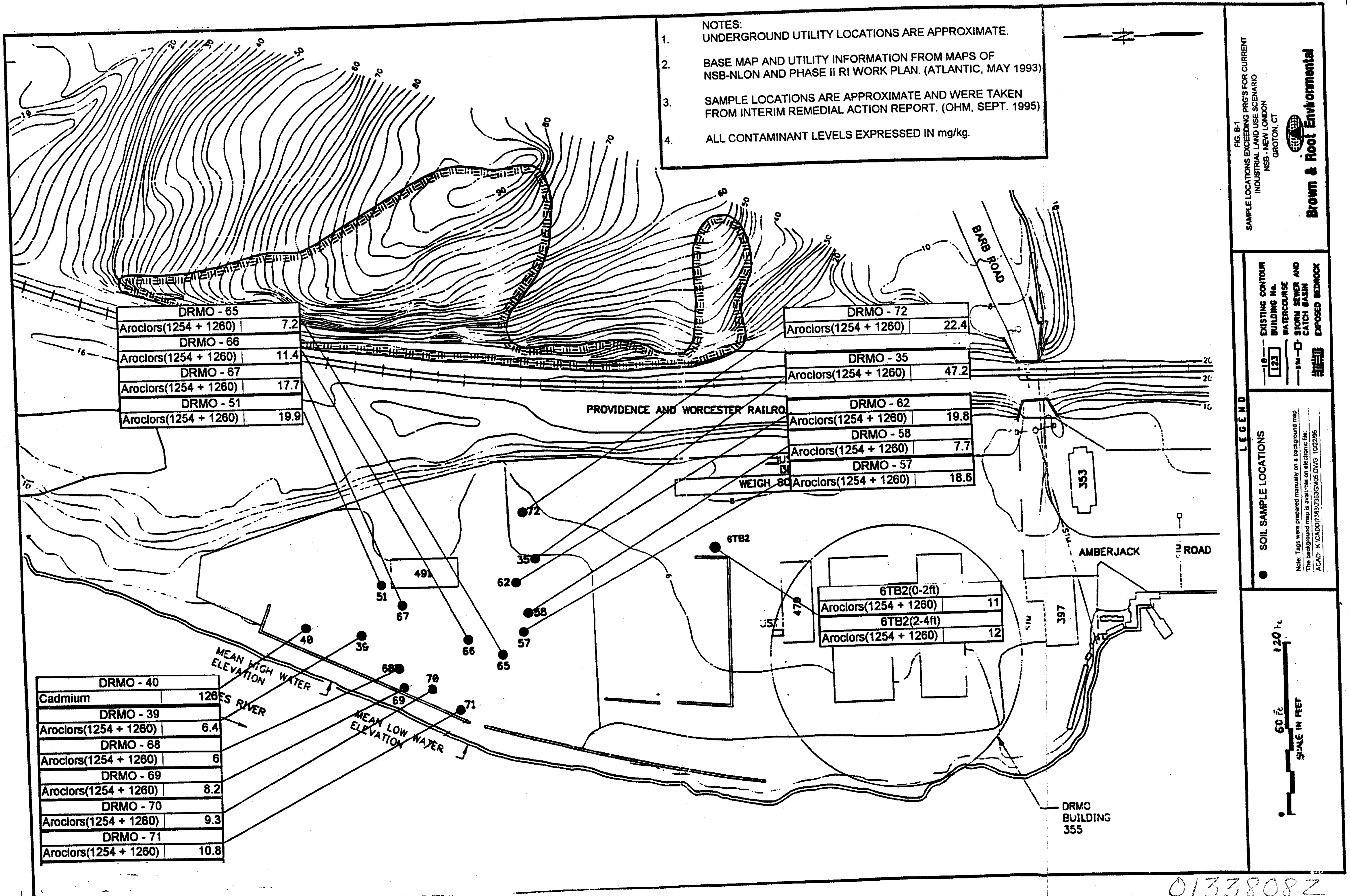
= (89,706 ft²)(0.5 ft)

= 44,853 ft³ ≅ 1,660 CY

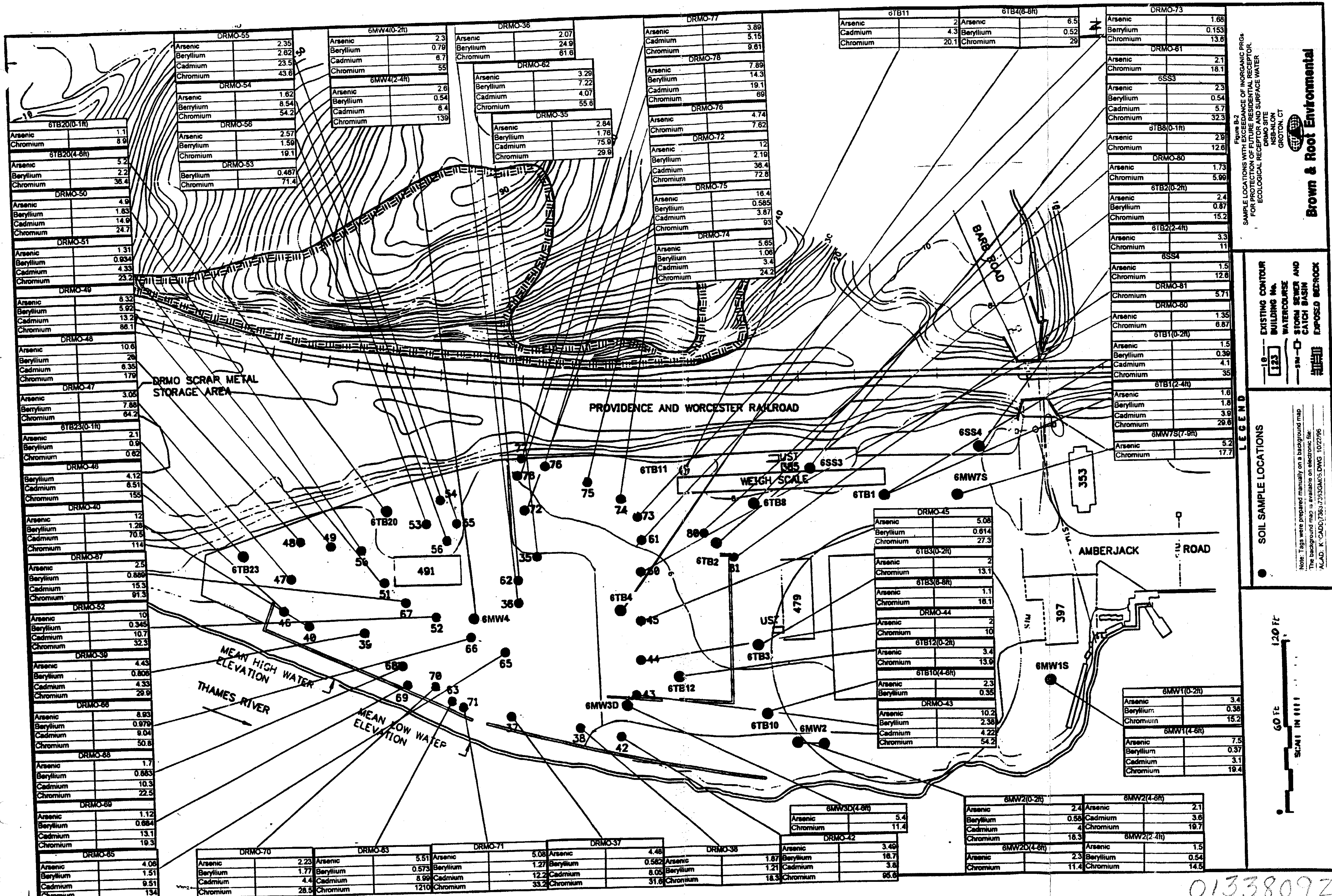
SEED AREA = 88,706 ft² (1 MSF / 1,000 ft²)

= 88.7 MSF

≅ 90 MSF


NOTES:
1. UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE.
2. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN. (ATLANTIC, MAY 1993)
3. SAMPLE LOCATIONS ARE APPROXIMATE AND WERE TAKEN FROM INTERIM REMEDIAL ACTION REPORT. (OHM, SEPT. 1995)
4. ALL CONTAMINANT LEVELS EXPRESSED IN mg/kg.
DRMO - 65
Aroclors(1254 + 1260) 7.2
DRMO - 66
Aroclors(1254 + 1260) 11.4
DRMO - 67
Aroclors(1254 + 1260) 17.7
DRMO - 51
Aroclors(1254 + 1260) 19.9
DRMO - 72
Aroclors(1254 + 1260) 22.4
DRMO - 35
Aroclors(1254 + 1260) 47.2
DRMO - 62
Aroclors(1254 + 1260) 19.8
DRMO - 58
Aroclors(1254 + 1260) 7.7
DRMO - 57
Aroclors(1254 + 1260) 18.6
6TB2(0-2ft)
Aroclors(1254 + 1260) 11
6TB2(2-4ft)
Aroclors(1254 + 1260) 12
DRMO - 40
Cadmium 126
DRMO - 39
Aroclors(1254 + 1260) 6.4
DRMO - 68
Aroclors(1254 + 1260) 6
DRMO - 69
Aroclors(1254 + 1260) 8.2
DRMO - 70
Aroclors(1254 + 1260) 9.3
DRMO - 71
Aroclors(1254 + 1260) 10.8
PROVIDENCE AND WORCESTER RAILROAD
BARB ROAD
AMBERJACK ROAD
WEIGH
MEAN HIGH WATER ELEVATION
MEAN LOW WATER ELEVATION
THAMES RIVER
491
479
353
397
6TB2
72
35
62
58
57
51
67
66
65
40
39
68
69
70
71
DRMO BUILDING 355
LEGEND
EXISTING CONTOUR
BUILDING No.
WATERCOURSE
STORM SEWER AND CATCH BASIN
EXPOSED BEDROCK
SOIL SAMPLE LOCATIONS
Note: Tags were prepared manually on a background map
The background map is available on electronic file:
ACAD: K:\CADD\7353\7363GM05.DWG 10/22/96
120 Ft
60 Ft
SCALE IN FEET
FIG. B-1
SAMPLE LOCATIONS EXCEEDING PRG'S FOR CURRENT
INDUSTRIAL LAND USE SCENARIO
NSB - NEW LONDON
GROTON, CT
Brown & Root Environmental

0133808Z



Sample	Arsenic	Beryllium	Cadmium	Chromium
6TB20(0-1ft)	1.1			8.9
6TB20(4-6ft)	5.2	2.2		36.4
DRMO-50	4.9	1.83	14.9	24.7
DRMO-51	1.31	0.934	4.33	23.2
DRMO-49	8.32	5.92	13.2	86.1
DRMO-48	10.6	26	6.35	179
DRMO-47	3.05	7.88		64.2
6TB23(0-1ft)	2.1	0.9		0.62
DRMO-46		4.12	8.51	155
DRMO-40	12	1.28	70.5	114
DRMO-67	2.5	0.889	15.3	91.3
DRMO-52	10	0.345	10.7	32.3
DRMO-39	4.43	0.806	4.33	29.9
DRMO-66	8.93	0.979	9.04	50.8
DRMO-68	1.7	0.663	10.3	22.5
DRMO-69	1.12	0.684	13.1	19.3
DRMO-65	4.06	1.51	9.51	134
DRMO-55	2.35	2.62	23.5	43.6
DRMO-54	1.62	8.54		54.2
DRMO-56	2.57	1.59		19.1
DRMO-53		0.487		71.4
6MW4(0-2ft)	2.3	0.79	6.7	55
6MW4(2-4ft)	2.6	0.54	6.4	139
DRMO-36	2.07	24.9		61.6
DRMO-62	3.29	7.22	4.07	55.6
DRMO-35	2.84	1.76	75.9	29.9
DRMO-77	3.89		5.15	9.61
DRMO-78	7.89	14.3	19.1	69
DRMO-76	4.74			7.62
DRMO-72	12	2.19	38.4	72.8
DRMO-75	16.4	0.585	3.87	93
DRMO-74	5.65	1.06	3.4	24.2
6TB11	2		4.3	20.1
6TB4(6-8ft)	6.5	0.52		29
DRMO-73	1.68	0.153		13.6
DRMO-61	2.1			18.1
6SS3	2.3	0.54	5.7	32.3
6TB8(0-1ft)	2.9			12.6
DRMO-80	1.73			5.99
6TB2(0-2ft)	2.4	0.87		15.2
6TB2(2-4ft)	3.3			11
6SS4	1.5			12.8
DRMO-81				5.71
DRMO-60	1.35			6.87
6TB1(0-2ft)	1.5	0.39	4.1	35
6TB1(2-4ft)	1.6	1.8	3.9	29.6
6MW7S(7-9ft)	5.2			17.7
DRMO-45	5.08	0.614		27.3
6TB3(0-2ft)	2			13.1
6TB3(6-8ft)	1.1			16.1
DRMO-44	2			10
6TB12(0-2ft)	3.4			13.9
6TB10(4-6ft)	2.3	0.35		
DRMO-43	10.2	2.38	4.22	54.2
6MW1(0-2ft)	3.4	0.38		15.2
6MW1(4-6ft)	7.5	0.37	3.1	19.4
DRMO-70	2.23	1.77	4.4	28.5
DRMO-63	5.51	0.573	8.99	1210
DRMO-71	5.08	1.27	12.2	33.2
DRMO-37	4.48	0.562	8.05	31.6
DRMO-38	1.87	1.21		18.3
6MW3D(4-6ft)	5.4			11.4
DRMO-42	3.49	16.7	3.8	95.6
6MW2(0-2ft)	2.4	0.58	4	18.3
6MW2D(4-6ft)	2.3			11.4
6MW2(4-6ft)	2.1		3.6	19.7
6MW2(2-4ft)	1.5	0.54		14.5

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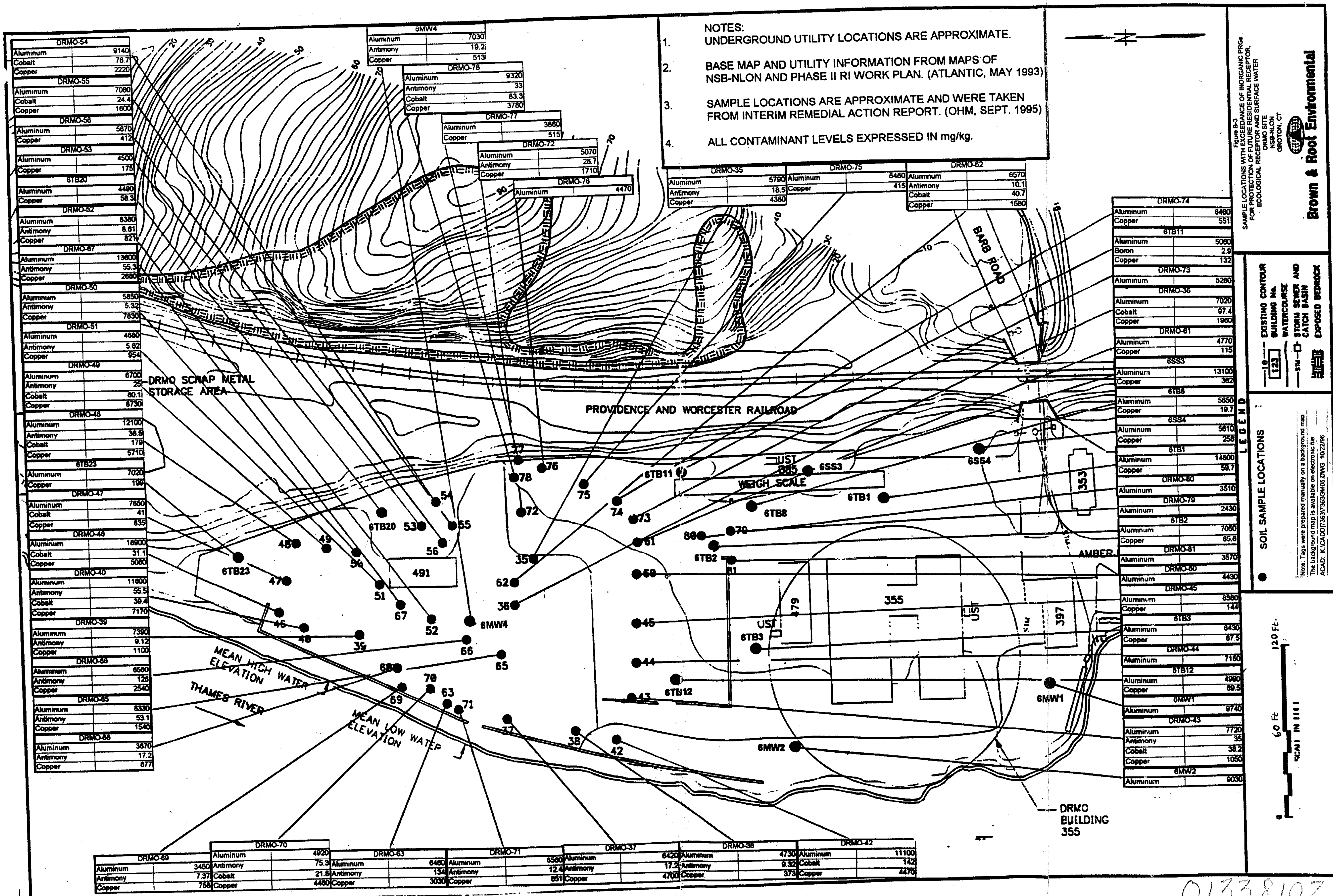
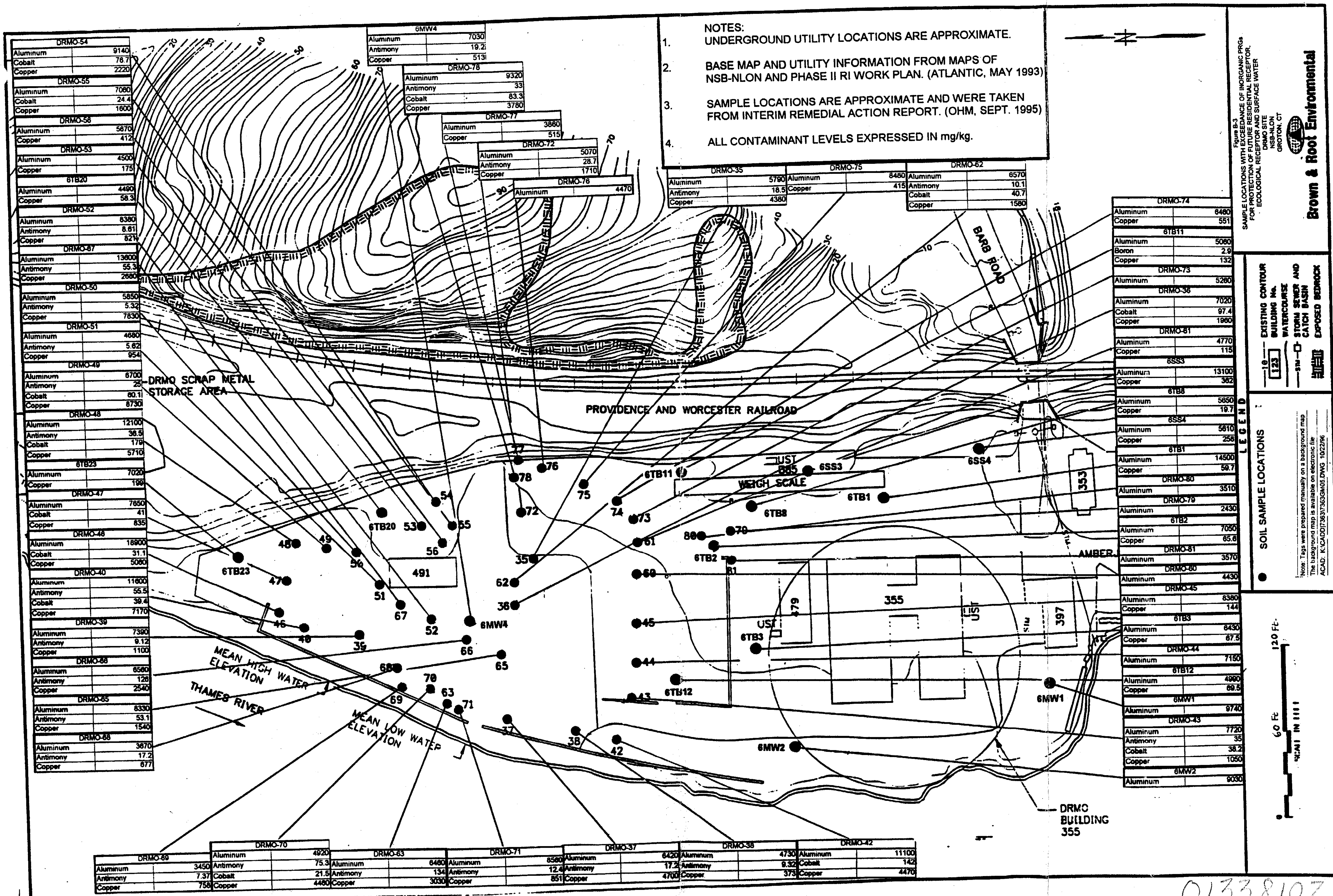


Figure B-3
SAMPLE LOCATIONS WITH EXCEEDANCE OF INORGANIC PRGs FOR PROTECTION OF FUTURE RESIDENTIAL RECEPTOR, ECOLOGICAL RECEPTOR AND SURFACE WATER
DRMO SITE
NSB-NLON
GROTON, CT

Brown & Root Environmental

0133810Z

Draft Final



DRMO-54	
Aluminum	9140
Cobalt	76.7
Copper	2220

DRMO-55	
Aluminum	7060
Cobalt	24.4
Copper	1600

DRMO-56	
Aluminum	5670
Copper	412

DRMO-53	
Aluminum	4500
Copper	175

6TB20	
Aluminum	4490
Copper	58.3

DRMO-52	
Aluminum	8380
Antimony	8.61
Copper	821

DRMO-67	
Aluminum	13600
Antimony	55.3
Copper	2680

DRMO-50	
Aluminum	5850
Antimony	5.32
Copper	7830

DRMO-51	
Aluminum	4680
Antimony	5.62
Copper	954

DRMO-49	
Aluminum	6700
Antimony	25
Cobalt	60.1
Copper	8730

DRMO-48	
Aluminum	12100
Antimony	36.5
Cobalt	179
Copper	5710

6TB23	
Aluminum	7020
Copper	199

DRMO-47	
Aluminum	7650
Cobalt	41
Copper	835

DRMO-46	
Aluminum	18900
Cobalt	31.1
Copper	5060

DRMO-40	
Aluminum	11600
Antimony	55.5
Cobalt	39.4
Copper	7170

DRMO-39	
Aluminum	7390
Antimony	9.12
Copper	1100

DRMO-66	
Aluminum	6560
Antimony	126
Copper	2540

DRMO-65	
Aluminum	8330
Antimony	53.1
Copper	1540

DRMO-68	
Aluminum	3670
Antimony	17.2
Copper	677

6MW4	
Aluminum	7030
Antimony	19.2
Copper	513

DRMO-78	
Aluminum	9320
Antimony	33
Cobalt	83.3
Copper	3780

DRMO-77	
Aluminum	3860
Copper	515

DRMO-72	
Aluminum	5070
Antimony	28.7
Copper	1710

DRMO-76	
Aluminum	4470

DRMO-35	
Aluminum	5790
Antimony	18.5
Copper	4380

DRMO-75	
Aluminum	8480
Copper	415

DRMO-62	
Aluminum	6570
Antimony	10.1
Cobalt	40.7
Copper	1580

DRMO-74	
Aluminum	6460
Copper	551

6TB11	
Aluminum	5060
Boron	2.9
Copper	132

DRMO-73	
Aluminum	5260

DRMO-36	
Aluminum	7020
Cobalt	97.4
Copper	1960

DRMO-61	
Aluminum	4770
Copper	115

6SS3	
Aluminum	13100
Copper	362

6TB8	
Aluminum	5650
Copper	19.7

6SS4	
Aluminum	5610
Copper	258

6TB1	
Aluminum	14500
Copper	59.7

DRMO-80	
Aluminum	3510

DRMO-79	
Aluminum	2430

6TB2	
Aluminum	7050
Copper	65.6

DRMO-81	
Aluminum	3570

DRMO-60	
Aluminum	4430

DRMO-45	
Aluminum	8360
Copper	144

6TB3	
Aluminum	6430
Copper	67.5

DRMO-44	
Aluminum	7150

6TB12	
Aluminum	4990
Copper	69.5

6MW1	
Aluminum	9740

DRMO-43	
Aluminum	7720
Antimony	35
Cobalt	38.2
Copper	1050

6MW2	
Aluminum	9030

DRMO-69	
Aluminum	3450
Antimony	7.37
Copper	758

DRMO-70	
Aluminum	4920
Antimony	75.3
Cobalt	21.5
Copper	4460

DRMO-63	
Aluminum	6460
Antimony	134
Copper	3030

DRMO-71	
Aluminum	8560
Antimony	12.4
Copper	851

DRMO-37	
Aluminum	6420
Antimony	17.2
Copper	4700

DRMO-38	
Aluminum	4730
Antimony	9.32
Copper	373

DRMO-42	
Aluminum	11100
Cobalt	142
Copper	4470

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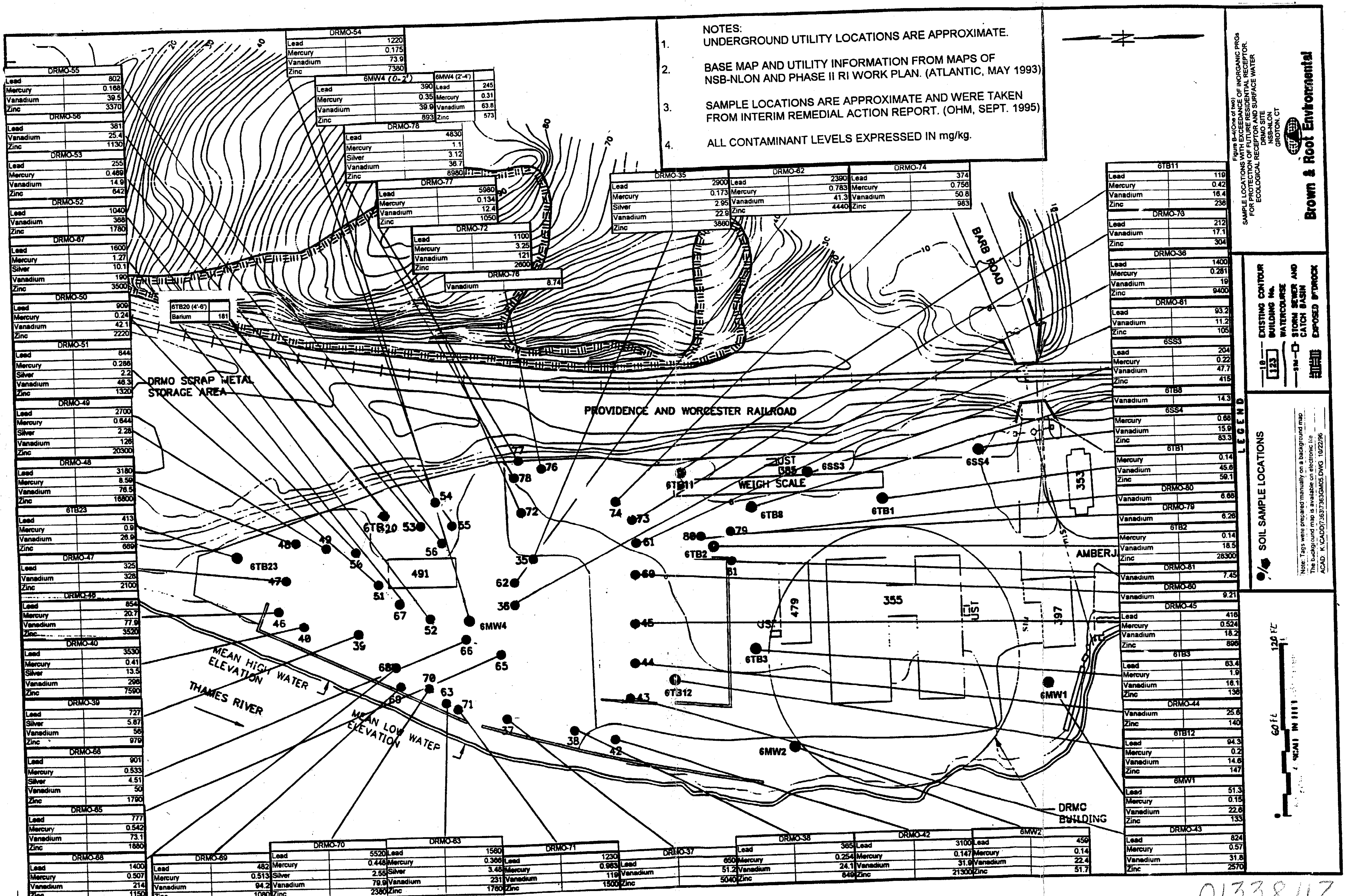


NOTES:

1. UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE.
2. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN. (ATLANTIC, MAY 1993)
3. SAMPLE LOCATIONS ARE APPROXIMATE AND WERE TAKEN FROM INTERIM REMEDIAL ACTION REPORT. (OHM, SEPT. 1995)
4. ALL CONTAMINANT LEVELS EXPRESSED IN mg/kg.

Sample	Lead	Mercury	Silver	Vanadium	Zinc	Barium
DRMO-55	802	0.168		39.5	3370	
DRMO-56	381			25.4	1130	
DRMO-53	255	0.469		14.9	642	
DRMO-52	1040			368	1780	
DRMO-67	1600	1.27	10.1	190	3500	
DRMO-50	909	0.24		42.1	2220	
DRMO-51	844	0.286	2.2	46.3	1320	
DRMO-49	2700	0.644	2.28	126	20300	
DRMO-48	3180	8.59		76.5	16800	
6TB23	413	0.9		26.9	669	
DRMO-47	325			328	2100	
DRMO-46	854	20.7		77.9	3520	
DRMO-40	3530	0.41	13.5	298	7590	
DRMO-39	727		5.87	56	979	
DRMO-66	901	0.533	4.51	50	1790	
DRMO-65	777	0.542		73.1	1880	
DRMO-68	1400	0.507		214	1150	
DRMO-69	482	0.513		94.2	1080	
DRMO-70	5520	0.448	2.55	79.9	2380	
DRMO-63	1560	0.366	3.48	231	1760	
DRMO-71	1230	0.983		119	1500	
DRMO-37	650			51.2	5040	
DRMO-38	365	0.254		24.1	849	
DRMO-42	3100	0.147		31.9	21300	
6MW2	459	0.14		22.4	51.7	
DRMO-54	1220	0.175		73.9	7380	
6MW4 (0-2')	390	0.35		39.9	893	
6MW4 (2'-4')	245	0.31		63.8	573	
DRMO-78	4830	1.1	3.12	36.7	8980	
DRMO-77	5980	0.134		12.4	1050	
DRMO-72	1100	3.25		121	2600	
DRMO-76				8.74		
6TB20 (4'-6')						181
DRMO-35	2900	0.173	2.95	22.9	3860	
DRMO-62	2390	0.783		41.3	4440	
DRMO-74	374	0.756		50.8	983	
6TB11	119	0.42		16.4	236	
DRMO-73	212			17.1	304	
DRMO-36	1400	0.281		19	9400	
DRMO-61	93.2			11.2	105	
6SS3	204	0.22		47.7	415	
6TB8				14.3		
6SS4		0.68		15.9	83.3	
6TB1		0.14		45.6	59.1	
DRMO-80				6.68		
DRMO-79				6.26		
6TB2		0.14		18.5	28300	
DRMO-81				7.45		
DRMO-60				9.21		
DRMO-45	416	0.524		18.2	896	
6TB3	63.4	1.9		16.1	136	
DRMO-44				25.6	140	
6TB12	94.3	0.2		14.6	147	
6MW1	51.3	0.15		22.6	133	
DRMO-43	824	0.57		31.8	2570	

LEGEND

- 10 — EXISTING CONTOUR
- 123 — BUILDING No.
- WATERCOURSE
- STM — STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK
- SOIL SAMPLE LOCATIONS

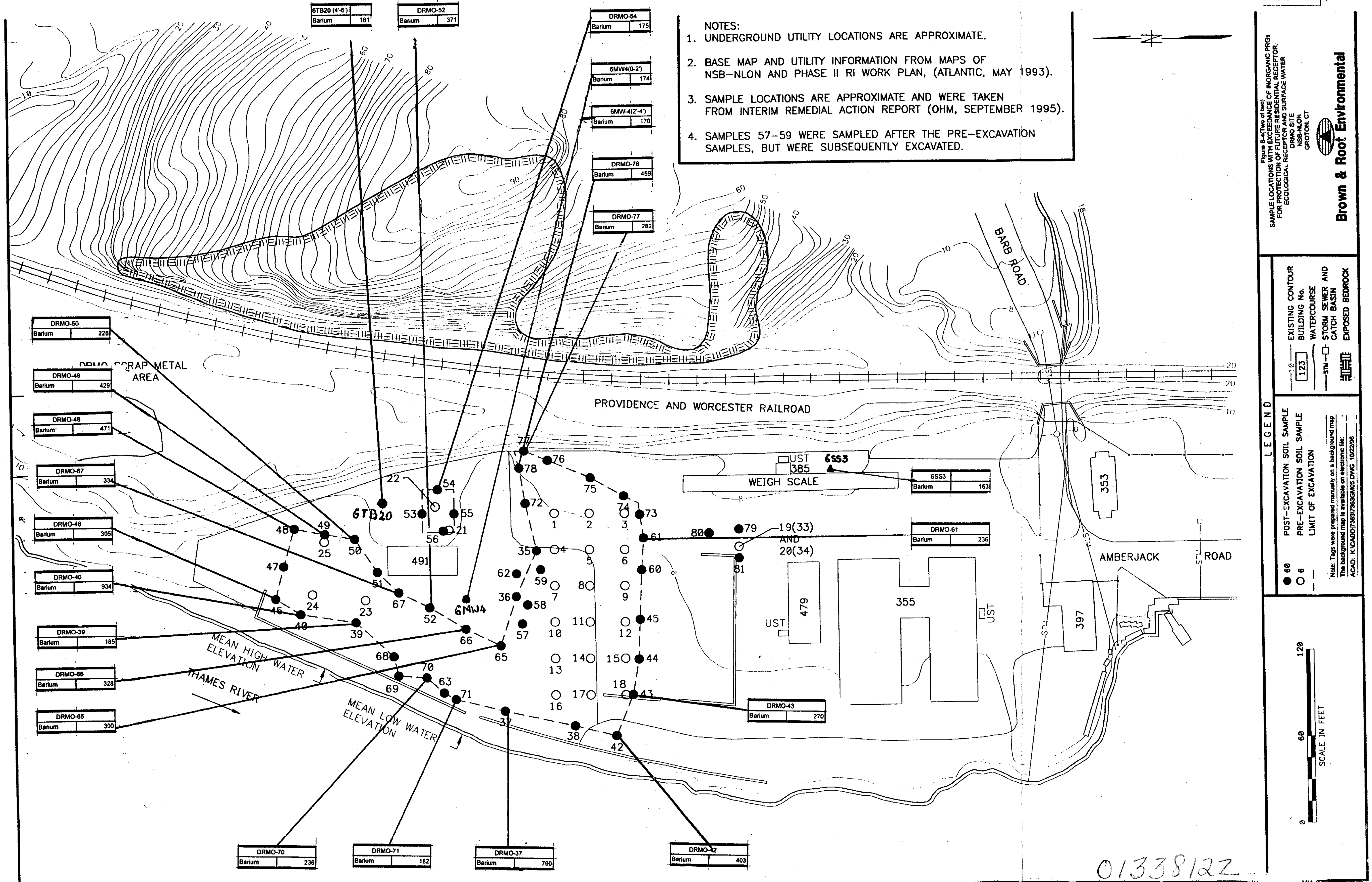
Note: Tags were prepared manually on a background map. The background map is available on electronic file ACAD: K:\CADD\7363\7363GM05.DWG 10/22/96

Figure B-4(One of two)
SAMPLE LOCATIONS WITH EXCEEDANCE OF INORGANIC PRGs FOR PROTECTION OF FUTURE RESIDENTIAL RECEPTOR, ECOLOGICAL RECEPTOR AND SURFACE WATER
DRMO SITE
NSB-NLON
GROTON, CT

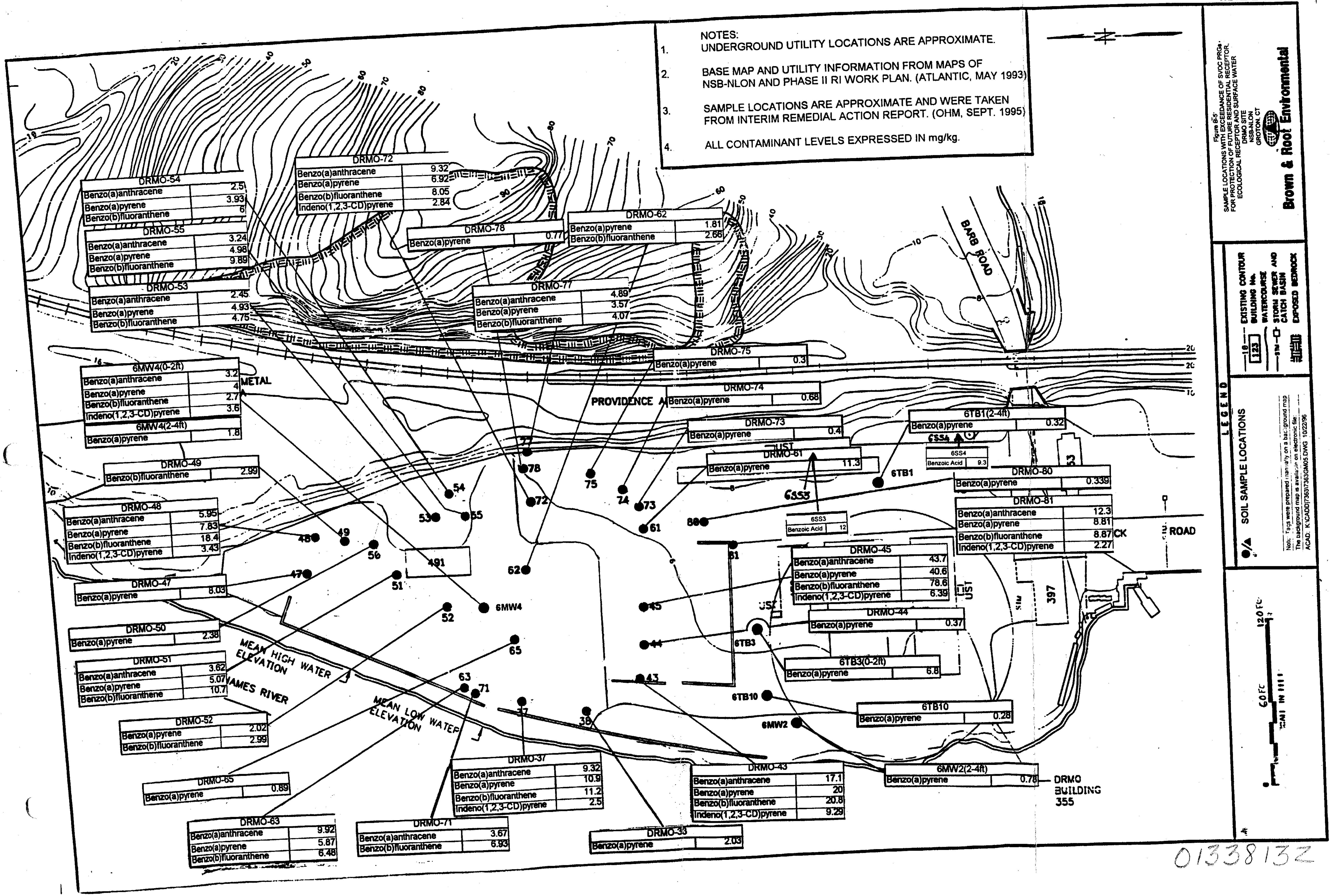
Brown & Root Environmental

01338112

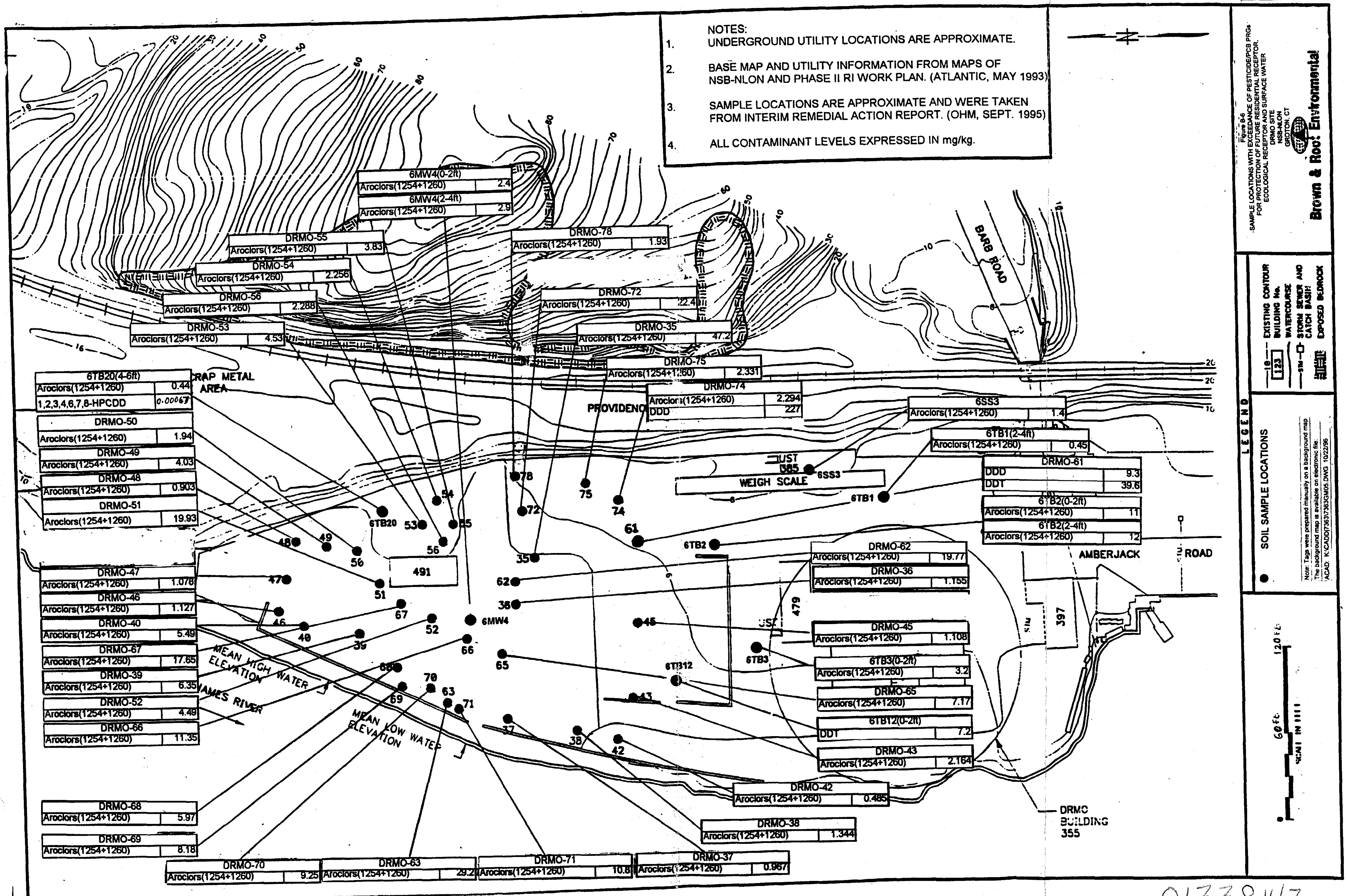
Draft Final



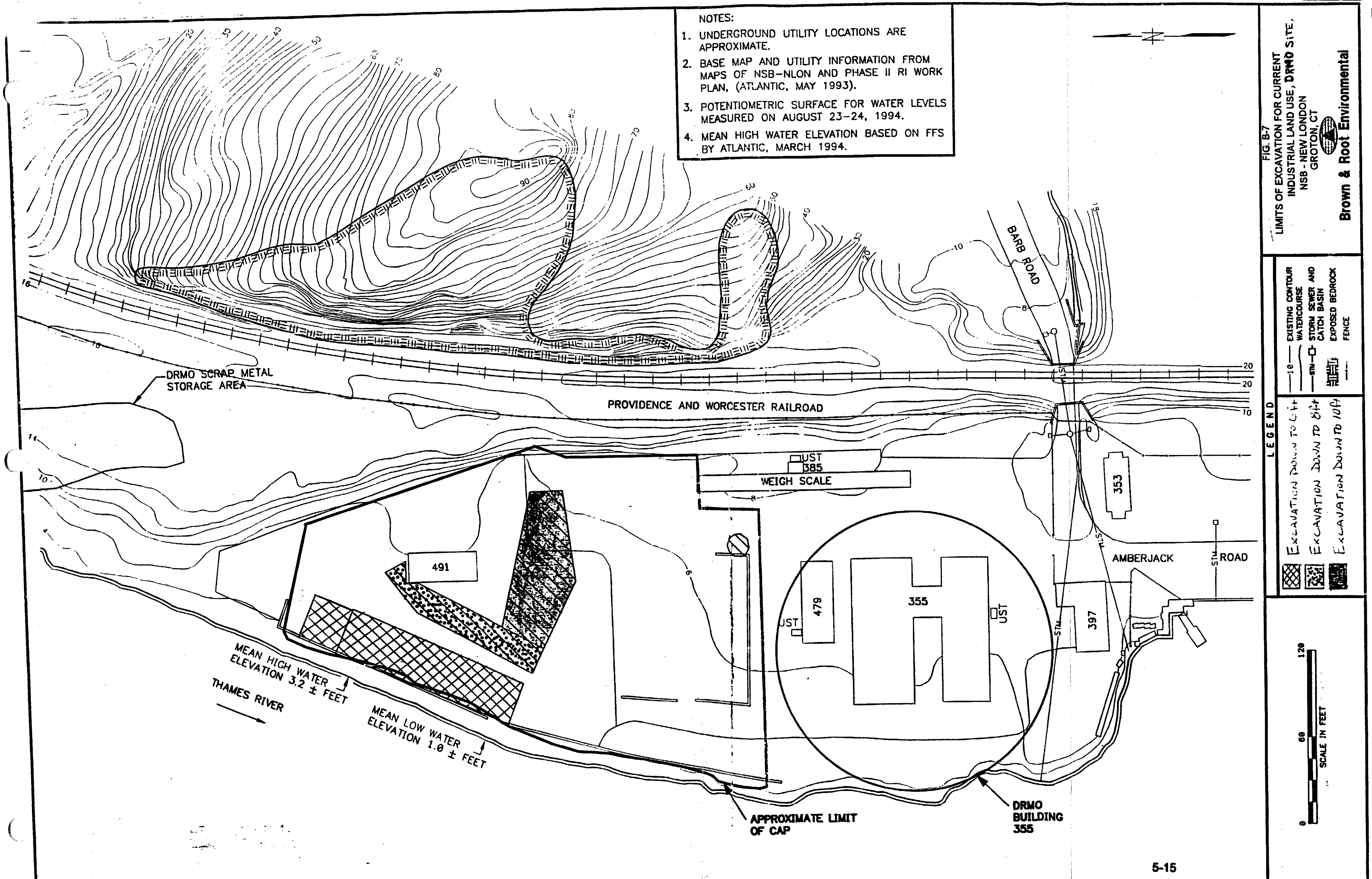
01338122


NOTES:
1. UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE.
2. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN. (ATLANTIC, MAY 1993)
3. SAMPLE LOCATIONS ARE APPROXIMATE AND WERE TAKEN FROM INTERIM REMEDIAL ACTION REPORT. (OHM, SEPT. 1995)
4. ALL CONTAMINANT LEVELS EXPRESSED IN mg/kg.
DRMO-54 Benzo(a)anthracene 2.5 Benzo(a)pyrene 3.93 Benzo(b)fluoranthene 6
DRMO-55 Benzo(a)anthracene 3.24 Benzo(a)pyrene 4.98 Benzo(b)fluoranthene 9.89
DRMO-53 Benzo(a)anthracene 2.45 Benzo(a)pyrene 4.93 Benzo(b)fluoranthene 4.75
DRMO-72 Benzo(a)anthracene 9.32 Benzo(a)pyrene 6.92 Benzo(b)fluoranthene 8.05 Indeno(1,2,3-CD)pyrene 2.84
DRMO-78 Benzo(a)pyrene 0.77
DRMO-62 Benzo(a)pyrene 1.81 Benzo(b)fluoranthene 2.66
DRMO-77 Benzo(a)anthracene 4.89 Benzo(a)pyrene 3.57 Benzo(b)fluoranthene 4.07
DRMO-75 Benzo(a)pyrene 0.3
DRMO-74 Benzo(a)pyrene 0.68
DRMO-73 Benzo(a)pyrene 0.4
DRMO-61 Benzo(a)pyrene 11.3
6TB1(2-4ft) Benzo(a)pyrene 0.32
6SS4 Benzoic Acid 9.3
DRMO-80 Benzo(a)pyrene 0.339
DRMO-81 Benzo(a)anthracene 12.3 Benzo(a)pyrene 8.81 Benzo(b)fluoranthene 8.87 Indeno(1,2,3-CD)pyrene 2.27
6SS3 Benzoic Acid 12
DRMO-45 Benzo(a)anthracene 43.7 Benzo(a)pyrene 40.6 Benzo(b)fluoranthene 78.6 Indeno(1,2,3-CD)pyrene 6.39
DRMO-44 Benzo(a)pyrene 0.37
6TB3(0-2ft) Benzo(a)pyrene 6.8
6TB10 Benzo(a)pyrene 0.28
6MW2(2-4ft) Benzo(a)pyrene 0.78
6MW4(0-2ft) Benzo(a)anthracene 3.2 Benzo(a)pyrene 4 Benzo(b)fluoranthene 2.7 Indeno(1,2,3-CD)pyrene 3.6
6MW4(2-4ft) Benzo(a)pyrene 1.8
DRMO-49 Benzo(b)fluoranthene 2.99
DRMO-48 Benzo(a)anthracene 5.95 Benzo(a)pyrene 7.83 Benzo(b)fluoranthene 18.4 Indeno(1,2,3-CD)pyrene 3.43
DRMO-47 Benzo(a)pyrene 8.03
DRMO-50 Benzo(a)pyrene 2.38
DRMO-51 Benzo(a)anthracene 3.62 Benzo(a)pyrene 5.07 Benzo(b)fluoranthene 10.7
DRMO-52 Benzo(a)pyrene 2.02 Benzo(b)fluoranthene 2.99
DRMO-65 Benzo(a)pyrene 0.89
DRMO-63 Benzo(a)anthracene 9.92 Benzo(a)pyrene 5.87 Benzo(b)fluoranthene 6.48
DRMO-71 Benzo(a)anthracene 3.67 Benzo(b)fluoranthene 6.93
DRMO-37 Benzo(a)anthracene 9.32 Benzo(a)pyrene 10.9 Benzo(b)fluoranthene 11.2 Indeno(1,2,3-CD)pyrene 2.5
DRMO-38 Benzo(a)pyrene 2.03
DRMO-43 Benzo(a)anthracene 17.1 Benzo(a)pyrene 20 Benzo(b)fluoranthene 20.8 Indeno(1,2,3-CD)pyrene 9.29
METAL
PROVIDENCE A
BARB ROAD
ROAD
MEAN HIGH WATER ELEVATION
THAMES RIVER
MEAN LOW WATER ELEVATION
DRMO BUILDING 355
491
397
UST
6TB1
6TB3
6TB10
6MW2
6MW4
6SS3
6SS4
LEGEND
EXISTING CONTOUR
BUILDING No.
WATERCOURSE
STORM SEWER AND CATCH BASIN
EXPOSED BEDROCK
SOIL SAMPLE LOCATIONS
Note: Tags were prepared manually on a background map. The background map is available on electronic file: ACAD: K:\CADD\7363\7363GM05.DWG 10/22/96
Figure B-5: SAMPLE LOCATIONS WITH EXCEEDANCE OF SVOC PRGs FOR PROTECTION OF FUTURE RESIDENTIAL RECEPTOR, ECOLOGICAL RECEPTOR AND SURFACE WATER
DRMO SITE
NSB-NLON
GROTON, CT
Brown & Root Environmental
0 60 FT 120 FT
01338132

Draft Final



01338142



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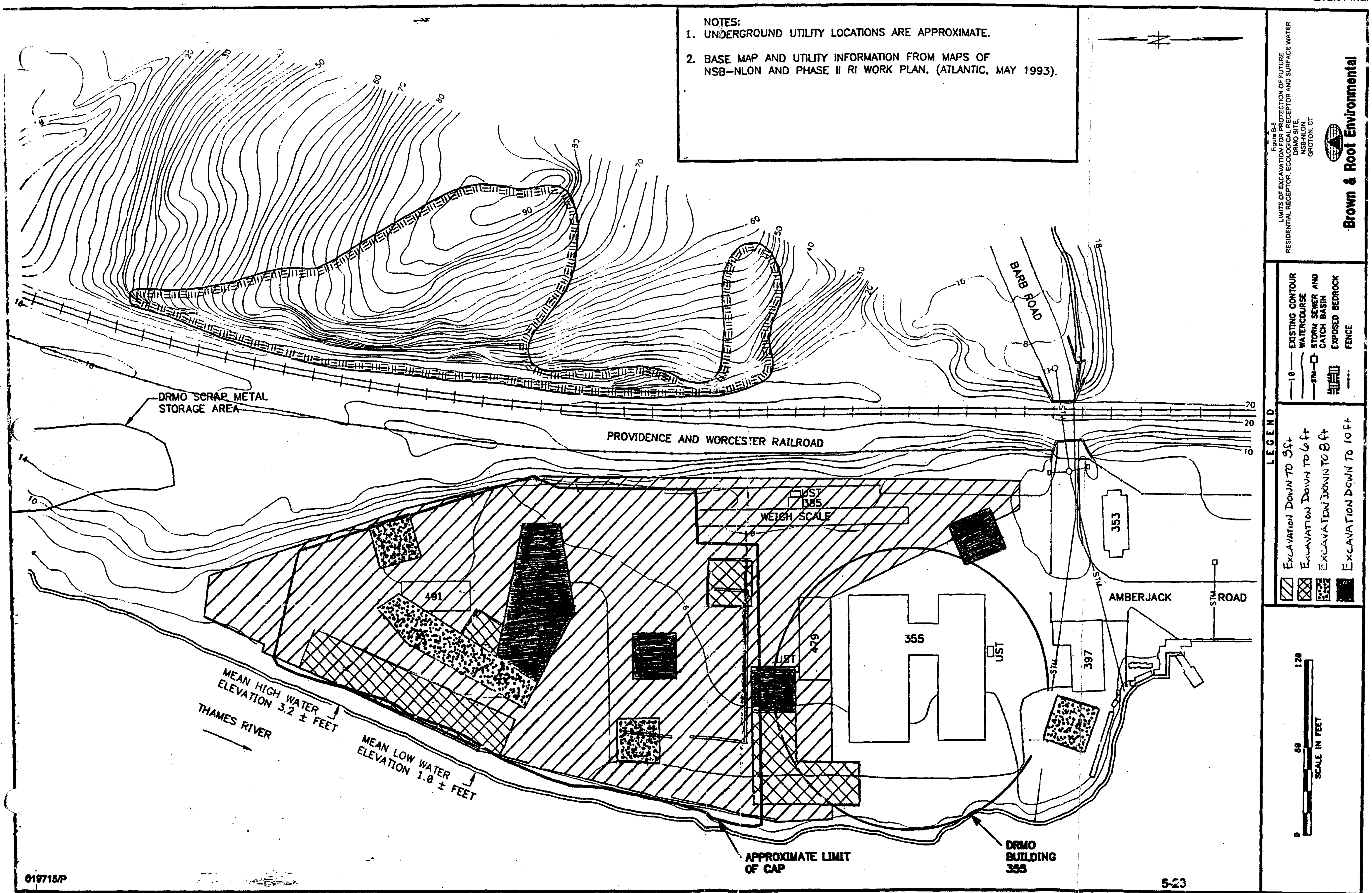


Figure B-8
LIMITS OF EXCAVATION FOR PROTECTION OF FUTURE RESIDENTIAL RECEPTOR, ECOLOGICAL RECEPTOR AND SURFACE WATER
DRMO SITE,
NSB-NLON,
GROTON, CT

Brown & Root Environmental

01338162

APPENDIX C

COST ESTIMATES

ALTERNATIVE 2

COST ESTIMATE

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Groundwater Monitoring
Alternative No. 2

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 MOBILIZATION/DEMOBILIZATION												
1.1 Office Trailer (1)	1	MO	$500.00				$500	$0	$0	$0	$500	
1.2 Storage Trailer (1)	1	MO	$500.00				$500	$0	$0	$0	$500	
1.3 Construction Survey	1	LS	$1,500.00				$1,500	$0	$0	$0	$1,500	
1.4 Equipment Mobilization/Demobilization	1	LS	$3,500.00				$3,500	$0	$0	$0	$3,500	
1.5 Site Utilities	1	MO	$700.00				$700	$0	$0	$0	$700	
2 DECONTAMINATION FACILITIES & SERVICES												
2.1 Decontamination Trailer	1	MO	$1,500.00				$1,500	$0	$0	$0	$1,500	
2.2 Temporary Truck Decon Pad	1	LS		$200.00	$500.00	$50.00	$0	$200	$500	$50	$750	
2.3 Decon Water	300	GAL	$0.20				$60	$0	$0	$0	$60	
3 INSTITUTIONAL CONTROLS												
3.1 Notices Posting	10	EA		$30.46	$20.03	$2.00	$0	$305	$200	$20	$525	
3.2 Deed Restrictions	1	LS	$5,000.00				$5,000	$0	$0	$0	$5,000	
4 MONITORING WELLS												
4.1 Install 3 Wells	120	LF	$120.00				$14,400	$0	$0	$0	$14,400	1 well 90 ft/2 wells 15 ft
4.2 Well Pumps	10	EA		$700.00	$132.00		$0	$7,000	$1,320	$0	$8,320	
4.3 Control Box	1	EA		$1,645.00			$0	$1,645	$0	$0	$1,645	
4.4 Air Line/Water Discharge Tubing	420	LF		$3.05			$0	$1,281	$0	$0	$1,281	
4.5 Inground Vaults	7	EA		$300.00	$141.00		$0	$2,100	$987	$0	$3,087	
4.6 Excavate/ Backfill In Ground Vaults	2	CY			$23.00		$0	$0	$46	$0	$46	
4.7 Above Ground Vaults	2	EA		$300.00	$141.00		$0	$600	$282	$0	$882	
4.8 Repair Existing Cap	1	LS		$100.00	$300.00		$0	$100	$300	$0	$400	Damaged by well const.
Subtotal							$27,660	$13,231	$3,635	$70	$44,596	
Burden on Labor Cost @ 30%									$1,091		$1,091	
Labor on Labor Cost @ 10%									$364		$364	
Material on Material Cost @ 10%								$1,323			$1,323	
SubContract on SubContract Cost @ 10%							$2,766				$2,766	
Total Direct Cost							$30,426	$14,554	$5,089	$70	$50,139	
Indirects on Total Direct Labor Cost @ 75%									$3,817		$3,817	
Profit on Total Direct Cost @ 10%											$5,014	
Subtotal											$58,970	
Health & Safety Monitoring @ 10%											$5,897	
Total Field Cost											$64,867	
Contingency on Total Field Cost @ 20%											$12,973	
Engineering on Total Field Cost @ 20%											$12,973	
TOTAL COST											$90,814	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Groundwater Monitoring
Alternative No. 2
Annual Cost

Item	Item Cost Annually	Item Cost Years 1 Thru 3	Item Cost Every 5 Years	Notes
Sampling		$20,000		Sampling quarterly, 14 groundwater samples per sampling period(incl. blanks and duplicates), quarterly plus travel, living and shipping costs.
Analysis		$48,000		Sampling quarterly, 14 groundwater samples per sampling period(incl. blank and duplicates) testing for TCL Volatiles and Semi-Volatiles, Pesticides/PCBs and Metals.
Reporting		$16,000		One report per quarter, 40 manhours per report plus other direct cost.
O & M of Site	$10,186			Maintain asphalt cap, fencing and signs.
5 Year Site Review			$10,000	Site analysis performed for years 5, 10, 15, 20, 25 and 30.
TOTALS	$10,186	$84,000	$10,000	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Groundwater Monitoring
Alternative No. 2
Present Worth Analysis

Year	Capital Cost	O & M Cost	Total Annual Cost
0	$90,814		$90,814
1		$94,186	$94,186
2		$94,186	$94,186
3		$94,186	$94,186
4		$10,186	$10,186
5		$20,186	$20,186
6		$10,186	$10,186
7		$10,186	$10,186
8		$10,186	$10,186
9		$10,186	$10,186
10		$20,186	$20,186
11		$10,186	$10,186
12		$10,186	$10,186
13		$10,186	$10,186
14		$10,186	$10,186
15		$20,186	$20,186
16		$10,186	$10,186
17		$10,186	$10,186
18		$10,186	$10,186
19		$10,186	$10,186
20		$20,186	$20,186
21		$10,186	$10,186
22		$10,186	$10,186
23		$10,186	$10,186
24		$10,186	$10,186
25		$20,186	$20,186
26		$10,186	$10,186
27		$10,186	$10,186
28		$10,186	$10,186
29		$10,186	$10,186
30		$20,186	$20,186
Total Cost			$708,394.00

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Groundwater Monitoring
Alternative No. 2

Assumptions (The following assumptions are used in the cost analysis)

- The time to complete well construction and upgrade will be one (1) month.
- Three new wells will be constructed. Two will be 15 feet and one will be 90 feet deep.
- Wells will be constructed of 2 inch diameter polyvinyl chloride (PVC).
- Drill rig will have ready access to all 3 drilling sites.
- An estimated price of $120 per linear foot for installing a well includes labor, equipment, materials, development and waste disposal.
- 10 sampling pumps will be purchased and installed. 7 in existing wells and 1 in each of the new wells.
- Geoguard pumps and equipment will be used for costing. Geoguard pumps will be 2 inches in diameter and capable of a 100 mL/min. flowrate.
- 5 of the existing wells (6MW2S, 6MW2D, 6MW3S, 6MW3D, 6MW1S) will be upgraded to in-ground, flush mounted vault boxes.
- 2 of the new wells (6MW10S and 6MW10D) will be constructed with in-ground, flush mounted vault boxes.
- A custom 6 inch well cap will be ordered for 6MW6D and an above ground vault box will be constructed around it.
- An above ground vault box will also be constructed on the new well 6MW9S.
- A Geoguard 2 inch well cap will fit in the current vault box at 6MW6S and the existing above ground vault box will be adequate.
- For the wells going through the geosynthetic cap, the caps integrity will be restored using bentonite and cold patch.
- A total of 10 groundwater samples will be taken each quarter. In addition, one duplicate and one blank sample will be sent in for analysis.
- Analysis cost approximately $1000 per sample for TCL Volatiles, Semi-Volatiles, Pesticides/PCBs, and TAL metals.
- A written report will be submitted after each sampling period.
- A final report and site review will be completed at the end of year 3.
- Any repairs to the asphalt cap beyond routine upkeep will be funded by the base DRMO to maintain the serviceability of the asphalt surface for their use.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: US NAVY NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: ALTERNATIVE 2 COST ESTIMATE	
BASED ON:	DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
TJR	JRR		6 FEB 97

1 Install Monitoring well   assume $120'/lf subcon

wells 90'
15'
15'
} - 120'

2. Pumps from vendor cost $595 (1995)   need 10
add 5% for inflation $30
add 5% shipping $30
add $40 for misc supplies $40
$695.00 say $700/ea material

cost to install Means 96-152-490-3040
$120 add 10% for Region = $132 Labor

3 Control Box $1,495 from vendor (1995)   need 1
$75 5% inflation
$75 5% shipping
$1645   material

4. Air Compressor - rent add to sampling cost

5. Hose 2 line tubing $2.75/ft from vendor (1995)
.15 5% inflation   need 420'
.15 5% shipping
$3.05/ft   material
$1281.00

CALCULATION WORKSHEET
Order No. 19116 (01-91)

CLIENT: US NAVY NORTHDIV CTO 267
JOB NUMBER: 7363
SUBJECT: ALTERNATIVE 2 COST ESTIMATE
BASED ON:
DRAWING NUMBER:
BY: TJR
CHECKED BY: JRL
APPROVED BY:
DATE: 6 FEB 97

6. ingrand vaults need 7

M96-026-254-0400 260 M 123 L

26 12 add 10% for Connecticut

13 6 add 5% for inflation

299 141

$300 material $141 Labor

7. Excavate/Backfill vaults

Means 96-022-250-0010 $19.80 L/cy say 2cy to excavate

1.98 add 10%

.99 add 5%

22.77 say $23/cy Labor

8. Above ground vaults 2 needed

Use same as ingrand vaults $300 M $141 Labor

9. Repair cap when installing 2 wells

say $300 L & $170 materials/ea

ALTERNATIVE 3

COST ESTIMATE

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Hot Spot Excavation, Offsite Disposal, Institutional Controls and Groundwater Monitoring
Alternative No. 3

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 MOBILIZATION/DEMOBILIZATION												
1.1 Office Trailer (1)	5	MO	$500.00				$2,500	$0	$0	$0	$2,500	
1.2 Storage Trailer (1)	5	MO	$500.00				$2,500	$0	$0	$0	$2,500	
1.3 Construction Survey	1	LS	$5,000.00				$5,000	$0	$0	$0	$5,000	
1.4 Portable Communication Equipment	2	SETS	$1,500.00				$3,000	$0	$0	$0	$3,000	
1.5 Equipment Mobilization/Demobilization	1	LS	$10,000.00				$10,000	$0	$0	$0	$10,000	
1.6 Site Utilities	5	MO	$4,000.00				$20,000	$0	$0	$0	$20,000	
1.7 Decontamination Trailer	5	MO	$1,500.00				$7,500	$0	$0	$0	$7,500	
2 DECONTAMINATION FACILITIES & SERVICES												
2.1 Laundry Service	20	WKS	$250.00				$5,000	$0	$0	$0	$5,000	
2.2 Truck Decon Pad												
a) Concrete Pad - 8"	40	CY		$70.00	$125.00	$5.00	$0	$2,800	$5,000	$200	$8,000	
b) Gravel Base - 6"	30	CY		$7.50	$3.33	$8.00	$0	$225	$100	$240	$565	
c) Curb	120	LF		$3.07	$1.99	$0.05	$0	$368	$239	$6	$613	
d) Collection Sump	1	LS		$1,450.00	$500.00	$220.00	$0	$1,450	$500	$220	$2,170	
e) Splash Guard	780	SF		$1.25	$1.00		$0	$975	$780	$0	$1,755	
2.3 Decontamination Services	5	MO	$1,200.00				$6,000	$0	$0	$0	$6,000	
2.4 Decon Water	55000	GAL	$0.20				$11,000	$0	$0	$0	$11,000	
2.5 Clean Water Storage Tank	1	EA		$3,000.00	$300.00		$0	$3,000	$300	$0	$3,300	3000 Gallon
2.6 Spent Water Storage Tank	1	EA		$5,000.00	$400.00		$0	$5,000	$400	$0	$5,400	5000 Gallon
3 DEWATERING & WASTEWATER TREATMENT												
3.1 Dewatering Pad - 40' x 40'w/5' Berm	75	CY		$4.50	$3.54	$10.10	$0	$338	$266	$758	$1,361	
3.2 HDPE Liner	1600	SF		$0.50	$0.20		$0	$800	$320	$0	$1,120	
3.3 Sand Layer -12"	60	CY		$6.00	$2.70	$7.43	$0	$360	$162	$446	$968	Replaced 13 Times
a) Place, Spread & Compact	60	CY			$0.84	$2.67	$0	$0	$50	$160	$211	
3.4 Geotextile Layer	180	SY		$1.40	$0.30		$0	$252	$54	$0	$306	
3.5 Gravel Layer - 12"	60	CY		$7.50	$2.70	$7.43	$0	$450	$162	$446	$1,058	
a) Place, Spread & Compact	60	CY			$0.84	$2.67	$0	$0	$50	$160	$211	
3.6 Drainage Pipe - 4" PVC	240	LF		$0.86	$1.44		$0	$206	$346	$0	$552	
3.7 Drainage Sump - 4' dia.	1	EA		$1,450.00	$500.00	$250.00	$0	$1,450	$500	$250	$2,200	
3.8 Polyethylene Cover	1600	SF		$0.20	$0.10		$0	$320	$160	$0	$480	
WASTEWATER TREATMENT SYSTEM												
3.9 Treatment Plant Supply Pump	1	EA		$1,790.99	$391.75	$6.21	$0	$1,791	$392	$6	$2,189	200 gpm
3.10 Bag Filter	1	EA		$500.00	$100.00		$0	$500	$100	$0	$600	
3.11 Filter Bags	250	EA		$25.00	$5.00		$0	$6,250	$1,250	$0	$7,500	
3.12 Activated Carbon Adsorber	1	EA		$137,943.72	$8,251.49	$1,305.22	$0	$137,944	$8,251	$1,305	$147,500	
3.13 Treatment Piping - 2"	200	LF		$13.00	$7.00		$0	$2,600	$1,400	$0	$4,000	
3.14 Electrical Generator	1	LS		$9,300.00	$920.00	$172.00	$0	$9,300	$920	$172	$10,392	
3.15 PE Piping for Treatment Plant - 4"	100	LF		$8.64	$4.08	$0.08	$0	$864	$408	$8	$1,280	
3.16 Discharge Pump	1	EA		$1,790.99	$391.75	$6.21	$0	$1,791	$392	$6	$2,189	200 gpm
3.17 PE Piping for Discharge - 4"	5000	LF		$8.64	$4.08	$0.08	$0	$43,200	$20,400	$400	$64,000	
3.18 Dewatering Pump	1	EA		$1,790.99	$391.75	$6.21	$0	$1,791	$392	$6	$2,189	200 gpm
3.19 PE Piping for Dewatering - 4"	10000	LF		$8.64	$4.08	$0.08	$0	$86,400	$40,800	$800	$128,000	
3.20 Spent Carbon Disposal												
a) Haul & Dispose	10	TON	$200.00				$2,000	$0	$0	$0	$2,000	Model City, NY
b) Subtitle D Disposal Samples	1	EA	$1,000.00	$35.00	$8.00	$5.00	$1,000	$35	$8	$5	$1,048	TCLP Analysis

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Hot Spot Excavation, Offsite Disposal, Institutional Controls and Groundwater Monitoring
Alternative No. 3

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
3.21 Dewatering Bed Disposal												
a) Haul & Dispose	2200	TON	$200.00				$440,000	$0	$0	$0	$440,000	Model City, NY
b) Subtitle D Disposal Samples	4	EA	$1,000.00	$35.00	$8.00	$5.00	$4,000	$140	$32	$20	$4,192	TCLP Analysis
4 EXCAVATION												
4.1 Remove Cap												
a) Remove and Load Asphalt Layer	1250	SY			$1.43	$1.98	$0	$0	$1,788	$2,475	$4,263	
b) Haul Asphalt	180	MI	$5.00				$900	$0	$0	$0	$900	8 loads X 20 loaded miles
c) Dispose of Asphalt Off-Site	104	CY	$49.50				$5,148	$0	$0	$0	$5,148	Local landfill
d) Remove Crushed Rock Layer	416	CY			$1.19	$2.65	$0	$0	$495	$1,102	$1,597	48 in bucket
e) Haul and Store Crushed Rock	416	CY			$1.95	$3.27	$0	$0	$811	$1,360	$2,172	
4.2 Install Sheet-Pile Walls	830	LF		$312.50	$156.25	$156.25	$0	$259,375	$129,688	$129,688	$518,750	Install to uniform 25ft bgs
4.3 Excavate and Load Contaminated Soil	2950	CY			$0.72	$1.30	$0	$0	$2,124	$3,835	$5,959	Including GCL
4.4 Perform Confirmation Sampling	48	EA	$157.00	$35.00	$8.00	$5.00	$7,536	$1,680	$384	$240	$9,840	PCB's only
5 CONTAMINATED SOIL DISPOSAL												
5.1 Haul and Dispose of Contaminated Soil in Landfill	2950	TON	$227.00				$669,650	$0	$0	$0	$669,650	Trans., treat and dispose
5.2 Sample Contaminated Soil	10	EA	$1,000.00				$10,000	$0	$0	$0	$10,000	
6 BACKFILL AND REPAIR CAP												
6.1 Clean Soil Fill												
a) Purchase and Haul	2950	CY	$23.52				$69,384	$0	$0	$0	$69,384	
b) Spread	2950	CY			$0.31	$0.94	$0	$0	$915	$2,773	$3,688	
c) Compact	2950	CY			$0.11	$0.21	$0	$0	$325	$620	$944	
6.2 Install New Geosynthetic Liner	11250	SF	$0.97				$10,913	$0	$0	$0	$10,913	
6.3 12 inch crushed rock layer												
a) Haul From Storage and Place	416	CY			$2.15	$3.60	$0	$0	$894	$1,498	$2,392	
b) Spread	416	CY			$0.31	$0.94	$0	$0	$129	$391	$520	
c) Compact	416	CY			$0.06	$0.08	$0	$0	$25	$33	$58	
6.4 Asphalt layer-3 in.	1375	SY	$5.22				$7,178	$0	$0	$0	$7,178	Area removed +10%
7 MONITORING WELLS												
7.1 Install 3 Wells	120	LF	$120.00				$14,400	$0	$0	$0	$14,400	1 well 90 ft/ 2 wells 15 ft
7.2 Well Pumps	10	EA		$700.00	$132.00		$0	$7,000	$1,320	$0	$8,320	
7.3 Control Box	1	EA		$1,645.00			$0	$1,645	$0	$0	$1,645	
7.4 Air Line/Water Discharge Tubing	420	LF		$3.05			$0	$1,281	$0	$0	$1,281	
7.5 Inground Vaults	7	EA		$300.00	$141.00		$0	$2,100	$987	$0	$3,087	
7.6 Excavate/ Backfill Inground Vaults	2	CY			$23.00		$0	$0	$46	$0	$46	
7.7 Above Ground Vaults	2	EA		$300.00	$141.00		$0	$600	$282	$0	$882	
7.8 Repair Existing Cap	1	LS		$100.00	$300.00		$0	$100	$300	$0	$400	Damaged by well const.
8 INSTITUTIONAL CONTROLS												
8.1 Notices Posting	10	EA		$30.46	$20.03	$2.00	$0	$305	$200	$20	$525	
8.2 Deed Restrictions	1	LS	$5,000.00				$5,000	$0	$0	$0	$5,000	
Subtotal							$1,319,608	$584,686	$224,845	$149,649	$2,278,788	
Burden on Labor Cost @ 30%									$67,454		$67,454	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Hot Spot Excavation, Offsite Disposal, Institutional Controls and Groundwater Monitoring
Alternative No. 3

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
Labor on Labor Cost @	10%								$22,485		$22,485	
Material on Material Cost @	10%							$58,469			$58,469	
SubContract on SubContract Cost @	10%						$131,961				$131,961	
Total Direct Cost							$1,451,569	$643,154	$314,783	$149,649	$2,559,155	
Indirects on Total Direct Labor Cost @	75%								$236,087		$236,087	
Profit on Total Direct Cost @	10%										$255,916	
Subtotal											$3,051,158	
Health & Safety Monitoring @	10%										$305,116	
Total Field Cost											$3,356,274	
Contingency on Total Field Cost @	20%										$671,255	
Engineering on Total Field Cost @	10%										$335,627	
TOTAL COST											**$4,363,156**	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Hot Spot Excavation, Offsite Disposal, Institutional Controls and Groundwater Monitoring
Alternative No. 3
Annual Cost

Item	Item Cost Annually	Item Cost Years 1 Thru 3	Item Cost Every 5 Years	Notes
Sampling		$20,000		Sampling quarterly, 14 groundwater samples per sampling period(incl. blanks and duplicates), quarterly plus travel, living and shipping costs.
Analysis		$48,000		Sampling quarterly, 14 groundwater samples per sampling period(incl. blank and duplicates) testing for TCL Volatiles and Semi-Volatiles, Pesticides/PCBs and Metals.
Reporting		$16,000		One report per quarter, 40 manhours per report plus other direct cost.
O & M of Site	$10,186			Maintain asphalt cap, fencing and signs.
5 Year Site Review			$10,000	Site analysis performed for years 5, 10, 15, 20, 25 and 30.
TOTALS	$10,186	$84,000	$10,000	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Hot Spot Excavation, Offsite Disposal, Institutional Controls and Groundwater Monitorin
Alternative No. 3
Present Worth Analysis

Year	Capital Cost	O & M Cost	Total Annual Cost
0	$4,363,156		$4,363,156
1		$94,186	$94,186
2		$94,186	$94,186
3		$94,186	$94,186
4		$10,186	$10,186
5		$20,186	$20,186
6		$10,186	$10,186
7		$10,186	$10,186
8		$10,186	$10,186
9		$10,186	$10,186
10		$20,186	$20,186
11		$10,186	$10,186
12		$10,186	$10,186
13		$10,186	$10,186
14		$10,186	$10,186
15		$20,186	$20,186
16		$10,186	$10,186
17		$10,186	$10,186
18		$10,186	$10,186
19		$10,186	$10,186
20		$20,186	$20,186
21		$10,186	$10,186
22		$10,186	$10,186
23		$10,186	$10,186
24		$10,186	$10,186
25		$20,186	$20,186
26		$10,186	$10,186
27		$10,186	$10,186
28		$10,186	$10,186
29		$10,186	$10,186
30		$20,186	$20,186
Total Cost			$4,980,736.00

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Hot Spot Excavation, Off site Disposal, Institutional Controls and Groundwater Monitoring
Alternative 3

ASSUMPTIONS

- Excavation depths will be as follows:
  - 6TB2 down to 8 feet
  - DRMO 57-72 down to 10 feet
  - DRMO 51-65 down to 8 feet
  - DRMO 40-71 down to 6 feet
- The site will meet the remedial goals after the excavation.
- The project will take 5 months to complete based on excavation output and transportation limitations.
- Groundwater is not considered contaminated, therefore disposal is at a no cost.
- Existing crushed rock drainage layer above the geosynthetic liner is clean and can be reused.
- Building 491 remains in place.
- Sheet piling is placed around the perimeter of each excavation except 6TB2 which will be overexcavated with a 1 to 1 slope.
- Confirmation sampling will be done at 25 foot intervals along the sidewalls of all excavations and on a 25 foot grid spacing throughout the bottoms of all excavations for a total of 48 samples.
- Clean materials will be brought in to backfill the excavation.
- The cap will be replaced in areas which are currently capped. The new cap will consist of a liner, 12 inch crushed rock layer and 3 inches of asphalt.
- Costs derived from Means are used with 10% added to represent local costs.
- Not enough soil is being excavated to warrant on site treatment.
- Necessary treatment will be done at and by the landfill. Costs for treatment, transportation and taxes are included in the disposal cost.
- Any repairs to the asphalt cap beyond routine upkeep will be funded by the base DRMO to maintain the serviceability of the asphalt surface for their use.

CLIENT: US NAVY NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: ALTERNATIVE 3 COST ESTIMATE CALCULATIONS FOR CADMIUM HITS	
BASED ON:	DRAWING NUMBER:
BY: JRR / CHECKED BY: TJR	APPROVED BY: / DATE: 2-20-97

CADMIUM HITS AT DRMO 35 } ACCOUNTED FOR IN AROCHLOR EXCAVATION
DRMO 72 }
DRMO 40 NEW EXCAVATION AREA

DRMO 40 ~ 30 ft × 30 ft (EXCAVATION DEPTH = 6 ft)
AREA = 900 ft^2
SHEET PILE PERIMETER = 90 ft (3 SIDES W BORDERING EXC.)

NEW TOTAL VOLUME FOR THE SITE 79,608 ft^3
5,400 ft^3
85,008 ft^3 = 3,148 CY

NEW SURFACE AREA TOTALS FOR THE SITE 10,328 ft^2
900 ft^2
11,228 ft^2 = 1,248 SY

VOLUME OF CRUSHED ROCK = TOTAL AREA × 1 ft
= 11,228 ft^3 ≅ 416 CY

SHEET PILING AREA 6,470 ft^2
+ (90 ft)(6 ft)
7,010 ft^2

WT OF EXCAVATED SOIL (ASSUME 100 lbs/ft^3)
= (85,008 ft^3)(100 lbs/ft^3)(1 TON/2,000 lbs)
= 4,250 TONS

WT OF ASPHALT (ASSUME ASPHALT IS 110 lbs/ft^3 AND 3 IN THICK)
= (11,228 ft^2)(0.25 ft)(110 lbs/ft^3)(1 TON/2,000 lbs)
= 154 TONS

VOLUME OF ASPHALT = (11,228 ft^2)(0.25 ft)(1 CY/27 ft^3) ≅ 104 CY

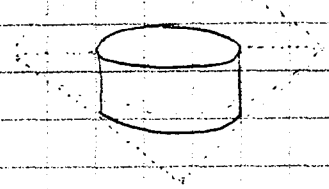
CLIENT	JOB NUMBER
US NAVY – NORTHDIV CTO 267	7363

SUBJECT	
ALT. 3 COST ESTIMATE	

BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
HRR	TJR		5 FEB 97

6TB2 HOT SPOT (15 ft DIA × 8 ft DEEP)

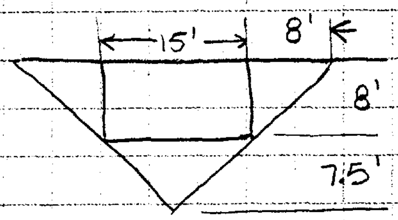


AREA EXC. APPROXIAMATED BY CONE WITH THE TOP CUT OFF

VOL OF A CONE = $\frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi (15.5\text{ ft})^2 (15.5\text{ ft})$

$= 3900\text{ ft}^3$



VOL OF EXCAVATION = VOL OF CONE − TOP

$= 3900\text{ ft}^3 - \frac{1}{3}\pi (7.5\text{ ft})^2 (7.5\text{ ft})$

$= 3458\text{ ft}^3$

AREA = $\pi r^2 = \pi (15.5\text{ ft})^2$

$\approx 755\text{ ft}^2$

DRMO 39 - 6TB19 (130 ft × 30 ft × 6 ft DEEP)

AREA = $3,900\text{ ft}^2$

PERIMETER = 320 ft

VOLUME = $3900\text{ ft}^2 (6\text{ ft}) = 23,400\text{ ft}^3$

DRMO 57–72 (10 ft DEEP)

AREA (USING PLANIMETER) = $3,683\text{ ft}^2$

PERIMETER = 235 ft

VOLUME = $3683\text{ ft}^2 (10\text{ ft}) = 36,830\text{ ft}^3$

DRMO 51–65 (8 ft DEEP)

AREA (USING PLANIMETER) = 1990 ft^2

PERIMETER = 275 ft

VOLUME = $1990\text{ ft}^2 (8\text{ ft}) = 15,920\text{ ft}^3$

CLIENT		JOB NUMBER	
US NAVY - NORTHDIV CTO 267		7363	
SUBJECT: ALT 3 COST ESTIMATE			
BASED ON		DRAWING NUMBER	
BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		5 FEB 97

VOLUME TOTALS FOR SITE:

3,458 ft³
23,400 ft³
36,830 ft³
15,920 ft³
79,608 ft³ = 2,948 CY

SURFACE AREA TOTALS FOR SITE:

755 ft²
3,900 ft²
3,683 ft²
1,990 ft²
10,328 ft² = 1,148 SY

VOLUME OF CRUSHED ROCK = TOTAL AREA × 1 ft
= 10,328 ft³ = 383 CY

VOLUME OF CONTAMINATED SOIL = 79,608 ft³ ≅ 2,950 CY

SHEET PILING AREAS

DRMO 39 - 6TB19 PERIMETER = 320 ft DEPTH = 6 ft
AREA = 1920 ft²

DRMO 57-72 PERIMETER = 235 ft DEPTH = 10 ft
AREA = 2,350 ft²

DRMO 51-65 PERIMETER = 275 ft DEPTH = 8 ft
AREA = 2,200 ft²

TOTAL AREA = 6,470 ft²

CLIENT US NAVY - NORTHDIV CTO 267	JOB NUMBER 7363
SUBJECT ALT 3 COST ESTIMATE	
BASED ON	DRAWING NUMBER
BY JRR / CHECKED BY TJR	APPROVED BY / DATE 5 FEB 97

WEIGHT OF EXCAVATED SOIL (ASSUME 100 lbs/ft^3)

$79{,}608\,ft^3 (100\,lbs/ft^3)(1\,ton/2000\,lbs) = 3{,}980$ TONS

WEIGHT OF ASPHALT (ASSUME ASPHALT IS 110 lbs/ft^3 AND 3" THICK)

$(10{,}328\,ft^2)(0.25\,ft)(110\,lbs/ft^3)(1\,ton/2{,}000\,lbs)$
$= 142$ TONS

VOLUME OF ASPHALT = $(10{,}328\,ft^2)(0.25\,ft)(1\,CY/27\,ft^3) \cong 96$ CY

DISPOSAL OF ASPHALT M96 020 612 0100
CY \$45 (SUBCONTRACT)
+ 4.5 10% FOR CT
\$ 49.5

DEWATERING PUMPS M96 021 404 650 (4" PUMPS (2))

UNIT	MAT'L	LABOR	EQUIP	
DAY		71.00	86.00	
		7.10	8.60	10% FOR CT
		78.10	~~94.60~~	

ADJ. TO 46.20 FOR 2 PUMPS

NEW GEOSYNTHETIC LINER ECHOS 33 08 05 08 FML/BENTONITE LINER
SUBCONTRACT SF 0.88
0.09 10% FOR CT
0.97

PCB TESTING DRMO GW MONITORING QUOTE
SUBCONTRACT EA \$157.00
+

		MAT'L	LABOR	EQUIP
SAMPLING	EA	35.00	8.00	5.00

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: US NAVY NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: ALT 3 COST ESTIMATE	
BASED ON:	DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		5 FEB 97

	UNIT	MAT'L	LABOR	EQUIP	
CRUSHED ROCK					
REMOVE M96 022 238 1850					
	CY		1.08	2.41	
			0.11	0.24	10% FOR CT
			1.19	2.65	
SPREAD (SAME AS FOR FILL)					
	CY		0.31	0.94	
COMPACT M96 022 226 5060					
	CY		0.05	0.07	
			0.06	0.08	10% FOR CT
LOAD & HAUL M96 A12.1-612 1400					
	CY		1.95	3.27	
			0.20	0.33	10% FOR CT
			2.15	3.60	
SOIL EXCAVATION					
1 1/2 CY HYDRAULIC BACKHOE M96 022 254 0610					
	CY		0.65	1.18	
			0.07	0.12	10% FOR CT
			0.72	1.30	
SHEET PILING					
DRIVE, EXTRACT & SALVAGE 15 ft M96 021 614 1300					
	SF	2.07	2.49	2.95	
		0.21	0.25	0.30	10% FOR CT
		2.28	2.74	3.25	
ASPHALT					
REMOVAL BITUMINOUS 3" M96 020 554 1710					
	SY		1.30	1.80	
			0.13	0.18	10% FOR CT
			1.43	1.98	

CLIENT US NAVY NORTHDIV CTO 267	JOB NUMBER 7363	
SUBJECT ALT 3 COST ESTIMATE		
BASED ON	DRAWING NUMBER	
BY JRR / CHECKED BY TJR	APPROVED BY	DATE 5 FEB 97

	UNIT	MAT'L	LABOR	EQUIP	
ASPHALT					
PLACEMENT 3" LAYER		M96 025 104 0160			
	SY	4.02	0.39	0.34	
		0.40	0.04	0.03	10% FOR CT
		4.42	0.43	0.37	
SUBCONTRACT	SY	5.22			

CLEAN HARBORS QUOTE JAN '97 (CT $0.02/lb STATE TAX (EST.) NOT INCLUDED)

OFF-SITE STABILIZATION
$187/TON (INCL TRANS. AND DISPOSAL)

ON-SITE STABILIZATION AND ON-SITE BACKFILL
$55/TON

ON-SITE STABILIZATION AND OFF SITE DISPOSAL
$157/TON (INCL TRANS. AND DISPOSAL)

USE $187/TON + [$0.02/lb (CT TAX)](2000 lb/TON)
= $227/TON

O & M COSTS FOR SITE ANNUALLY

ASPHALT PREPARE AND CLEAN SURFACE M96 025 458 0800
SUBCONTRACT $0.11/SY
+ 10% FOR CT = $0.12

ASPHALT SLURRY SEALING, 2 COATS M96 025 458 0800
SUBCONTRACT $1.60/SY
+ 10% FOR CT = $1.76

APPROXIAMATE AREA OF CAP = 43,000 ft^2 ≅ 4,780 SY

TOTAL ASPHALT MAINENANCE = 4,780 SY ($1.88/SY) = $8,986

CLIENT US NAVY NORTHDIV CTO 267	JOB NUMBER 7363
SUBJECT ALT 3 COST ESTIMATE	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		27 FEB 97

MAINTAIN FENCING AND SIGNS
2 LABORERS FOR 1 DAY
$200 FOR MATERIALS

ASSUME A TOTAL OF $700 / YR

ASPHALT PATCHING – APPROXIAMATE 100 SY AREA
ONCE PER YEAR ASSUME $500

TOTAL O & M COSTS ANNUALLY

CLEAN AND SEAL ASPHALT CAP	$ 8,986
FENCING AND SIGNS	$ 700
ASPHALT PATCHING	$ 500
	$ 10,186

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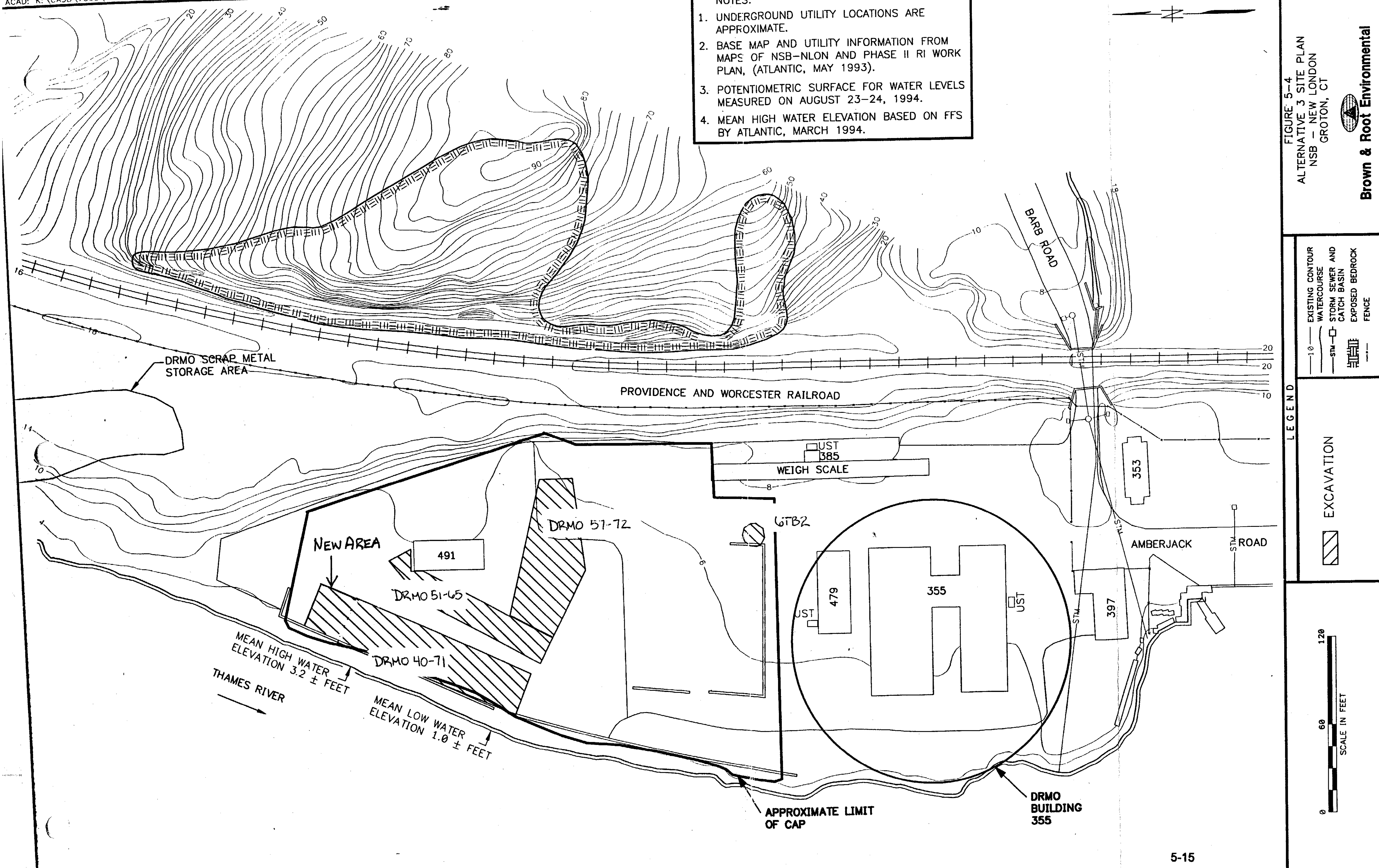

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ALTERNATIVE 4

COST ESTIMATE

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Excavation, Treatment, and Offsite Disposal of Contaminated Soil
Alternative No. 4

			Unit Cost				Total Cost				Total Direct	
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Cost	Comments
1 MOBILIZATION/DEMOBILIZATION												
1.1 Office Trailer (1)	9	MO	$500.00				$4,500	$0	$0	$0	$4,500	
1.2 Storage Trailer (1)	9	MO	$500.00				$4,500	$0	$0	$0	$4,500	
1.3 Construction Survey	1	LS	$6,000.00				$6,000	$0	$0	$0	$6,000	
1.4 Portable Communication Equipment	2	SETS	$1,500.00				$3,000	$0	$0	$0	$3,000	
1.5 Equipment Mobilization/Demobilization	1	LS	$10,000.00				$10,000	$0	$0	$0	$10,000	
1.6 Site Utilities	9	MO	$4,000.00				$36,000	$0	$0	$0	$36,000	
1.7 Decontamination Trailer	9	MO	$1,500.00				$13,500	$0	$0	$0	$13,500	
2 DECONTAMINATION FACILITIES & SERVICES												
2.1 Laundry Service	36	WKS	$250.00				$9,000	$0	$0	$0	$9,000	
2.2 Truck Decon Pad												
a) Concrete Pad - 8"	40	CY		$70.00	$125.00	$5.00	$0	$2,800	$5,000	$200	$8,000	
b) Gravel Base - 6"	30	CY		$7.50	$3.33	$8.00	$0	$225	$100	$240	$565	
c) Curb	120	LF		$3.07	$1.99	$0.05	$0	$368	$239	$6	$613	
d) Collection Sump	1	LS		$1,450.00	$500.00	$220.00	$0	$1,450	$500	$220	$2,170	
e) Splash Guard	780	SF		$1.25	$1.00		$0	$975	$780	$0	$1,755	
2.3 Decontamination Services	9	MO	$1,200.00				$10,800	$0	$0	$0	$10,800	
2.4 Decon Water	120000	GAL	$0.20				$24,000	$0	$0	$0	$24,000	
2.5 Clean Water Storage Tank	1	EA		$3,000.00	$300.00		$0	$3,000	$300	$0	$3,300	3000 Gallon
2.6 Spent Water Storage Tank	1	EA		$5,000.00	$400.00		$0	$5,000	$400	$0	$5,400	5000 Gallon
3 DEWATERING & WASTEWATER TREATMENT												
3.1 Dewatering Pad - 40' x 40'w/5' Berm	75	CY		$4.50	$3.54	$10.10	$0	$338	$266	$758	$1,361	
3.2 HDPE Liner	1600	SF		$0.50	$0.20		$0	$800	$320	$0	$1,120	
3.3 Sand Layer -12"	60	CY		$6.00	$2.70	$7.43	$0	$360	$162	$446	$968	Replaced 13 Times
a) Place, Spread & Compact	60	CY			$0.84	$2.67	$0	$0	$50	$160	$211	
3.4 Geotextile Layer	180	SY		$1.40	$0.30		$0	$252	$54	$0	$306	
3.5 Gravel Layer - 12"	60	CY		$7.50	$2.70	$7.43	$0	$450	$162	$446	$1,058	
a) Place, Spread & Compact	60	CY			$0.84	$2.67	$0	$0	$50	$160	$211	
3.6 Drainage Pipe - 4" PVC	240	LF		$0.86	$1.44		$0	$206	$346	$0	$552	
3.7 Drainage Sump - 4' dia.	1	EA		$1,450.00	$500.00	$250.00	$0	$1,450	$500	$250	$2,200	
3.8 Polyethylene Cover	1600	SF		$0.20	$0.10		$0	$320	$160	$0	$480	
WASTEWATER TREATMENT SYSTEM												
3.9 Treatment Plant Supply Pump	1	EA		$1,790.99	$391.75	$6.21	$0	$1,791	$392	$6	$2,189	200 gpm
3.10 Bag Filter	1	EA		$500.00	$100.00		$0	$500	$100	$0	$600	
3.11 Filter Bags	250	EA		$25.00	$5.00		$0	$6,250	$1,250	$0	$7,500	
3.12 Activated Carbon Adsorber	1	EA		$137,943.72	$8,251.49	$1,305.22	$0	$137,944	$8,251	$1,305	$147,500	
3.13 Treatment Piping - 2"	200	LF		$13.00	$7.00		$0	$2,600	$1,400	$0	$4,000	
3.14 Electrical Generator	1	LS		$9,300.00	$920.00	$172.00	$0	$9,300	$920	$172	$10,392	
3.15 PE Piping for Treatment Plant - 4"	100	LF		$8.64	$4.08	$0.08	$0	$864	$408	$8	$1,280	
3.16 Discharge Pump	1	EA		$1,790.99	$391.75	$6.21	$0	$1,791	$392	$6	$2,189	200 gpm
3.17 PE Piping for Discharge - 4"	5000	LF		$8.64	$4.08	$0.08	$0	$43,200	$20,400	$400	$64,000	
3.18 Dewatering Pump	1	EA		$1,790.99	$391.75	$6.21	$0	$1,791	$392	$6	$2,189	200 gpm
3.19 PE Piping for Dewatering - 4"	10000	LF		$8.64	$4.08	$0.08	$0	$86,400	$40,800	$800	$128,000	
3.20 Spent Carbon Disposal												
a) Haul & Dispose	10	TON	$200.00				$2,000	$0	$0	$0	$2,000	Model City, NY
b) Subtitle D Disposal Samples	1	EA	$1,000.00	$35.00	$8.00	$5.00	$1,000	$35	$8	$5	$1,048	TCLP Analysis
3.21 Dewatering Bed Disposal												
a) Haul & Dispose	2200	TON	$200.00				$440,000	$0	$0	$0	$440,000	Model City, NY
b) Subtitle D Disposal Samples	4	EA	$1,000.00	$35.00	$8.00	$5.00	$4,000	$140	$32	$20	$4,192	TCLP Analysis
4 DEMOLITION												
4.1 3 Light Duty Buildings												
a) Demolition												
1) Walls	3000	SF			$0.91	$0.35	$0	$0	$2,730	$1,050	$3,780	
2) Ceilings	140	LF			$3.29	$1.41	$0	$0	$461	$197	$658	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Excavation, Treatment, and Offsite Disposal of Contaminated Soil
Alternative No. 4

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
2) Foundation	3700	SF			$2.62	$0.50	$0	$0	$9,694	$1,850	$11,544	
b) Dumpster	2	WK	$418.00				$836	$0	$0	$0	$836	40 CY
c) Haul	40	MI	$5.00				$200	$0	$0	$0	$200	10 miles per trip, 4 trips
d) Dispose	124	CY	$49.50				$6,138	$0	$0	$0	$6,138	
4.2 UST's												
a) Pump Tank	400	GAL			$1.77	$0.02	$0	$0	$708	$8	$716	
b) Dispose of Tank Sludge	400	GAL	$2.70				$1,080	$0	$0	$0	$1,080	
c) Remove UST's	2	EA			$255.73	$693.14	$0	$0	$511	$1,386	$1,898	
d) Decontaminate Tanks	440	SF			$0.68	$0.15	$0	$0	$299	$66	$365	
e) Haul	2	EA	$578.00				$1,156	$0	$0	$0	$1,156	Transport for salvage
5 EXCAVATION												
5.1 Remove Cap												
a) Remove Asphalt Layer	9970	SY		$1.30	$1.80	$3.10	$0	$12,961	$17,946	$30,907	$61,814	
b) Load and Haul Asphalt	1234	TON	$5.64				$6,960	$0	$0	$0	$6,960	20 loaded miles
c) Dispose of Asphalt Off-Site	831	CY	$49.50				$41,135	$0	$0	$0	$41,135	
d) Remove Crushed Rock Drainage Layer	1593	CY			$1.19	$2.65	$0	$0	$1,896	$4,221	$6,117	48 in bucket
e) Haul and Store Rock Drainage Layer	1593	CY			$1.95	$3.27	$0	$0	$3,106	$5,209	$8,315	10 miles per trip
5.2 Install Sheet-Pile Walls	2000	LF		$312.50	$156.25	$156.25	$0	$625,000	$312,500	$312,500	$1,250,000	Uniform installation to 25ft bgs
5.3 Excavate Contaminated Soil	15664	CY			$0.65	$1.18	$0	$0	$10,182	$18,484	$28,665	Including GCL
5.4 Dispose of Treated Soil in Landfill	15611	TON	$157.00				$2,450,927	$0	$0	$0	$2,450,927	Stabilize, haul and dispose
5.5 Perform Confirmation Sampling	260	EA	$955.00				$248,300	$0	$0	$0	$248,300	TCL VOA, SVOA, P/PCB, and metals
6 TREATMENT												
6.1 Thermal Desorption												
a) Mob/Demob	1	LS	$297,300.00				$297,300	$0	$0	$0	$297,300	
b) Treatability Study	1	LS	$25,000.00				$25,000	$0	$0	$0	$25,000	
c) Treatment	18325	TON		$98.12	$1.19	$0.80	$0	$1,798,049	$21,807	$14,660	$1,834,516	
d) Shredder Mob/Demob	1	LS	$4,757.00				$4,757	$0	$0	$0	$4,757	
e) Shredder(first month)	1	MO	$46,055.00				$46,055	$0	$0	$0	$46,055	
f) Shredder(additional months)	8	MO	$19,417.00				$155,336	$0	$0	$0	$155,336	
g) Conveyor	1	EA	$5,864.00				$5,864	$0	$0	$0	$5,864	
h) Performance Testing	12	EA	$1,000.00				$12,000	$0	$0	$0	$12,000	
6.2 Chemical Fixation/Solidification												
a) Treatability Study	1	LS	$10,000.00				$10,000	$0	$0	$0	$10,000	
b) Treatment	18325	TON	$50.00				$916,250	$0	$0	$0	$916,250	
c) Performance Testing	12	EA	$1,000.00				$12,000	$0	$0	$0	$12,000	
7 BACKFILL AND RESTORE												
7.1 12 Inch Rock Drainage												
a) Haul from Storage and Place	1593	CY			$2.15	$3.60	$0	$0	$3,425	$5,735	$9,160	
b) Spread	1593	CY			$0.31	$0.94	$0	$0	$494	$1,497	$1,991	
c) Compact	1593	CY			$0.06	$0.08	$0	$0	$96	$127	$223	
7.2 Purchase and Place Clean Soil Fill	15664	CY		$3.79	$5.54	$14.19	$0	$59,367	$86,779	$222,272	$368,417	
b) Spread	15664	CY			$0.28	$0.85	$0	$0	$4,386	$13,314	$17,700	
c) Compact	15664	CY			$0.11	$0.21	$0	$0	$1,723	$3,289	$5,012	
7.3 Restore Area												
a) Purchase and Haul Topsoil	1660	CY	$34.28				$56,905	$0	$0	$0	$56,905	6 inch topsoil layer
b) Spread Topsoil	1660	CY			$0.28	$0.85	$0	$0	$465	$1,411	$1,876	
c) Seed	90	MSF	$39.30				$3,537	$0	$0	$0	$3,537	
Subtotal							$4,870,035	$2,805,977	$563,340	$643,800	$8,883,151	
Burden on Labor Cost @ 30%									$169,002		$169,002	
Labor on Labor Cost @ 10%									$56,334		$56,334	
Material on Material Cost @ 10%								$280,598			$280,598	
SubContract on SubContract Cost @ 10%							$487,004				$487,004	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Excavation, Treatment, and Offsite Disposal of Contaminated Soil
Alternative No. 4

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
Total Direct Cost							$5,357,039	$3,086,574	$788,676	$643,800	$9,876,088	
Indirects on Total Direct Labor Cost @ 75%									$591,507		$591,507	
Profit on Total Direct Cost @ 10%											$987,609	
Subtotal											$11,455,203	
Health & Safety Monitoring @ 10%											$1,145,520	
Total Field Cost											$12,600,724	
Contingency on Total Field Cost @ 20%											$2,520,145	
Engineering on Total Field Cost @ 8%											$1,008,058	
TOTAL COST											$16,128,927	

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Excavation, Treatment, and Offsite Disposal, Institutional Controls and Groundwater Monitoring
Alternative No. 4
Present Worth Analysis

Year	Capital Cost	O & M Cost	Total Annual Cost
0	$16,128,927		$16,128,927

Total Cost $16,128,927.00

NAVAL SUBMARINE BASE - NEW LONDON
Groton, Connecticut
Site 6 DRMO
Excavation, Treatment and Offsite Disposal of Contaminated Soil
Alternative 4

ASSUMPTIONS

- The entire alternative will take 9 months to complete based on treatment and transportation capacity.
- The site will meet all remedial goals after the excavation of designated areas.
- Excavation depths will be as follows:
    - Main eco area down to 3 feet to take care of the surface hits.
    - Hits below 3 feet will be overexcavated 2 feet below the hit and 900 square feet (30 feet by 30 feet) around the hit.
- Contaminants detected at 6MW5S, which is upgradient from the DRMO, are from another source and will not be addressed in this alternative.
- Buildings 479 and 491 will be demolished and not replaced.
    - The buildings are assumed to be constructed of concrete block with a steel beam supported roof for costing.
    - The building foundation is assumed to be 6 in wire reinforced concrete.
    - The steel beams from the roof will be salvaged at no cost.
- The weigh scale will be demolished and not replaced.
- The two UST's, one near bldg. 479 and the other near the weigh station, will be removed and not replaced.
    - The UST's are 5,000 gallons in capacity.
    - They are not leaking but contain 200 gallons of residual product.
    - They were used as fuel/oil tanks.
    - They will be salvaged as clean scrap metal at no cost.
- Place and remove sheet piling will be used for excavations at or below 6 feet below the ground level.
- The treatment system is set up at the sight.
- A dewatering pad will be placed in an excavated area after excavation and removed prior to restoration efforts and will require 220 LF of PVC drainage pipe.
- Confirmation samples will be taken every 25 feet of the perimeter and every 625 square feet along the floor of the excavation. For excavations deeper than 3 feet additional samples will

be taken at 25 foot intervals along the sidewalls of the excavation. The total number of samples is approxiamated as 260.

- Dewatering pumps will be utilized for work in excavations below the water table, assumed to be 3 feet below the surface for the entire site, in addition to 1000 LF of PVC piping.
- The 12 inch crushed rock drainage layer will be used as backfill on site with hauling and storage costs associated with it.
- Clean materials will brought in to backfill the excavation.
- A 6 inch layer of topsoil will be spread on the backfill and the entire excavation area will be hydroseeded.
- Costs derived from Means and ECHOS are used with 10% added to represent local costs.
- Groundwater is not considered to be contaminated, therefore disposal is at no cost.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: US NAVY - NORTHDIV CTO 267	JOB NUMBER: 7363
SUBJECT: ALTERNATIVE 4 COST ESTIMATE CALCULATIONS	
BASED ON:	DRAWING NUMBER:

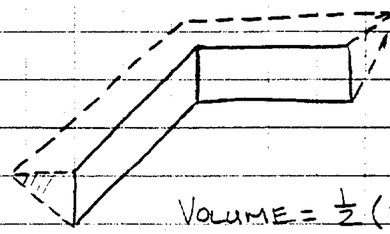
BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		12 FEB 97

MAIN ECO AREA EXCAVATION (EXCAVATE TO 3 ft)

AREA = 82,926 ft^2 (USING PLANIMETER)

PERIMETER = 1,410 ft

OVEREXCAVATION (ASSUME 1 TO 1 SLOPE)



Approximate as a triangular rod with a length = perimeter

VOLUME = $\frac{1}{2}$ (1,410 ft)(3 ft)(3 ft) = 6,345 ft^3

AREA = (3 ft)(1,410 ft) = 4,230 ft^2

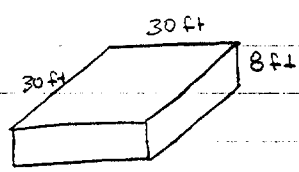
VOLUME = AREA (3 ft)

= (82,926 ft^2)(3 ft)

= 248,778 ft^3

HOT SPOT AT 6MW1S (30 ft × 30 ft × 8 ft DEEP)

USE SHEET PILE – NO OVEREXCAVATION



AREA = (30 ft)(30 ft) = 900 ft^3

PERIMETER = 4 (30 ft) = 120 ft

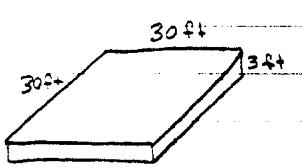
VOLUME = AREA (DEPTH)

= 900 ft^2 (8 ft)

= 7200 ft^3

HOT SPOT AT 6TB2 (30 ft × 30 ft × 6 ft)

USE SHEET PILE – NO OVEREXCAVATION



DEPTH OF EXC. = 6 ft – 3 ft (ALREADY EXC.) = 3 ft

AREA = (30 ft)(30 ft) = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (3 ft)

= 2,700 ft^3

CALCULATION WORKSHEET Order No. 19116 (01-91)

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BY: JRR / CHECKED BY: TJR	APPROVED BY: / DATE: 12 FEB 97

DRMO 51-65 (DEPTH OF EXC. = 8 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 5 ft)

USE SHEET PILE – NO OVEREXCAVATION

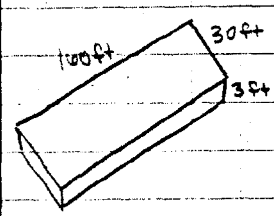
AREA = 1,990 ft^2 (USING PLANIMETER)

PERIMETER = 275 ft

VOLUME = $(1,990\ ft^2)(5\ ft)$

= 9,950 ft^3

DRMO 40-71 (DEPTH OF EXC. = 6 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 3 ft)



USE SHEET PILE – NO OVEREXCAVATION

AREA = 160 ft (30 ft) = 4,800 ft^2

PERIMETER = 380 ft

VOLUME = $(4800\ ft^2)(3\ ft)$

= 14,400 ft^3

DRMO 57-72 (DEPTH OF EXC. = 10 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 7 ft)

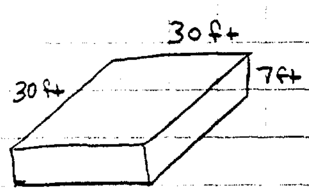
USE SHEET PILE – NO OVEREXCAVATION

AREA = 3,683 ft^2 (USING PLANIMETER)

PERIMETER = 235 ft

VOLUME = $(3,683\ ft^2)(7\ ft)$ = 25,781 ft^3

DRMO 45 (30 ft x 30 ft x 10 ft)



USE SHEET PILE – NO OVEREXCAVATION

DEPTH OF EXC. = 10 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 7 ft

AREA = (30 ft)(30 ft) = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (7 ft)

= 6,300 ft^3

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: US NAVY - NORTHDIV CTO 267	JOB NUMBER: 7363
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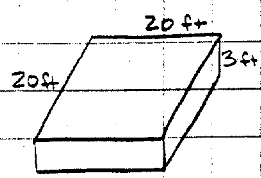
6MW4S (20 ft × 20 ft × 6 ft DEEP)



USE SHEET PILE — NO OVEREXCAVATION

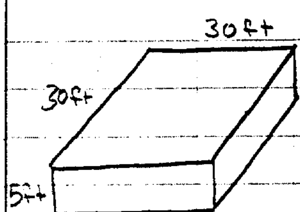
DEPTH OF EXC = 6 ft (BELOW SURFACE) − 3 ft (ALREADY EXC) = 3 ft

AREA = (20 ft)(20 ft) = 400 ft^2

PERIMETER = 80 ft

VOLUME = 400 ft^2 (3 ft)
= 1200 ft^3

6TB20 (30 ft × 30 ft × 8 ft DEEP)



USE SHEET PILE - NO OVEREXCAVATION

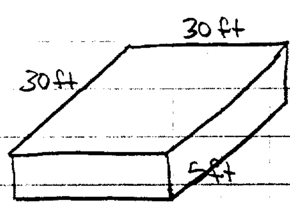
DEPTH OF EXC = 8 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 5 ft

AREA = (30 ft)(30 ft) = 900 ft^2

PERIMETER = 4 (30 ft) = 120 ft

VOLUME = (900 ft^2)(5 ft)
= 4,500 ft^3

6MW3D (30 ft × 30 ft × 8 ft DEEP)



USE SHEET PILE — NO OVEREXCAVATION

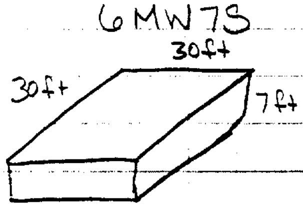
DEPTH OF EXC. = 8 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 5 ft

AREA = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (5 ft)
= 4,500 ft^3

6MW7S (30 ft × 30 ft × 10 ft)



USE SHEET PILE — NO OVEREXCAVATION

DEPTH OF EXC. = 10 ft (ASSUME ENTIRE AREA OUTSIDE OF ECO EXC.)

AREA = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (10 ft) = 9,000 ft^3

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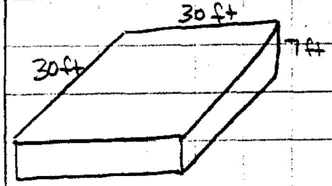
6TB3 (30 ft × 30 ft × 10 ft DEEP)



USE SHEET PILE – NO OVEREXCAVATION

DEPTH OF EXCAVATION = 10 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 7 ft

AREA = 900 ft^2

PERIMETER = 120 ft

VOLUME = 900 ft^2 (7 ft)

= 6,300 ft^3

6TB10 – 6MW2

USE SHEET PILE – NO OVEREXCAVATION

DEPTH OF EXCAVATION = 8 ft (BELOW SURFACE) − 3 ft (ALREADY EXC.) = 5 ft

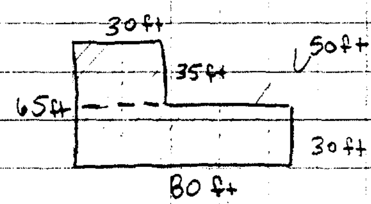
AREA = 30 ft (35 ft) + 30 ft (80 ft)

= 1,050 ft^2 + 2,400 ft^2

= 3,450 ft^2

PERIMETER = 30 ft + 35 ft + 50 ft + 30 ft + 80 ft + 65 ft

= 290 ft



VOLUME = 3,450 ft^2 (5 ft) + 25 ft (30 ft)(3 ft)

(AREA NOT WITHIN MAIN 3 ft EXC.)

= 19,500 ft^3

CLIENT	JOB NUMBER
US NAVY - NORTHDIV CTO 267	7363
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TOTAL VOLUMES:

248,778 ft^3	MAIN ECO AREA
7,200 ft^3	6MW1S
2,700 ft^3	6TB2
9,950 ft^3	DRMO 51-65
14,400 ft^3	DRMO 40-71
25,781 ft^3	DRMO 57-72
6,300 ft^3	DRMO 45
1,200 ft^3	6MW4S
4,500 ft^3	6TB20
4,500 ft^3	6MW3D
9,000 ft^3	6MW7S
6,300 ft^3	6TB3
19,500 ft^3	6TB10-6MW2
6,345 ft^3	OVEREXCATION
366,454 ft^3	
≈ 13,575 CY	

TOTAL WEIGHT (ASSUMING 100 lb/ft^3)

$= (366{,}454\ ft^3)(100\ lb/ft^3)(1\ TON/2{,}000\ lb)$

$= 18{,}322.7$ TONS

≅ 18,325 TONS

TOTAL SURFACE AREA OF SITE:

87,156 ft^2	MAIN ECO AREA + OVEREXCATION
900 ft^2	6MW1S
900 ft^2	6MW7S
750 ft^2	6MW2 (30ft x 25ft AREA OUTSIDE OF MAIN ECO EXC.)
89,706 ft^2	

= 9,967.3 SY

≅ 9,970 SY

CLIENT US NAVY – NORTHDIV CTO 267	JOB NUMBER 7363
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SHEET PILING AREAS (ESTIMATE USING PERIMETER X EXCAVATION NEEDED)

6MW1S (PERIMETER)(EXC NEEDED) =	(120 ft)(8 ft) =	960 ft²
6TB2	(120 ft)(3 ft) =	360 ft²
DRMO 51-65	(275 ft)(5 ft) =	1,375 ft²
DRMO 40-71	(380 ft)(3 ft) =	1,140 ft²
DRMO 57-72	(235 ft)(7 ft) =	1,645 ft²
DRMO 45	(120 ft)(7 ft) =	840 ft²
6MW4S (ONLY NEED HALF OF THE PERIMETER SHEET PILED BECAUSE OF BORDERING EXC.)	(40 ft)(3 ft) =	120 ft²
6TB20	(120 ft)(5 ft) =	600 ft²
6MW3D	(120 ft)(5 ft) =	600 ft²
6MW7S	(120 ft)(10 ft) =	1,200 ft²
6TB3 (SUBTRACT 30 ft FROM PERIMETER BECAUSE OF BORDERING EXCAVATION)	(90 ft)(7 ft) =	630 ft²
6TB10 – 6MW2 (")	(260 ft)(5 ft) =	1,300 ft²
		10,770 ft²

TOPSOIL VOLUME = TOTAL SURFACE AREA X DEPTH (ASSUME A 6 IN LAYER)

= (89,706 ft²)(0.5 ft)

= 44,853 ft³ ≅ 1,660 CY

SEED AREA = 88,706 ft² (1 MSF / 1,000 ft²)

= 88.7 MSF

≅ 90 MSF

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ASPHALT (ASSUME 3" LAYER @ 110 lbs/ft^3)

VOLUME = $(89{,}706\ ft^2)(0.25\ ft)$

$= 22{,}426.5\ ft^3 \cong 831$ CY

WEIGHT = $(22{,}426\ ft^3)(110\ lbs/ft^3)(1\ TON/2{,}000\ lbs)$

$= 1{,}233.5$ TON $\cong 1{,}234$ TON

AREA = $(89{,}706\ ft^2)(1\ SY/9\ ft^2)$

$= 9{,}967.3$ SY $\cong 9{,}970$ SY

CONFIRMATION SAMPLES

EVERY 25 ft OF PERIMETER = $(1{,}410\ ft + 157\ ft)(1\ SAMPLE/25\ ft)$

$\cong 63$ SAMPLES

HORIZONTAL GRID EVERY $(25\ ft)(25\ ft) = 625\ ft^2$

$(86{,}540\ ft^2)(1\ SAMPLE/625\ ft^2)$

$\cong 138$ SAMPLES

DEEPER (> 3 ft) EXCAVATION SIDEWALLS

APPROXIAMATE AS 2 SAMPLES/25 ft OF TRENCH-LIKE EXC.

4 SAMPLES/EACH FOR SQUARE OR CIRCULAR EXC.

$\cong 58$ SAMPLES

TOTAL = 63 + 138 + 58

$= 259$ SAMPLES

$\cong 260$ SAMPLES

CLIENT	JOB NUMBER
US NAVY – NORTHDIV CTO 267	7363
SUBJECT	
ALTERNATIVE 4 COST ESTIMATE CALCULATIONS	
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DEWATERING PAD – REQUIRE 1 DAY HOLDING TIME
– MATERIAL NO MORE THAN 2 ft THICK
– ASSUME CAPACITY OF THERMAL DESORPTION IS 150 TONS/DAY

VOLUME OF SOIL = 150 TONS (2000 lb/TON)(1 ft^3/100 lbs)
= 3,000 ft^3

AREA REQ'D AT 2 ft DEPTH = (3,000 ft^3)/(2 ft)
= 1,500 ft^2

+ ADD'L ~7% = 1,500 ft^2 (1.07) ≅ 1,600 ft^2 = 178 SY
(ASSUME DIMENSIONS 40 ft x 40 ft)

PVC PIPING ASSUME AROUND THE PERIMETER + ONE CORNER TO CORNER
PERIMETER = 40 ft + 40 ft + 40 ft + 40 ft = 160 ft
DIAGONAL = $\sqrt{(40 ft)^2 + (40 ft)^2} \hat{=} 57$ ft

PIPING = 160 ft + 57 ft = 217 ft ≅ 220 ft

SHEET PILING AREAS: 235 ft (8 ft) = 1,880 ft^2
275 ft (6 ft) = 1,650 ft^2
320 ft (4 ft) = 1,280 ft^2
4,810 ft^2

CRUSHED ROCK DRAINAGE LAYER: (12 IN THICK, CAP ≅ 43,000 ft^2)
VOLUME = (43,000 ft^2)(1 ft) = 43,000 ft^3
= 1,593 CY

WEIGHT (ASSUME 100 lb/ft^3)
= (43,000 ft^3)(100 lb/ft^3)(1 TON/2000 lbs)
= 2,150 TONS

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BLDG 491 (50 ft x 20 ft) ASSUME 10 ft HIGH, BLOCK WALLS 0.5 ft THICK

AREA = 1000 ft^2

PERIMETER = 140 ft

SURFACE AREA OF WALLS = 140 ft (10 ft) = 1400 ft^2

ROOF - ASSUME STEEL FRAMING BEAMS 4"x8" SPACED AT 10 ft INTERVALS

NO. OF BEAMS = 3 BEAMS 20 ft LONG

LENGTH = 60 ft

BLDG 479 (60 ft x 20 ft) ASSUME 10 ft HIGH, BLOCK WALLS 0.5 ft THICK

AREA = 1200 ft^2

PERIMETER = 160 ft

SURFACE AREAS OF WALLS = (160 ft)(10 ft) = 1600 ft^2

ROOF - ASSUME STEEL FRAMING BEAMS 4"x8" SPACED AT 10 ft INTERVALS

NO. OF BEAMS = 4 BEAMS 20 ft LONG

LENGTH = 80 ft

WEIGH SCALE (10 ft x 150 ft) ASSUME 6" WIRE REINFORCED CONCRETE

AREA = 1500 ft^2

VOLUME = 750 ft^3

TOTAL WALL AREA = 1400 ft^2 + 1600 ft^2 = 3000 ft^2

TOTAL BEAM LENGTHS = 80 ft + 60 ft = 140 ft

TOTAL CONCRETE AREA = 1000 ft^2 + 1200 ft^2 + 1500 ft^2 = 3,700 ft^2

VOLUME OF DEMOLITION MATERIALS: (ASSUME RECYCLING OF STEEL BEAMS)

= 3000 ft^2 (0.5 ft) + 3700 ft^2 (0.5 ft)

= 3,350 ft^3 = 124 CY

DUMPSTER (40 CY): NO. OF LOADS = (124 CY)/40 CY = 3.1 = 4 LOADS

CALCULATION WORKSHEET Order No. 19116 (01-91)

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UST SURFACE AREA (ASSUME 8 ft DIA X 13 ft 4 IN)(5,000 GAL EA)

AREA = $2\pi r^2 + 2\pi r h$ (2 X ENDS + CIRCUMFERENCE X HEIGHT)

= $2\pi(4ft)^2 + 2\pi(4ft)(13.33ft)$

= $436 ft^2 \sim 440 ft^2$

TOPSOIL VOLUME = $(91,890 ft^2)(0.5 ft)$ ASSUME 6 IN LAYER

= $45,945 ft^3$

= 1702 ~ 1700 CY

SEED AREA = $(91,890 ft^2)(1 MSF/1,000 ft^2)$

≅ 92

ASPHALT (ASSUME 3")(ASSUME 110 lb/ft³)

VOLUME = $(91,890 ft^2)(0.25 ft)$

= $22,973 ft^3$ ≅ 851 CY

WEIGHT = $(22,973 ft^3)(110 lb/ft^3)(1 TON/2000 lbs)$

= 1,264 TONS

AREA = $91,890 ft^2 (1 SY/9 ft^2)$ = 10,210 SY

CONFIRMATION SAMPLES

EVERY 25 ft OF PERIMETER = (1,410 ft + 157 ft)/25

= 63

25 ft GRID SAMPLES APPX ≅ 60

TOTAL ≅ 120

DEWATERING PAD GRAVEL BASE (6 IN.)

AREA = $(600 ft^2)(1 SY/9 ft^2)$ = 178 SY

VOL (GRAVEL AND CONCRETE PAD) = $1600 ft^2 (0.5 ft + 0.5 ft)$

= $1600 ft^3$ = 59 CY

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	UNIT	MAT'L	LABOR	EQUIP	
DEWATERING PAD 6" (40'x40')		ECHOS 1802 0321			
	SF	2.24	1.42	0.17	
		0.22	0.14	0.02	10% CT
		2.46	1.56	0.19	
6" CURB (PERIMETER = 160 ft)		ECHOS 1801 0201			
	LF	0.86	0.61	0.01	
		0.09	0.06	—	10% CT
		0.95	0.67	0.01	
PVC DRAINAGE PIPE 4" DIA		MEANS 96 027 168 2000			
	LF	0.86	1.44		
		0.09	0.14		10% CT
		0.95	1.58		
DRAINAGE PUMP 1/2 HP		M96 152 480 7180			
	EA	206	60		
		21	6		10% CT
		227	66		
FOUNDATION 6" GRAVEL		M96 022 308 0100			
	SY	4.42	0.23	0.29	
		0.44	0.02	0.03	10% CT
		4.86	0.25	0.32	

CLIENT US NAVY - NORTHDIV CTO 267

JOB NUMBER 7363

SUBJECT ALTERNATIVE 4 COST ESTIMATE

BASED ON

DRAWING NUMBER

BY JRR | CHECKED BY TJR | APPROVED BY | DATE 5 FEB 97

	UNIT	MAT'L	LABOR	EQUIP.	
BLDG DEMO					
WALLS (CEMENT BLOCK) M96 020 754 2040					
	SF		0.83	0.32	
			0.08	0.03	10% CT
			0.91	0.35	
ROOF (STEEL BEAMS 4"X8") M96 020 714 2020					
	LF		2.99	1.28	
			0.30	0.13	10% CT
			3.29	1.41	
FOUNDATION REMOVAL 6" WIRE REINFORCED M96 020 754 0420					
	SF		2.38	0.45	
			0.24	0.05	10% CT
			2.62	0.50	
DISPOSE AS BLDG MAT'L M96 020 612 0100					
	CY	SUBCONTRACT	45		
			4.5	10% CT	
			49.50		
DUMPSTER 40 CY M96 020 620 0840					
	WK	SUBCONTRACT	380		
			38	10% CT	
			418		
HAULING					
	MI	SUBCONTRACT	5.00		

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ALTERNATIVE 4 COST ESTIMATE	
BASED ON	DRAWING NUMBER

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	UNIT	MAT'L	LABOR	EQUIP	
REMOVE UST'S					
REMOVE ECHOS 3310 9502					
	EA		232.48	630.13	
			23.25	63.01	10% CT
			255.73	693.14	
PUMP ECHOS 16 01 9023					
	GAL		1.61	0.02	
			0.16	—	10% CT
			1.77	0.02	
DISPOSE OF SLUDGE M96 020 880 0390					
	GAL SUBCONTRACT	2.45			
		0.25	10% FOR CT		
		2.70			
TRANSPORT TANKS M96 020 880 1023					
	EA SUBCONTRACT	525			
		53	10% FOR CT		
		578			
DECONTAMINATE TANK W/STEAM ECHOS 33 17 0804					
	SF		0.62	0.14	
			0.06	0.01	10% CT
			0.68	0.15	

CLIENT US NAVY - NORTHDIV CTO 267	JOB NUMBER 7363		
SUBJECT ALTERNATIVE 4 COST ESTIMATE			
BASED ON	DRAWING NUMBER		
BY JRR	CHECKED BY TJR	APPROVED BY	DATE 5 FEB 97

	UNIT	MAT'L	LABOR	EQUIP
THERMAL DESORPTION				
MOB/DEMOB ECHOS 33 140201				
	EA	SUB — 297,292.50		
INDIRECT FIRING ECHOS 33 14 0205				
	TON	89.20	1.08	0.73
	(+10%)	98.12	1.19	0.80
DEWATERING SLAB 6" ECHOS 18020321				
	SF	2.24	1.42	0.17
		0.22	0.14	0.02 10%a
		2.46	1.56	0.19
CONVEYOR-INCLINED ECHOS 33 18 8403				
	EA	4209.66	1279.89	374.20
		SUBCONTRACT 5,863.75		
SHREDDER ECHOS 3313 2405				
	MO	SUB - 46,055 FOR FIRST MONTH		
		19,417 ADDITIONAL MONTHS (ECHOS 3313 2406)		
SHREDDER MOB/DEMOB ECHOS 33 13 2404				
	LS	4,756.68		
FILTER PRESS ECHOS 33 333001				
	TON	SUB — 65.40		
SETTLING TANKS ECHOS 19 040403 (4,000 GAL EA)				
	MO	SUB - 535.13		

CALCULATION WORKSHEET
Order No. 19116 (01-91)

CLIENT	JOB NUMBER
US NAVY - NORTHDIV CTO 267	7363

SUBJECT: ALTERNATIVE 4 COST ESTIMATE

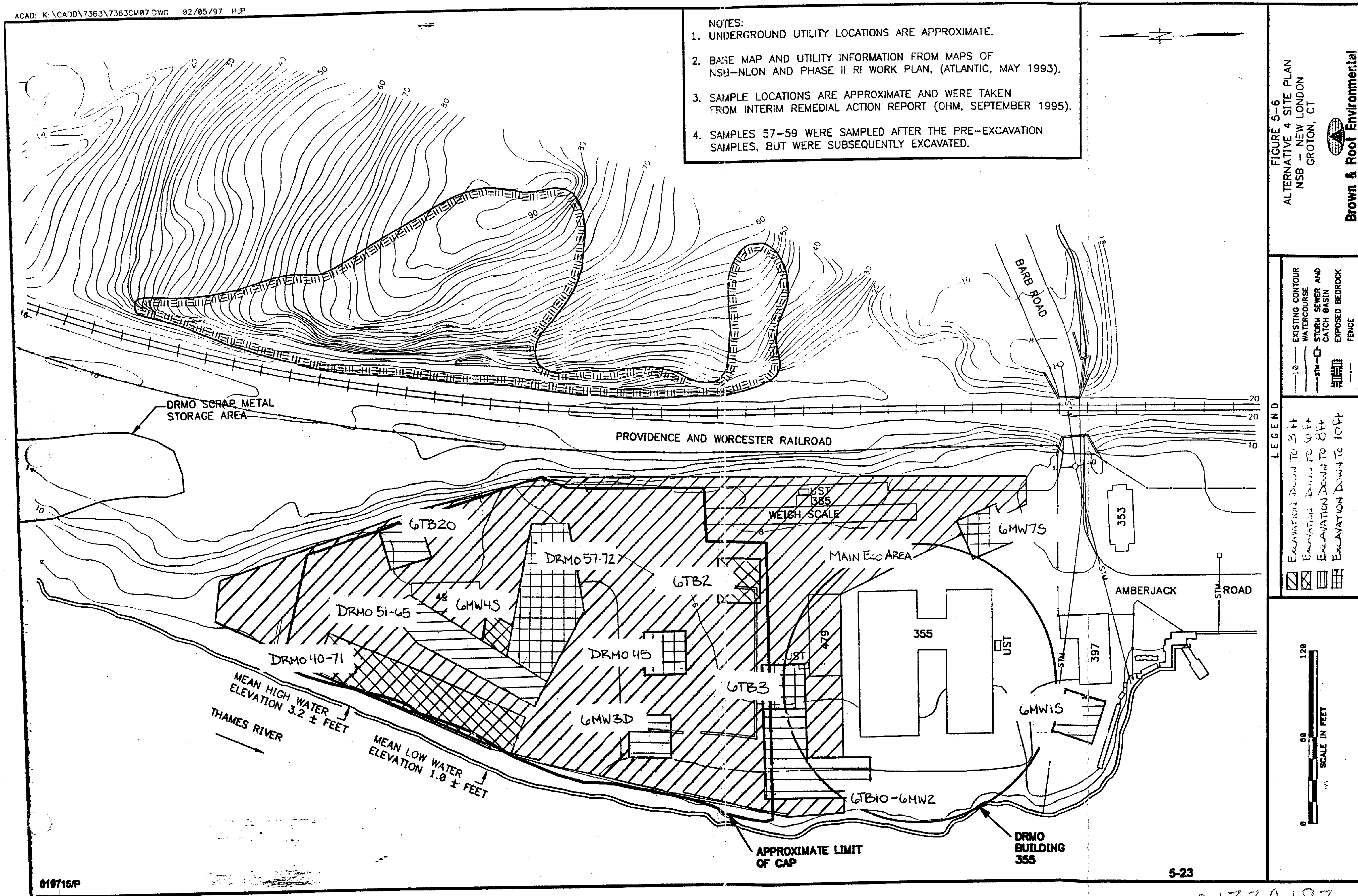
BASED ON:

DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
JRR	TJR		5 FEB 97

	UNIT	MAT'L	LABOR	EQUIP
RESTORE SITE (FROM RECENT CES REPORT)				
PURCHASE AND HAUL TOPSOIL				
	CY	SUBCONTRACT 34.28		
SPREAD				
	CY		0.28	0.85
SEED				
	MSF	SUBCONTRACT 39.30		

ROUGH DRAFT



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