RI99275DF

DRAFT FINAL
ENGINEERING EVALUATION/COST ANALYSIS

RAYMARK-SHORE ROAD
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045
EPA Work Assignment No. 035-NSEE-01H3
TtNUS Project No. N0162

June 1999

TETRA TECH NUS, INC.

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ACRONYMS AND ABBREVIATIONS USED IN THE ENGINEERING EVALUATION/COST ANALYSIS

ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BTU	British Thermal Unit
°C	degree Celsius
CAA	Clean Air Act
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Amended by SARA in 1986. Also called the Superfund Law.
cf	cubic foot
CFR	Code of Federal Regulations
CLP	(EPA) Contract Laboratory Program
cm	centimeter
COC	Contaminant of Concern
CT DEP	Connecticut Department of Environmental Protection
CWA	Clean Water Act
CY	cubic yard
DAS	Direct Analytical Services
DDT	Dichloro diphenyl trichloroethane
dia	diameter
DNAPL	dense non-aqueous phase liquid
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
°F	degree Fahrenheit
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
ft	foot
ft^2/day	square foot per day
ft^3/day	cubic foot per day
g	gram
GB	State of Connecticut classification for non-drinking water sources
gpd	gallon per day
gpm	gallon per minute
GRA	General Response Actions
HBC	Housatonic Boat Club
HHRA	Human Health Risk Assessment
HI	Hazard Index
HNUS	Halliburton NUS Corporation
hr	hour
HQ	Hazard Quotient
IEUBK	EPA's Integrated Exposure Uptake and Biokinetic Model for lead exposure
ILCR	Incremental Lifetime Cancer Risk
in.	inch

kg	kilogram
l	liter
lb	pound
LDR	land disposal restriction
m	meter
μ	micro (prefix)
μg/dL	micrograms per deciliter
μg/kg	microgram per kilogram
μg/l or μg/L	microgram per liter
MCL	Federal Safe Drinking Water Act maximum contaminant level. The primary MCL is health-based; the secondary is aesthetic-based.
MCLG	Federal Safe Drinking Water Act maximum contaminant level goal.
MEP	Multiple Extraction Procedure
mg	milligram
mg/kg	milligram per kilogram
mg/l or mg/L	milligram per liter
mi	mile
ml	milliliter
MOA	Memorandum of Agreement
mph	miles per hour
MSL	mean sea level
NCP	National Oil and Hazardous Substances Contingency Plan
NOAA	National Oceanic Atmospheric Administration
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
NPW	Net Present Worth
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	(EPA's) Office of Solid Waste and Emergency Response
OU2	Operable Unit No. 2
OU3	Operable Unit No. 3
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POTW	Publicly-Owned Treatment Works
ppb	part per billion
PPE	personal protective equipment
ppm	part per million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
psi	pound per square inch
PVC	polyvinyl chloride
QA/QC	Quality Control/Quality Assurance
RAC	Response Action Contract
RAO	Remedial Action Objective
Raymark Facility	Raymark Industries, Inc. Facility
RCRA	Resource Conservation and Recovery Act

Removal Action	Action taken by EPA to address immediate danger to public health and the environment
RfC	Reference Concentration
RfD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	(EPA's) Record of Decision. Documents the selection of a cost-effective Superfund remedy.
RSRs	State of Connecticut Remediation Standard Regulations
SARA	Superfund Amendments and Reauthorization Act of 1986. Amended CERCLA. Also known as the Superfund law.
SB/SC	State of Connecticut Classification for Coastal and Marine Surface Water
SPLP	Synthetic Precipitation Leaching Procedure
sf	square foot
SVOC	Semivolatile Organic Compound
TBC	To Be Considered
TCDD	2,3,7,8 – tetrachlorodibenzo-p-dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalency
TPH	Total Petroleum Hydrocarbons
TSDF	(RCRA) Treatment, Storage, and Disposal Facility
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers
USCS	Unified Soils Classification System
USDOI	U.S. Department of the Interior
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
Weston	Roy F. Weston, Inc.

EXECUTIVE SUMMARY

This document contains the results of an Engineering Evaluation/Cost Analysis (EE/CA) conducted for EPA for the Raymark-Shore Road Study Area in Stratford, Connecticut. The EE/CA was performed to evaluate options for a Non-Time-Critical Removal Action needed to protect human health and the environment from contaminated soil-waste/fill material in the Study Area that is believed to have originated at the former Raymark Facility. The soil-waste/fill material contains levels of lead, asbestos, PCBs, and dioxins that pose a risk to human health.

The approximately 4-acre Study Area is comprised of a 1,350-foot section of Shore Road, the Housatonic Boat Club, and a small portion of the eastern slope of the Shakespeare Theater property (see Figure 1-2).

Temporary barriers constructed by the CTDEP at the time the soil-waste/fill material was discovered at the Study Area have eroded and no longer provide the necessary level of protection for people nor the environment. Although long-term remedial measures are being planned for the entire area affected by the Raymark soil-waste/fill, EPA decided to conduct this final removal action for the Study Area because of the potential risks to those who live and work in the area.

EPA has adopted site screening levels for lead (greater than 400 ppm), asbestos (greater than 1%), PCBs (greater than 1 ppm) and dioxins (greater than or equal to 1 TEQ) to protect public health and the environment. Three "hot spot" areas have been identified within the Study Area that exceed these screening levels (see Figure1-6). The lead level defines the Study Area; all other contaminants that exceed the site screening levels are within the Study Area boundary.

The hot spot data have been evaluated to determine current or potential exposures to this contamination and the potential effects of the exposure to the Study Area contaminants. A streamlined human health risk evaluation determined that occasional recreational users exposed to these hot spots would be faced with an unacceptable level of risk, both now and in the future, if no action were taken to prevent their contact with the contamination. As a result, this removal action focuses on these hot spot areas, with lead as the principal contaminant to address. Bringing the lead down to an acceptable level will also reduce concentrations of the other three contaminants of concern to acceptable levels.

A variety of technology options were evaluated for site cleanup: no action, limited action, removal, and disposal. These were further evaluated against three major criteria: effectiveness, implementability, and cost. Based on direction from EPA, three viable removal (excavation) alternatives were assessed in greater detail. Each contains deed restrictions, varying levels of excavation, and a choice of an in-town or an out-of-town disposal option.

After comparing each alternative against the major criteria, and then to each other, EPA recommends selection of Alternative 3. Alternative 3 is the only alternative that fully complies with state requirements. It would provide greater protection to human health and the environment and be more effective in the long term than Alternatives 1 and 2. Alternative 3 would require excavating the hot spot areas to a depth of 5.5 feet below ground surface. Approximately 34,786 cubic yards would be excavated and disposed at an in-town storage facility. Approximately 40,000 cubic yards of clean fill would be imported to restore the Study Area to its original elevation. This alternative would cost approximately $5,288,793.

EPA's proposed schedule for carrying out the Non-Time-Critical Removal Action is to hold a public hearing on this proposal on July 14, 1999. Public comments will be accepted during a public comment period that ends of August 16, 1999. EPA anticipates selecting the removal option by the end of September, 1999. Actual cleanup work would commence in late fall of 1999.

1.0 INTRODUCTION

This report presents the results of the Engineering Evaluation/Cost Analysis (EE/CA) performed for Shore Road (see Site Locus Map, Figure 1-1 and the Study Area, Figure 1-2), located in Stratford, Connecticut. The EE/CA was performed to develop and support selecting a Non-Time-Critical Removal Action (NTCRA) that addresses contaminated soils in the Study Area. As documented in the January 1999 Approval Memorandum (provided in Appendix A), the U.S. Environmental Protection Agency (EPA) has determined that an EE/CA is necessary to address human health and environmental threats. This EE/CA report presents three NTCRA alternatives that address human health and environmental threats posed by asbestos, lead, polychlorinated biphenyls (PCBs), and dioxins present in the surface and subsurface at the Study Area. This report was prepared by Tetra Tech NUS, Inc. (TtNUS) for EPA Region I, under Contract No. 68-W6-0045, Work Assignment No. 035-NSEE-01H3.

The EE/CA was prepared consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR 300; and the Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA (EPA, 1993).

1.1 Purpose and Organization of Report

This report presents the EE/CA process results so EPA can select the most appropriate alternative that meets the stated removal action objectives.

Section 1.0 presents the introduction, provides a site description and historical information, and summarizes the findings of the site investigations and streamlined risk evaluation. Section 2.0 describes the regulatory basis for the proposed NTCRA, establishes the scope and objectives of the NTCRA, identifies regulatory considerations (ARARs), and presents a proposed schedule for NTCRA implementation. Section 3.0

describes the development of the removal action alternatives. Section 4.0 provides descriptions of the potential alternatives, along with detailed evaluations of each alternative.

1.2 EE/CA Objectives and Approach

The overall objective of the EE/CA is to develop and evaluate potential removal action alternatives that can be implemented to address human health and environmental threats posed by asbestos, lead, PCBs, and dioxins present in the surface and subsurface at the site. The EE/CA consists of three components:

- Develop removal action objectives that are protective of human health and the environment, and achieve the overall goals of the NTCRA.

- Develop removal action alternatives. Technologies are assembled into alternatives to provide cleanup strategies for the contaminated media of concern at the site.

- Evaluate alternatives. Alternatives are evaluated based on a detailed analysis of effectiveness, implementability, and cost.

As indicated by EPA guidance on performing EE/CAs, alternatives were evaluated based on relative effectiveness, implementability, cost, and compliance with ARARs to the extent practicable. Further, alternatives that exceed $2 million dollars were evaluated to determine their consistency with future remedial actions to be taken at the Study Area.

1.3 Site Background

This section presents the Raymark Facility history, and a site and land use description of the Study Area, and describes previous response actions conducted at the Study Area.

1.3.1 Raymark Facility History

The former Raymark Industries, Inc. Facility (the "Raymark Facility") was located at 75 East Main Street in Stratford, Fairfield County, Connecticut. From 1919 until September 1989, Raymark manufactured automotive and heavy brake friction components using asbestos, lead, copper, and a variety of adhesives and resins. As a result of manufacturing and waste disposal practices, soils at the Raymark Facility became contaminated with asbestos, lead, copper, PCBs, and other contaminants. Wastes produced as the result of manufacturing processes were routinely disposed of at the Raymark Facility to backfill low lying areas that created additional space for Raymark Facility expansion. The site was proposed on the National Priorities List (NPL) on January 18, 1994 and listed on April 25, 1995.

While the Raymark Facility was active, it was also common practice for the company to give away its excess manufacturing wastes for use as fill within the Town of Stratford. Although this practice was employed during most of the Raymark Facility's 70 years of operation, off-site disposal of wastes increased as areas within the Raymark Facility were filled. A RCRA §3013 Order was issued in 1987, which required Raymark to investigate the Raymark Facility to determine the extent of contamination. The Raymark Facility closed manufacturing operations in 1989. In 1993, the Federal Agency for Toxic Substances and Disease Registry (ATSDR) performed a health assessment. As a result of the assessment, ATSDR issued a Public Health Advisory for the Raymark Facility and locations around the Town of Stratford where Raymark waste had come to be located.

In response to ATSDR's Health Advisory, EPA and the Connecticut Department of Environmental Protection (CTDEP) identified potential historic disposal locations, sampled numerous properties, and performed a series of removal actions from 1993 through 1996. These removal actions were performed at the former Raymark Facility and at residential, commercial, and municipal properties throughout the Town of Stratford where Raymark waste, with contaminants in excess of site screening levels, had come to be located. A remedial action for source control was completed at the Raymark Facility in 1997. EPA is continuing remedial activities for other areas that received Raymark waste as fill and for groundwater under and around the Raymark Facility.

1.3.2 Study Area Description and Surrounding Land Use

In 1993, the CTDEP sampled soils at Shore Road and the Housatonic Boat Club (see site locus map, Figure 1-1). The soil contained asbestos concentrations up to 90 percent, as well as elevated levels of lead and PCBs. To address the risks posed by these contaminants, CTDEP performed an interim removal action consisting of capping the area with a geotextile, then covering the geotextile with 6 inches of wood chips. This temporary capping, completed in 1994, was intended to be an interim measure. At that time, it was anticipated that a permanent solution would be implemented as part of the Ferry Creek remedial action. A Draft Remedial Investigation report for Ferry Creek was issued in June 1998 that identified the risks from the contaminated soil-waste/fill (B&RE, June 1998).

The temporary cap placed over Raymark soil-waste in the Shore Road and Housatonic Boat Club area has been compromised by heavy traffic, river overflows, and storm runoff. The 6-inch layer of wood chips is missing in some areas, exposing the geotextile, which frequently shows some degree of damage. In addition, Shore Road's pavement, originally built on contaminated fill, is failing. The town is reluctant to perform any repairs because of potential contaminant exposure, which is of particular concern because the area receives considerable automotive and foot traffic. Shore Road continues to be used as a town road that provides access to the Housatonic Boat Club, the Shakespeare Theater (located on the western side of Shore Road across from the Boat Club), and several residences, see Figure 1-5a. Outdoor events have been held on the grounds of the Shakespeare Theater, attracting crowds that walk along Shore Road, which overlooks the Housatonic River.

The sampling methodology used in the March 1999 subsurface investigation is presented in Section 1.4.1.

The Shore Road Study Area (Study Area) (approximately 4 acres) includes a 1,350 foot section of Shore Road, the Housatonic Boat Club, and a small portion of the eastern slope of the Shakespeare Theater property (see Figure 1-2). The western boundary of the Study Area lies on the west side of Shore Road, at the base of the slope along the edge of the Shakespeare Theater property. The Study Area includes the section of Shore Road from the curve on the south side, to just north of the end of the boat club parking area on the north side. The Study Area continues east to the Housatonic River, includes the riprap bank (30′ from top of bank into the river) and includes a peninsula of land extending south from the Housatonic Boat Club parking area on the east side of the site. The Study Area was defined by the lateral extent of contamination; it includes the areas where soil contamination exceeds site screening levels. The Study Area review focused on soils only. Wetland contamination will be the subject of the upcoming Area II Remedial Investigation (under W.A. No. 002). A map of the Study Area showing the lateral extent of the contamination is presented on Figure 1-5a.

Review of historical aerial photographs of the Study Area (Figure 1-3) indicates the current locations of Shore Road and the parking area associated with the Housatonic Boat Club were previously wetlands. The Housatonic Boat Club was constructed prior to 1940 on piers/piles adjacent to the channel of the Housatonic River. An elevated walkway was also constructed on piers and provided access to the Housatonic Boat Club from the shore. Over time, the wetlands were filled in (apparently the fill originated at the Raymark Facility) such that the elevated walkway was no longer required to access the boat club.

The Shakespeare Theater lies approximately 16 feet above mean sea level (msl). Shore Road and the Housatonic Boat Club parcel are approximately 8 feet above msl. The Shore Road and Housatonic Boat Club topography is generally flat. The Housatonic Boat Club site surface is largely unpaved, except for two structures and an associated paved parking area. Access to the Housatonic Boat Club is partially restricted by a chain-link fence that borders its perimeter on three sides. The property features two structures: an approximately 5,350-square foot building, and a covered dock that is approximately 120 feet south of the main structure. The two buildings were built on piles and lie over the Housatonic River. They are connected by a causeway.

1.4 Site Characterization

This section summarizes data sources used in this EE/CA to characterize the soil-waste/fill contamination at the site, and describes Study Area weather conditions.

1.4.1 Data Sources

The EE/CA was conducted using existing data compiled by consultants to the EPA and additional data collected by TtNUS. This section summarizes the primary data sources used to prepare this EE/CA. The full citations for the referenced reports are provided in the reference section.

In May 1993, soil screening was performed at Shore Road. The evaluation consisted of collecting 11 samples from various Shore Road locations and at the northern end of the Boat Club lot. Screening results revealed concentrations of chrysotile asbestos up to 90 percent, lead above 10,000 ppm, and PCBs up to 285 ppm. Later that year, a broader screening was conducted of approximately 50 surficial soil samples from Shore Road. These samples also detected high levels of contamination in the area, and confirmed that the Boat Club property warranted further investigation. Sample locations from both previous and recent investigations are presented on Figure 1-4. Analytical data are summarized in Appendix B.

In April 1994, 15 soil borings were advanced as part of a subsurface investigation of the Boat Club property. Samples obtained from these borings contained concentrations of up to 38,700 ppm lead and 65 percent asbestos, discovered at various depths within the Study Area.

In March 1999, a subsurface investigation was conducted to better characterize the nature and extent of the Study Area fill. Seventy-nine soil borings were advanced and sampled.

Boring locations were staked out in 50-foot intervals throughout the Shore Road Site using a grid design. The subcontractor began with the soil borings on the centerline of Shore Road. The sampling continued along grid lines running parallel to Shore Road. The grid line west of Shore Road was advanced, and the results from the lead, PCB and asbestos analyses were reviewed to determine which borings on the next southwesterly grid line were to be advanced. If the results of one of the three analyses for a sample exceed the EPA-determined criteria (400 ppm for lead, 1 ppm for total PCBs and 1 percent for asbestos), then a boring was advanced at the southwesterly location. If the results did not exceed any of the criteria, no additional samples were collected along that row (in a southwesterly direction). All borings on the northeast side of Shore Road were advanced regardless of the analytical results. Soil samples were collected from each soil boring at three discrete intervals. A minimum 2-inch diameter macro-core sampler was advanced to the appropriate soil sampling intervals. The first sample started at ground surface and continued for 6 inches. Sampling continued through the soil at the depth intervals of 1.5 – 2.5 feet and 3 – 4 feet below ground surface. In areas covered with asphalt, the first interval started immediately beneath the asphalt and then proceeded as indicated above.

The soil from each sample interval was placed in a decontaminated stainless steel bowl, homogenized, and then transferred to the appropriate sample containers for analysis. Soil sample descriptions and depth intervals were documented on the sample logsheet or boring log, with other pertinent sampling data. A maximum of three samples from each soil boring interval were submitted to an on-site mobile laboratory for analysis of lead and PCBs and sent to an off-site laboratory for asbestos analysis all on a rapid (24-hour) turn-around basis. Soil was collected from every location for possible dioxin analysis pending field laboratory results. The samples were stored in coolers at 4°C. In an effort to ensure distribution of sampling points for dioxins, TtNUS used the following scheme for sending soil samples for dioxin analysis:

- If two of the three EPA-determined criteria are exceeded, a sample was sent for dioxin analysis.

- In an insufficient number of samples exceeded two of the three criteria, or if the samples exceeding the criteria are grouped together on the site, the TtNUS site representative attempted to select from throughout the site (both vertically and horizontally).

1.5 Site Environment

This section presents a general description of the geologic features, including soil-waste/fill characteristics, extent, thickness and volume, and hydrogeologic features of the site based on soil boring logs. Boring logs are included in Appendix C.

1.5.1 Study Area Geology

This discussion of the Study Area geology is a general discussion of soils (natural deposits and artificial fill deposits) encountered in on-site borings, with an emphasis on surficial soils. The description of overburden geologic materials presented below is based on 16 soil borings that were advanced to depths up to 22 feet below grade by B&RE/HNUS in 1994, as part of the Phase I RI and on the recent 79 shallow borings advanced during the March 1999 field effort (see Appendix C).

The surficial deposits that occur at, and within, the shallow subsurface of the Study Area are mapped as Stratford outwash sediments, fill deposits, and swamp/marsh deposits (Flint, 1968). Soil descriptions from the boring logs are consistent with the regional descriptions and mapping. Overburden consists of a complex sequence of alluvial and outwash deposits (sand and gravel) ranging from silty sands to coarse gravels. Organic silt deposits are common in the study area, frequently underlying fill materials, where present.

In addition, many areas of the overburden have been mixed with contaminated fill and Raymark soil-waste.

Fill materials in the Study Area generally consisted of varying amounts of silty or gravelly sand with artificial fill materials intermixed, or of organic silt or silt, also with artificial fill materials present at some locations. At several borings in the Study Area, fill materials were underlain by sand or sand and gravel deposits (BC-SB3, -SB7, -SB8, -SB9). At other Study Area borings, fill materials were underlain by a dark brown/black or gray silt or organic silt, sometimes interbedded with sand or silty sand, with some gravel at some locations. Artificial materials observed within fill in the Study Area included glass, ceramic, brick, fibrous material, fiber pads, asphalt, concrete, and ash/cinders.

Bedrock was not encountered in any of the soil borings from the Study Area. The majority of the soil borings were shallow with a maximum depth of only 22 feet below ground surface. The bedrock underlying the Study Area has been mapped as the Derby Hill Schist (Fritts, 1965). The Derby Hill Schist consists of a medium to fine grained, greenish-gray to dark gray, chloritic, muscovite, schist. There are variable quantities of quartz, sodic plagioclase, and minor accessory minerals associated with this unit.

1.5.2 Soil-Waste/Fill Characteristics

Samples were collected to determine the chemical and physical nature of the soil-waste/fill within the Study Area. This section summarizes the results of the fill characterization.

The Raymark soil-waste/fill consists of a mixture of natural and manmade materials. Natural materials include various amounts of clay, silt, sand, and gravel. Manmade materials consist of charcoal, asphalt, metal, brick, glass, brake pad chips, asbestos fibers, and other miscellaneous types of manufacturing debris that were mentioned in Section 1.5.1. The man-made materials are mixed with sands and varying amounts of silt, clay, and gravel. This soil-waste/fill is often difficult to distinguish from the natural soil deposits in the area. The appearance and vertical distribution of this waste material is based on data collected during the field investigation activities described in Section 1.4.1.

1.5.3 Fill Extent, Thickness, and Volume

The lateral extent, thickness, and volume of soil-waste/fill was estimated by TtNUS using monitoring data, and observations from soil borings compiled during the field investigations. This section summarizes the approach used to estimate the lateral and vertical extent of the soil-waste/fill.

Initially the lateral boundaries of the soil-waste/fill at the site were delineated using historical aerial photographs of the Study Area and observations of contaminant presence recorded during soil boring investigations. Aerial photographs of the Study Area indicate Shore Road and the Housatonic Boat Club were once wetlands along the Housatonic River. Based on the assumption that this area was filled, additional subsurface investigations were initiated to more precisely identify the lateral boundaries of the contamination. In general, the final delineation of the contamination was based on a combination of the presence (through visual observation) of manmade materials such as those described in the previous section, and laboratory confirmation of contaminants.

The vertical depth of the soil-waste/fill was estimated using data from the subsurface investigations at the site. Based on the field data, it was estimated that the surface area of the Study Area is approximately 170,800 square feet. The estimated depth of the contamination is based on the soil boring observations. Manmade material was identified at various depths within the borings, but at depths no deeper than 12 feet below current ground surface. Eight feet was used as the average thickness of fill material for the entire Study Area to calculate the volume of soil-waste/fill which is conservatively estimated to be approximately 1.4 million cubic feet (50,600 cubic yards).

This assumption is reinforced through observation of historical aerial photographs. In the July 16, 1943 aerial photograph presented in Figure 1-3, it is evident that the area currently used as the parking lot for the Housatonic Boat Club was formerly wetlands. For the purpose of estimating the thickness of soil-waste/fill present at the site, it was assumed that the elevation of this wetlands area ranged from 4 feet above msl to sea level. The current elevation of the parking area is 8 feet above msl, further suggesting that the thickness of soil-waste/fill material ranges from 4 to 8 feet.

1.5.4 Hydrogeology

Information concerning the hydrogeology at the Study Area is limited due to the limited quantity of monitoring wells in the area. One monitoring well (MW-120) is located on the Housatonic Boat Club Property near Shore Rd. as indicated on Figure 1-2. Five water level measurements have been taken at this location and are listed below.

April 25, 1994 = 5.46 feet below ground surface (bgs). (Approximate low tide).
May 9, 1994 = 5.74 feet bgs. (Approx. 1 hour past high tide).
May 16, 1994 = 5.87 feet bgs.
August 24, 1994 = 6.12 feet bgs.
March 27, 1995 = 5.85 feet bgs.

The 1994 and 1995 water level information indicates a water table elevation ranging from approximately 2.18 to 2.84 feet NAD 1929. By assuming that the April water level data represents a seasonal high and the August data represents the seasonal low, there appears to be a 0.66-ft. seasonal variation in the water levels. For the purpose of this EE/CA, 5.5 feet bgs was assumed to be the depth to the mean high water table. If necessary, additional data could be collected to gain a more complete understanding of the Study Area hydrogeology caused by the tides and seasons.

1.5.5 Meteorology

A NOAA Climatological Station is located at the Bridgeport - Sikorsky Airport, approximately 2 miles from the Study Area. Data from this station have been used for more than 30 years to describe the area climate. A data summary is provided below.

The Town of Stratford, Fairfield County, Connecticut, is located in a temperate-humid climate characterized by highly changeable weather. Daily and annual temperature variations are influenced by Long Island Sound and the Atlantic Ocean. There are monthly, seasonal, and annual variations in temperature and wind, as well as precipitation, which is in the form of both rain and snow.

July is the warmest month, with an average temperature of 73.7 degrees F. Average wind speed and direction for the warmest months is 10.2 miles per hour (mph) from the southwest. The coldest month is January, with an average temperature of 28.9 degrees F. Average wind direction and speed for the colder portion of the year is 13.3 mph from the northwest.

Normal annual precipitation for the area is 41.66 inches of rain, with a regular distribution throughout the year. Snowfall typically occurs between November and April, with a mean of 25 inches per year (NOAA, 1993).

1.6 Nature and Extent of Contamination

A summary of the nature and extent of contamination in soils at the Study Area is provided below. Sample locations are depicted on Figure 1-4. For the purpose of this EE/CA, the nature and extent of the contamination focuses on lead, PCB, asbestos, and dioxins where lead contamination above the site screening level creates the largest volume requiring remediation. Other contaminants are present within the Study Area, but will not be detailed in this EE/CA. These are detailed in the Draft RI dated June 1998. It is assumed that exceedances of these other contaminants are present within the Study Area soils and any action taken to address soil contaminated with lead, PCB, asbestos, and dioxins will also address the other contaminants.

As discussed in Section 1.5.3 of this report, the delineation of the Study Area was based on the results of soil boring investigations. These data were used to define the location of soils that exceeded any one of the following site screening level criteria previously established for the Raymark Facility: 400 ppm for lead, 1 percent for asbestos, 1 ppm for PCBs or 1 ppb in terms of Toxicity Equivalency (TEQ) for dioxins. The entire area containing an exceedance of any one of these criteria comprises the area to be addressed by the NTCRA. The lateral extent of this area defines the Study Area that is referenced in this section.

Figure 1-5a shows the lateral extent of contamination at the Study Area. Figures 1-5b through 1-5i show the delineation of specific contaminant concentrations (for lead, asbestos, PCBs, and dioxins) throughout the Study Area. These figures summarize the analytical data compiled during the soil boring investigations performed by TtNUS in March 1999 and during previous field efforts. Results (expressed as a range of concentrations) are presented for the surficial layer (0-2 feet bgs) of soil and a lower layer (2-4 feet bgs) of soil. Where available, analytical data for depths between 4 and 6 feet bgs are not shown on the figures but are presented in Appendix B.

1.6.1 Potential Sources of Contamination

A description of the potential sources of contamination affecting the Study Area associated with past operational and disposal practices of the Raymark Facility is presented below.

1.6.1.1 Lead

Lead was one of the primary metals used at the Raymark Facility to fabricate various brake and friction materials, and was detected at elevated concentrations in the Study Area. The operations process used other metals but they are not the focus of this EE/CA.

1.6.1.2 Asbestos

Asbestos was detected in soil samples collected from the Study Area. Asbestos is a group of magnesium silicate minerals that contain varying quantities of iron and calcium silicates. Because of its non-combustible and heat-resistant properties, asbestos was commonly used to manufacture brake linings, gaskets, fireproof fabrics, roofing materials, and electrical and heat insulation, and as a reinforcing agent in rubber and plastics.

Asbestos-containing material was a primary component of the products manufactured at the Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads and linings. Asbestos was also used to manufacture friction materials (clutches and automatic transmission plates) and gaskets.

1.6.1.3 Polychlorinated Biphenyls (PCBs)

The PCBs detected in the environmental samples collected from the Study Area consisted primarily of Aroclor 1262 and Aroclor 1268. PCBs are extremely stable chemicals with a wide range of physical properties. They have been historically used in plasticizers, adhesives, lubricants, heat transfer fluids, and as dielectric fluids in transformers and capacitors. Aroclor 1262 and Aroclor 1268, specifically, are commonly used as plasticizers in synthetic resins. Aroclor 1268 is also commonly used as a wax extender and plasticizer in rubbers.

No information has been provided directly by the Raymark Facility documenting the specific use of PCBs as part of their manufacturing process. However, the EPA has reported that PCBs were used in manufacturing brake linings. The Raymark Facility was also known to have used and/or manufactured both rubber (gasket materials) and resins (phenolic resins in brake linings). Aroclor 1262 and Aroclor 1268 may have been used as plasticizers in these materials.

1.6.1.4 Dioxins

Environmental samples from the Study Area contained detectable concentrations of dioxins. Dioxins are not manufactured commercially. Chlorinated dioxins are formed during the production of chlorinated compounds (such as PCBs, herbicides, pesticides, and chlorophenols), or as a result of incomplete combustion of chlorinated chemical compounds (such as PCBs). The term "dioxins" is commonly used to refer to a specific group of polychlorinated dibenzo-p-dioxin chemical compounds. The toxicity of one specific compound, 2,3,7,8-tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD), has been studied more than other known dioxins. The toxicity of all other dioxins are expressed in relation to 2,3,7,8-TCDD, and are reported in terms of Toxicity Equivalency (TEQ).

1.6.1.5 Chemical Compounds used or Handled at the Raymark Facility

A number of chemical compounds and materials, other than those discussed above, were handled, stored, and/or used in manufacturing processes at the Raymark Facility. A list of these chemicals was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and is presented in the *Draft Final Remedial Investigation Report*, (B&RE 1995). No RCRA Part B application for the Raymark Facility was ever filed.

1.6.2 Lead Contamination Discussion

Elevated concentrations of lead were detected in both the surficial (0-2 feet below ground surface (bgs)) and subsurface soils (2-4 feet bgs). Concentrations were typically comparable yet more widely spread out in the surficial soils. Lead contamination was used to define the Study Area because areas with lead typically also contain elevated levels of asbestos, PCBs, and/or dioxin.

High concentrations of lead were found in the Study Area. Numerous samples taken from the Study Area both from 0 to 2 feet and 2 to 4 feet indicated lead concentrations above 10,000 mg/kg (see Figures 1-5b and 1-5c). Many of the samples within the parking lot, especially along the shoreline, indicate lead concentrations from 400-10,000 mg/kg and higher. A site screening level of 400 mg/kg lead, previously established for the Raymark Facility, was used to determine the limits of the removal action.

1.6.3 Asbestos Contamination Discussion

High concentrations of asbestos were detected in both the surficial and subsurface soil layers (see Figures 1-5d and 1-5e). The distribution and magnitude of asbestos concentrations within the two layers were comparable, encompassing the Housatonic Boat Club parking area and Shore Road at concentrations between 1 and 50 percent asbestos. Peak concentrations of greater than 50 percent were found on Shore Road near the entrance to the Housatonic Boat Club parking lot and along the shoreline between the boat ramp and Boat House. No asbestos concentrations above 1 percent were detected on the Shakespeare Theater property other than along the Shore Road shoulder. Only the eastern boundary of the Theater property was included in this EE/CA, and not the entire Shakespeare property.

An site screening level of 1 percent asbestos, previously established for removal cleanups from the Raymark soil-waste, was used to determine the limits of the removal action, although all asbestos contaminated soil-waste within the Study Area is defined by the lead contamination.

1.6.4 PCBs Contamination Discussion

PCBs were detected in samples from both the surficial (0-2 feet bgs) and subsurface (2-4 feet bgs) soil layers throughout the Study Area (see Figures 1-5f and 1-5g). Concentrations were comparable but somewhat higher in the surficial layer, especially along Shore Road. No PCB concentrations above 1 ppm were detected on the Shakespeare Theater property, although one or two points on the Shore Road shoulder along the Shakespeare Theater property had PCB concentrations greater than 1 ppm.

Elevated concentrations of PCBs were found scattered throughout the Study Area. A few samples in both the surface and subsurface soils exceeded 10 ppm, with the majority of the PCB contamination between 1 and 10 ppm. A site screening level of 1 ppm total PCBs, previously established for removal cleanups from Raymark waste, was used to determine the limits of the removal action. All PCB contaminated soil-waste is within the Study Area defined by the lead contamination.

1.6.5 Dioxin Contamination Discussion

Dioxin contamination was detected in both surface and subsurface soil layers (see Figures 1-5h and 1-5i). An site screening level of 1 µg/kg TEQ, previously established for removal cleanups from Raymark waste, was used to determine the limits of the removal action; although all dioxin contaminated soil-waste is within the Study Area defined by the lead contamination.

1.7 Streamlined Human Health Risk Evaluation

This section presents the results of the streamlined risk evaluation. This evaluation is intended to identify current or potential exposures with a qualitative summary of the exposure routes, likely contaminants of concern, and potential human health effects of the principal contaminants associated with the Shore Road area.

TtNUS prepared a quantitative risk assessment on the Housatonic Boat Club and nearby wetlands in June of 1998 as part of a Draft Remedial Investigation Report (B&RE, 1998). The draft report identified risks to human health from exposures to lead, asbestos, dioxins, and PCBs. Because of the large geographic extent of the Study Area and the presence there of a wide range of lead concentrations, the report indicated that lead risks might be underestimated (through averaging).

EPA performed a further evaluation to examine potential "hot spots" (See Appendix A). This hot spot evaluation was the basis for developing this EE/CA. An additional sampling effort was undertaken in March 1999 to fully determine the lateral extent of contamination. The investigation resulted in redefining the extent of contamination and therefore of the Study Area, as discussed under 1.3.2.

The March 1999 sample data were added to the existing database. The results were re-evaluated and a new, enlarged hot spot area was identified as hot spot #1 (See Figure 1-6). Of the soil samples collected, each sample location analyzed met one of the following criteria: 400 ppm for lead, 1 percent for asbestos, or 1 ppm for PCBs; however, the area of risk analysis is defined by lead concentrations exceeding 400 ppm. Based on this analysis, the hot spot area has been expanded from the areas identified in the removal justification documents in Appendix A to the area shown on Figure 1-6. An asbestos and lead hot spot identified in the removal justification documentation has also been re-evaluated. This area has been enlarged slightly and is identified as hot spot #2 shown on Figure 1-6.

1.7.1 Overview of the Study Area

The Study Area encompasses portions of Shore Road, the Housatonic Boat Club, and a small portion of the eastern slope of the Shakespeare Theater property. The Study Area (approximately 4 acres) is bounded by the Shakespeare Theater property and residences to the west, the Housatonic River or related wetlands to the east and the southeast, residences and Elm Street to the south, and a public boat launch area in the north as described in Section 1.3.2.

1.7.2 Previous Risk Evaluation

The quantitative risk assessment on the Housatonic Boat Club and nearby wetlands was submitted to EPA in draft form as part of a Remedial Investigation (RI) Report (B&RE, June 1998). In that report, the Housatonic Boat Club and nearby wetlands were known as Area C. Area C encompasses a portion of this Study Area. The Draft RI summarized the evaluation of recreational users, current commercial workers, and future commercial workers.

The report identified PCBs, dioxins, asbestos, and lead as contaminants of concern. Noncarcinogenic risks from a long list of contaminants fell below the accepted Hazard Index of 1. Total carcinogenic risks, including risks from PCBs and dioxins, were approximately 1×10^{-5}. Asbestos cannot be evaluated using traditional risk assessment guidance. However, a significant threat to human health may occur when asbestos fibers become airborne. The presence of asbestos at concentrations ranging from 1 to 90 percent within the Study Area indicated the potential for significant adverse health effects. Commercial worker exposures to lead were evaluated using the *EPA's Technical Review Workgroup for Lead Model.* A lead exposure point concentration of 1390 mg/kg, representing the 95 percent UCL value for surface soils, was put into the model. The 95 percent UCL of the arithmetic mean is defined as a value that, when calculated repeatedly for randomly drawn subsets of the site data, equals or exceeds the true mean 95 percent of the time. The 95 percent UCL of the mean provides a conservative estimate of the average concentration. Results indicated fetal blood lead levels ranging from 9.4 µg/dL to 13.7 µg/dL. The established level of concern for fetal blood lead levels is 10ug/dL. Since lead was detected at a maximum concentration of 25,300 mg/kg in Area C surface soils, it was determined that lead risks in localized areas of Area C were likely to be underestimated (see Appendix A).

EPA further evaluated lead contamination within localized areas where lead concentrations were high. These locations were identified as "hot spots" within the Housatonic Boat Club area (EPA, 1998). (See Appendix A). The highest lead concentrations detected in "hot spots" #1 and #2 were 25,300 mg/kg and 23,000 mg/kg, respectively. Results of this analysis indicated two distinct locations with surface soil lead exposure point concentrations that, when used as input for the model, resulted in fetal blood lead levels ranging from 41 to 55 mg/dL and 15 to 21 mg/dL. These concentrations are above the established level of concern of 10 μg/dL.

1.7.3 Potential Human Receptors and Exposure Pathways

This quantitative lead risk evaluation assessed recreational users for exposures to surface soils. Possible exposures of recreational users to site-related contaminants would result from recreational activities such as maintaining boats stored in the boatyard.

The scenario used in this evaluation differs from the previous evaluation. The scenario was changed from the commercial worker to the frequent recreational visitor. This scenario (outdoor recreational as opposed to the indoor commercial scenario) is more reflective of site use, in that female visitors working on their own boats are more likely to contact surface soils on a frequent basis than female commercial workers at the Housatonic Boat Club. The frequency of exposure was decreased from the typical worker exposure frequency of 250 days/year to an exposure frequency of 150 days/year. The soil ingestion rate was increased to reflect the outdoor exposure scenario. These two changes roughly balance each other out.

1.7.3.1 Current and Future Recreational Users

The Study Area is primarily recreational. Adult recreational users were evaluated for exposure to lead in surficial soils (0 to 2 feet bgs) under current and future land uses. Recreational users are assumed to be exposed to site soils for 150 days/year. These receptors are assumed to ingest an average of 100 mg/day of soil.

1.7.3.2 Exposure Pathways

The primary routes of exposure for potential human receptors at the Study Area are incidental ingestion of soil and dermal contact with soil. Exposure routes associated with soil contact are evaluated for recreational users.

Other potential exposure routes such as groundwater use, and inhalation of fugitive dust and volatile emissions were not evaluated for the following reasons:

- The shallow aquifer at the Study Area is not used as a potable water supply. Shallow groundwater at the site discharges to the Housatonic River and its tributaries. In addition, groundwater at the site is not used or expected to be used in the future as a potable water supply because of brackish conditions and productivity constraints. Therefore no nearby residents are evaluated for exposure to contaminated drinking water. It should be noted that groundwater quality at Ferry Creek is being investigated under a separate work assignment.

- Potential exposure to volatile emissions and fugitive dust from the Study Area is considered to be minimal relative to ingestion and dermal pathways, except for potential inhalation of asbestos. A quantitative evaluation of asbestos exposure cannot be performed using traditional risk assessment methods. A qualitative discussion of asbestos results is included in Section 1.7.5.3.

1.7.4 Contaminants of Concern (COC)

The COCs used for this risk evaluation were identified in the June 1998 Draft RI assessment (B&RE, 1998). Based on this information, toxicity profiles were prepared for the four contaminants of concern. Information has been compiled to identify the potential health hazards associated with human exposure to these COCs. A literature review was conducted to prepare a limited toxicological evaluation of each contaminant to characterize its toxic properties, its carcinogenicity, and other adverse health effects it presents to receptors. This information is presented below.

1.7.4.1 Asbestos

Asbestos is a group of naturally occurring minerals. These minerals are comprised of long, thin fibers. These fibers are resistant to heat and chemicals, properties that have made them useful in a variety of products (building materials, friction products, and heat-resistant fabrics).

Asbestos is a known human carcinogen via inhalation. Numerous human studies of asbestos exposure have shown an increase in cancer of the lung tissue and mesothelioma, cancer of the membrane surrounding the lung. There is also less certain evidence that asbestos inhalation causes gastrointestinal cancer. Breathing asbestos may also cause a non-cancer effect known as asbestosis, which is an accumulation of scar-like tissue in the lungs and tissue surrounding the lungs. The health effects of ingesting asbestos are unclear and cannot be quantitatively assessed. Equivocal human data exist indicating carcinogenic effects from exposure to asbestos via drinking water. Animal studies have not shown that exposure to asbestos causes an increase in cancer.

1.7.4.2 Lead

Lead is a naturally occurring bluish-gray metal. It has no characteristic taste or smell. Lead has many uses: in batteries, ammunition, paint, solder, roofing, and caulking. Adverse health effects may occur as a result of inhaling or ingesting lead. Exposure to lead in fetuses, infants, and children causes neurotoxic effects involving deficits in cognitive function and developmental delays. In school-age children, these effects have been measured using standardized IQ tests. Acute exposure may cause severe brain or kidney damage in adults and children.

Lead-exposed workers have reported symptoms including fatigue, depression, irritability, decreased libido, and headaches. Decreases in vasomotor and fine motor control have also been observed. Lead exposure may increase blood pressure in men.

1.7.4.3 Polychlorinated Biphenyls (PCBs)

PCBs are a family of man-made chemicals containing more than 200 individual compounds known as congeners. Because PCBs do not burn easily and are good insulators, they were used as coolants and lubricants in transformers, capacitors, and other electrical equipment. PCBs have not been manufactured in the United States since 1977, although they were still available in the marketplace, i.e., lubricating oils, until the early 1980s. PCB mixtures are also known by their trade names. The trade names of the PCBs associated with Raymark are Aroclor-1262 and Aroclor-1268.

Based on animal studies, PCBs have been classified as a B2, or probable, carcinogen. Observed effects on workers exposed to PCBs include skin irritations such as acne or rashes.

1.7.4.4 Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (Dioxins and Furans or simply "Dioxins")

Dioxins (and dioxin-like compounds) can be formed:

- Through the chlorination of naturally occurring phenolic compounds such as wood pulp, e.g., chlorine bleaching of paper.

- As byproducts in the manufacture of chlorinated compounds.

- During various combustion processes, e.g., municipal waste, sewage sludge, and hospital incineration.

These persistent hydrophobic compounds accumulate in soils, sediments, and organic matter and can be redistributed.

Dioxins have been shown to be potent toxins in animals, with the potential to produce a range of adverse effects. Dioxins are classified as probable carcinogens based on animal data. Noncancer effects of dioxin include developmental and reproductive effects, immune suppression, and disruption of regulatory hormones.

1.7.5 Updated Evaluation

Soil samples were collected in March 1999 to clearly define the lateral extent of soil contamination. For the purpose of risk evaluation, surface soils were defined as soils collected from depths of 0 to 2 feet bgs. Samples collected from 1.5 to 2.5 feet bgs were included in the 0 to 2 feet data set.

1.7.5.1 Evaluation of Data

In an effort to support and elaborate on past risk assessment conclusions, data from the latest round of sampling (together with earlier data) are included in Appendix D, Table D-1 and displayed in Figures 1-5b through 1-5i. The figures are color-coded to aid in visualization and identification of potential hot spots. Examination of these figures reveals that the highest concentrations of lead, asbestos, and PCBs presented in this EE/CA occur within the same locations that are identified in the EPA action memorandum (Appendix A). The lead hot spots evaluated in this previous work are still apparent. In addition, high concentrations of lead, asbestos, and PCBs appear along Shore Road and in other areas of the Housatonic Boat Club. Dioxin concentrations above 1 ppb were detected within the area evaluated in this investigation. These additional areas are now included within the Study Area and were included in this Risk Evaluation.

The areas selected for further evaluation in this report are shown on Figure 1-6. Based on the data, it was decided to further evaluate an enlarged area (hot spot #1), encompassing most of Shore Road and the Housatonic Boat Club. The outline of hot spot #1 was drawn to include all samples (past and present) in the combined dataset with lead concentrations greater than or equal to 400 mg/kg; however, there are some samples with little or no lead contamination and samples located beneath pavement that are included within the hot spot. To address the concern that the evaluation of risks due to lead contamination may underestimate risks due to inclusion of these samples with little or no contamination, a smaller hot spot #2 was defined within hot spot #1. Hot spot #2 includes lead samples greater than 400 mg/kg and does not include any sampling locations covered by pavement along and beneath Shore Road.

A third hot spot (hot spot #3) was identified in a localized portion of hot spot #1. Hot spot #3 was defined based on lead concentrations greater than 400 mg/kg along and under Shore Road. As most of these sampling locations are covered by pavement, a full evaluation of hot spot #3 is not included in this EE/CA; however, a comparison of the average concentration in this area to the concentrations in the other hot spot areas is included in Section 1.7.5.2.

Data from earlier sampling resulted in maximum surface soil concentrations of 25,300 mg/kg lead, 75,810 μg/kg PCBs, 64 percent asbestos, and 0.007 μg/kg dioxins. Maximum surface soil concentrations from recent sampling were 56,000 mg/kg for lead, 43,600 μg/kg for PCBs, 85 percent for asbestos and 11.958 μg/kg for dioxins. Exposures to PCBs and dioxin were not re-evaluated in this EE/CA as discussed in Section 1.7.5.4.

1.7.5.2 Lead Exposures

Lead was identified as a COC in surface soil in Area C (B&RE, 1998). Subsequent evaluation of lead hot spots by EPA demonstrated unacceptable lead risks in localized areas of both Area C, and now the Study Area. The maximum concentration of lead detected in surface soils is 56,000 mg/kg in the March 1999 sampling effort. The maximum concentration of lead detected previously in surface soils was 25,300 mg/kg and 38,700 mg/kg in deeper soils.

The approach to selecting the exposure point concentrations is different from EPA's previous evaluation. In the earlier evaluations, the selected exposure point concentrations represented the 95 percent UCLs. Since the lead model used is intended to result in a full range or possible blood lead concentrations based on the soil lead concentration entered into the model, it is more appropriate to input an average concentration. Entering a 95 percent UCL tends to bias the model outputs toward the high end, thus potentially overestimating risk. The exposure point concentrations selected for use in this evaluation are the arithmetic average soil lead concentrations based on the results of old and new data for the hot spot #1 and hot spot #2 exposure areas shown in Figure 1-6. As noted above, these areas encompass larger areas than included in the earlier hot spot analysis.

Exposure to lead in surface soil by the future recreational visitor in Hot Spot #1 was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996b). Hot spot #1 includes many soil samples collected from beneath the current road surface. For this reason, this area is considered a potential future risk. A list of samples and results is presented in Appendix D, Table D-2. The exposure point concentration of 3,900 mg/kg for surface soil was used to estimate blood-lead levels for future recreational users of the Housatonic Boat Club and represents the average surface soil concentration based on results of both previous and recent data. The previous exposure point concentration of 1390 mg/kg represents the 95 percent UCL of the average concentration. Exposure assumptions were used to represent female recreational visitors who visit the Study Area to work on their boats 4 days/week during 9 months of the year. The results are presented in Table 1-1. Under this scenario, the model estimated that the 95th percentile blood lead concentration among fetuses born to women having site exposures ranged from 22.23 μg/dL to 30.17 μg/dL, which exceeds the established level of concern of 10 μg/dL.

Exposure to lead in surface soil by the current recreational visitor in hot spot #2 was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996b). The original EPA hot spot has been slightly

TABLE 1-1
LEAD EVALUATION HOT SPOT #1
FREQUENT RECREATIONAL USER
DRAFT FINAL ENGINEERING EVALUATION / COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT

CALCULATIONS OF 95TH PERCENTILE FETAL BLOOD LEAD CONCENTRATIONS FOR ADULT EXPOSURE TO SOIL

Exposure Parameter	Description (units)	GSD_i = 1.8 - 2.1; $PbB_{adult,0}$ = 1.7 - 2.2			
		Adult 1	**Adult 2**	**Adult 3**	**Adult 4**
$PbB_{adult,0}$	Typical blood lead concentration in adult women of child-bearing age in absence of site exposures (ug/dL)	1.7	1.7	2.2	2.2
PbS	Site-specific soil lead concentration (mg/kg)	3900	3900	3900	3900
BKSF	Biokinetic slope factor (ug/dL per ug/day))	0.4	0.4	0.4	0.4
IR_s	Intake rate of soil, includes outdoor soil and indoor soil-derived dust (g/day)	0.100	0.100	0.100	0.100
AF_s	Absolute gastrointestinal absorption fraction (unitless)	0.12	0.12	0.12	0.12
EF_s	Exposure frequency (days/year)	150	150	150	150
AT	Averaging time (days/year)	365	365	365	365
$GSD_{i,adult}$	Estimate of individual geometric standard deviation among adults (unitless)	1.8	2.1	1.8	2.1
$R_{fetal/maternal}$	Constant of proportionality between fetal blood lead concentration at birth and maternal blood lead concentration (unitless)	0.9	0.9	0.9	0.9
$PbB_{adult,central}$	**Calculated central estimate of blood lead concentrations in adult women of child-bearing age from site exposures (ug/dL)**	**9.39**	**9.39**	**9.89**	**9.89**
$PbB_{fetal,0.95}$	**Calculated 95th percentile blood lead concentrations among fetuses born to women having site exposures (ug/dL)**	**22.23**	**28.65**	**23.42**	**30.17**

NOTE: According to the cited guidance document, this adult exposure model is not applicable for infrequent site exposures, where the EF_s is less than 1 day/week.

OBJECTIVE: Adult exposure to lead in soil is addressed by an evaluation of the relationship between the site soil lead concentration and the blood lead concentration in the developing fetuses of adult women. This spreadsheet calculates a range of 95th percentile fetal blood lead concentrations from central estimates of blood lead concentrations in pregnant adult women using the exposure parameters identified below (U.S. EPA, Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, December 1996).

RELEVANT EQUATIONS:

$$PbB_{adult,central} = PbB_{adult,0} + (PbS \times BKSF \times IR_s \times AF_s \times EF_s)/AT$$

and

$$PbB_{fetal,0.95} = PbB_{adult,central} \times GSD_{i,adult}^{1.645} \times R_{fetal/maternal}$$

enlarged to include new data with lead concentrations greater than 400 ppm. This area is not covered by pavement. A cap of wood chips was placed in this area previously; however, much of this covering has been washed away. For this reason, this area is considered a current risk. A list of samples and results is presented in Appendix D, Table D-3. The exposure point concentration of 5,568 mg/kg for surface soil was used to estimate blood-lead levels for current recreational users of the Study Area and represents the average surface soil concentration based on results of both previous and recent data. The previous exposure point concentration of 1390 mg/kg represents the 95 percent UCL of the average concentration. Exposure assumptions were used to represent female recreational visitors who visit the Study Area to work on their boats 4 days/week during 9 months of the year. The results are presented in Table 1-2. Under this scenario, the model estimated that the 95^{th} percentile blood lead concentration among fetuses born to women having site exposures ranged from 30.02 μg/dL to 40.21 μg/dL, which exceeds the established level of concern of 10 μg/dL. Under the previous risk evaluation scenario, the 95^{th} percentile blood lead concentration among fetuses born to women having site exposures ranged from 9.4 μg/dL to 13.7 μg/dL.

The approach used in this evaluation differs from the previous evaluation in two important ways.

1. The scenario was changed from the commercial worker to the frequent recreational visitor. This scenario is more reflective of site use, in that female visitors working on their own boats are more likely to contact surface soils on a frequent basis than female commercial workers at the Housatonic Boat Club. The frequency of exposure was decreased from the typical worker exposure frequency of 250 days/year to an exposure frequency of 150 days/year. The soil ingestion rate was increased to reflect the outdoor exposure scenario. These two changes roughly balance each other out.

2. The approach to selecting the exposure point concentrations is different. In the earlier evaluations, the selected exposure point concentrations represented the 95 percent UCLs. Since the lead model used is intended to result in a full range of possible blood

TABLE 1-2
LEAD EVALUATION HOT SPOT #2
FREQUENT RECREATIONAL USER
DRAFT FINAL ENGINEERING EVALUATION /COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT

CALCULATIONS OF 95TH PERCENTILE FETAL BLOOD LEAD CONCENTRATIONS FOR ADULT EXPOSURE TO SOIL

Exposure Parameter	Description (units)	GSD_i = 1.8 - 2.1; $PbB_{adult,0}$ = 1.7 - 2.2			
		Adult 1	Adult 2	Adult 3	Adult 4
$PbB_{adult,0}$	Typical blood lead concentration in adult women of child-bearing age in absence of site exposures (ug/dL)	1.7	1.7	2.2	2.2
PbS	Site-specific soil lead concentration (mg/kg)	5568	5568	5568	5568
BKSF	Biokinetic slope factor (ug/dL per ug/day))	0.4	0.4	0.4	0.4
IR_s	Intake rate of soil, includes outdoor soil and indoor soil-derived dust (g/day)	0.100	0.100	0.100	0.100
AF_s	Absolute gastrointestinal absorption fraction (unitless)	0.12	0.12	0.12	0.12
EF_s	Exposure frequency (days/year)	150	150	150	150
AT	Averaging time (days/year)	365	365	365	365
$GSD_{i,adult}$	Estimate of individual geometric standard deviation among adults (unitless)	1.8	2.1	1.8	2.1
$R_{fetal/maternal}$	Constant of proportionality between fetal blood lead concentration at birth and maternal blood lead concentration (unitless)	0.9	0.9	0.9	0.9
$PbB_{adult,central}$	**Calculated central estimate of blood lead concentrations in adult women of child-bearing age from site exposures (ug/dL)**	**12.68**	**12.68**	**13.18**	**13.18**
$PbB_{fetal,0.95}$	**Calculated 95th percentile blood lead concentrations among fetuses born to women having site exposures (ug/dL)**	**30.02**	**38.68**	**31.20**	**40.21**

Note: According to the cited guidance document, this adult exposure model is not applicable for infrequent site exposures, where the EF_s is less than 1 day/week.

OBJECTIVE: Adult exposure to lead in soil is addressed by an evaluation of the relationship between the site soil lead concentration and the blood lead concentration in the developing fetuses of adult women. This spreadsheet calculates a range of 95th percentile fetal blood lead concentrations from central estimates of blood lead concentrations in pregnant adult women using the exposure parameters identified below (U.S. EPA, Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, December 1996).

RELEVANT EQUATIONS: $PbB_{adult,central} = PbB_{adult,0} + (PbS \times BKSF \times IR_s \times AF_s \times EF_s)/AT$

and

$$PbB_{fetal,0.95} = PbB_{adult,central} \times GSD_{i,adult}^{1.645} \times R_{fetal/maternal}$$

lead concentrations based on the soil lead concentration entered into the model, it is more appropriate to input an average concentration. Entering a 95 percent UCL tends to bias the model outputs toward the high end, thus potentially overestimating risk. The exposure point concentrations selected for use in this evaluation are the arithmetic average soil lead concentrations for the hot spot #1 and hot spot #2 exposure areas shown in Figure 1-6. As noted above, these areas encompass larger areas than included in the earlier hot spot analysis.

The results of this evaluation indicate that unacceptable risk is not limited to the original hot spots, but is applicable throughout the Study Area. It should be noted that many samples showing little or no contamination are included in the hot spot #1 data set, reducing the mean concentration used in the evaluation. For hot spot #2, the arithmetic average lead concentration encompassing EPA's original large lead hot spot (plus a few additional samples located nearby) was 5568 mg/kg. Risks from lead exposure in this Study Area are greater than those estimated for the area as a whole. A third hot spot consisting of samples obtained from along and beneath Shore Road was identified as hot spot #3 shown on Figure 1-6. A list of samples and results is presented in Appendix D, Table D-4. The arithmetic average lead concentration from hot spot #3 was 7764 mg/kg. Since this concentration is greater than the 3900 mg/kg input into the model, risks from lead exposure in this area are expected to be greater than those estimated for the area as a whole. Risks from lead exposure along Shore Road are clearly potential future risks, since this area is currently covered by pavement. In contrast, risks from other areas of the site represent current risks.

1.7.5.3 Asbestos Exposures

Asbestos cannot be evaluated by traditional risk assessment guidance. However, a significant threat to human health may occur when asbestos fibers become airborne. Asbestos was detected at a concentration range of 1 to 90 percent in earlier sampling. It should be noted that some samples included in the EPA evaluation of hot spots were not included in the TtNUS database due to missing information on sampling locations. The maximum asbestos concentration reported in the Study Area database prior to addition of the data 1999 is 70 percent. Further sampling results indicate the presence of asbestos in concentrations as high as 90 percent. The presence of asbestos at concentrations ranging from 1 to 90 percent in the area indicate the potential for significant adverse health effects.

1.7.5.4 PCB and Dioxin Exposures

PCB and dioxin exposures were not re-evaluated as part of the updated risk evaluation, other than to note the presence of concentrations above 1 ppm and 1 ppb, respectively, in the same locations as high asbestos and lead concentrations. This decision is based on the conclusion of earlier evaluations that lead is the principal risk driver. The risk estimates for exposures to PCBs and dioxins for the future commercial worker, current commercial worker, and adult and pre-adolescent recreational users determined in the Draft RI report (B&RE, June 1998) are within the EPA target cancer risk range (1E-4 to 1E-6).

1.7.6 Summary of Human Health Risk Evaluation

This section presents a summary of major risk evaluation findings for the Study Area. Two potential receptor groups were evaluated: the recreational user and commercial worker.

- All hazard indices are less than unity, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

- Total Aroclors (PCBs) and dioxin/furans are primary contaminants of concern.

- Exposure to lead in soil by the commercial worker was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996b). The results of the slope-factor approach indicate that adverse effects are possible for fetuses of pregnant workers exposed to lead in soil at the Study Area.

- Further evaluation by EPA concluded that earlier estimates of risk resulting from commercial lead exposures underestimated risks from exposure to lead in more localized areas of the Study Area. These estimates were based on commercial exposures to lead in surface soil 250 days/year, assuming a soil ingestion rate of 50 mg/day, and utilizing a 95 percent UCL as the exposure point concentration.

- March 1999 data confirms the EPA risk evaluation. Asbestos, PCBs, and lead were found together in a more extensive area than the limited hot spots evaluated earlier. Dioxin concentrations above 1 ppb were detected within the lead, asbestos, and PCB hot spots. Unacceptable risks from recreational exposures to lead in the Study Area are present both under current site conditions and under future conditions. Risks from recreational exposures to lead in surface soil were based on adult exposure 150 days/year, soil ingestion rate of 100 mg/day, and utilizing the arithmetic mean lead concentration for the exposure point concentration.

- Asbestos was detected at a concentration range of 1 to 90 percent in earlier sampling. March 1999 sampling results indicate the presence of asbestos in concentrations as high as 85 percent. Since asbestos contamination is co-located with high lead concentrations, removal of soils contaminated with lead will address asbestos risks. Future lead risks in hot spot #1 area based on surface soils both exposed and covered by pavement. Current lead risks in hot spot #2 were evaluated for surface soils in the area of the Housatonic Boat Club not covered by pavement. Future lead risks in hot spot #3 may result from exposure to soils currently covered by pavement.

1.8 Ecological Evaluation

This section presents the characteristics of the Study Area that are relevant to defining the present on-site habitats. The characteristics of the Study Area are shown in Section 1.3.2.

1.8.1 Ecological Setting

Shore Road is a narrow two-lane road with a bituminous asphalt surface. The asphalt is generally in poor condition. The road shoulders vary from approximately 4 to 20 feet wide and are vegetated with upland grasses and weed species. Common reed (*Phragmites australis*) and a few woody shrub species (*Iva frutescens, betula populifolia*) are also present along the eastern shoulder of the roadway. The road (and shoulder) were built on soil-waste associated with the Raymark Site.

The Shakespeare Theater property is approximately 16 feet above mean sea level (msl) and is situated along the western edge of Shore Road. The property's two structures include the large theater building and a small storage building. The Shakespeare Theater grounds consist of gravel and asphalt parking areas, paved driveways, and a maintained lawn with some areas of deciduous (*Acer sacchrum, Acer platanoides, Prunus serotina, Quercus rubra*) and conifer tree (*Pinus strobus*) canopy species.

The wetlands located to the east of Shore Road are estuarine, intertidal wetlands dominated by smooth cordgrass (*Spartina alterniflora*) and salt meadow hay (*Spartina patens*). Generally, these wetlands are flooded during high tide and are exposed and drained during low tide cycles (B&RE, 1998). As previously mentioned, the wetlands associated with this area are being addressed under a separate work assignment.

1.8.2 Wildlife

Most wildlife species would be expected to use the limited habitat available at the Shore Road Study Area on a transient basis. Most wildlife use would be expected when moving between the estuarine wetlands to the east, and the habitat available at the Shakespeare Theater/Selby Pond area and suburban residential areas to the west.

Mammals expected to use the area include raccoon (*Procylon lotor*) and oppossum (*Didelphis virginiana*), which have been observed in the Study Area vicinity. Other small mammal species, such as mice and eastern cottontail (*Sylvilagus floridanus*), may also use the habitat in the Study Area vicinity.

Several bird species have been observed at the Shakespeare Theater property and these species may spend time foraging, resting, or collecting materials for nesting in the vegetated areas along Shore Road. Bird species observed in the upland areas immediately west of the site include American robin (*Turdus migratorius*), common grackle (*Quisculus quiscula*), black-capped chickadee (*Parus atricapillus*), tree swallow (*Iridoprocne bicolor*), and a colony of monk parakeets (*Myiopsitta monachus*).

No reptiles were observed on site during the field activities. However, as with the mammal and bird species listed above, reptile species may potentially use the site for foraging, cover, and breeding purposes. Species that may be present include the eastern garter snake (Thamnophis s. sirtalis), eastern milk snake (Lampropeltis t. triangulum), and eastern smooth green snake (Opheodrys v. vernalis) (DOI, 1997; B&RE, 1998).

2.0 NON-TIME-CRITICAL REMOVAL ACTION OBJECTIVES

This section describes the rationale for conducting a NTCRA to address fill containing asbestos, lead, dioxins and PCBs at the site; presents the overall scope and objectives of the proposed NTCRA; identifies the statutory limits on removal actions; and identifies potential applicable or relevant and appropriate requirements. A proposed schedule for selecting the NTCRA and a discussion of possible future remedial activities are also provided.

2.1 Regulatory Basis for a Removal Action

This section identifies the site conditions that provide the legal justification for conducting a NTCRA to address contaminated fill at the site. These site conditions correspond to factors cited in Section 300.415(b)(2) of the NCP that provide a basis for conducting a removal action:

- (i) actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.
- (ii) high levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate.
- (iii) weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.
- (iv) the availability of other appropriate federal or state response mechanisms to respond to the release.

An evaluation of the conditions at the Study Area concluded that the above listed factors are applicable as described below.

(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants – There is both the current and future potential for direct human exposure to contaminants in soils along and beneath Shore Road, as well as the area surrounding the Housatonic Boat Club. These areas are contaminated with asbestos, lead, PCBs, and dioxins. While past measures were taken to prevent access to the soils, weather and use of the area has compromised the interim capping efforts. There is a current and future potential for human exposure through direct contact and inhalation of soil, and the potential for exposure to animals.

(ii) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate – The preliminary risk screening was completed using surface soil data that found unacceptable levels of lead and asbestos. In areas where the interim cap has been compromised, this surface soil is subject to movement via surface water runoff and air transport. Leaching of contamination via infiltration is another potential migration mechanism. Because of this, there is a current potential for pollutant migration.

(iii) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released – Shore Road and the area surrounding the Housatonic Boat Club building are within the 100-year flood zone. There have been numerous occurrences of flooding within the Study Area. Precipitation is also believed to have the ability to mobilize contaminants where releases could reach the Housatonic River during flooding and rainstorm events. A risk assessment currently underway found elevated levels of site-related contamination in both river sediments and in crab tissue. The Housatonic River is used for fishing, for recreational boating, and by the oyster industry.

(iv) The availability of other appropriate federal or state response mechanisms to respond to the release – There are no other known federal or state funds or response mechanisms available to finance this action. The Town of Stratford requested that an action be taken in the Study Area to address the potential of contaminant exposure for both current use and for future redevelopment and reuse plans. CTDEP concurs with the town's request for an action.

Consequently, based on the NCP factors listed and described above, a potential threat exists to public health or welfare or the environment at the Shore Road/ Housatonic Boat Club area and, therefore, a removal action is appropriate to abate, prevent, minimize, stabilize, mitigate, or eliminate such threat(s). In particular, a removal action is necessary to control and contain the release of hazardous substances along Shore Road and the Housatonic Boat Club area through source control measures.

This removal action is designated as non-time-critical because more than 6 months' planning time is available before on-site activities must be initiated. As a result, EPA will require the EE/CA completion pursuant to 40 CFR § 300.415(b)(4)(i).

2.2 Removal Action Objectives

Remedial action objectives (RAOs) were identified that would achieve the overall goal of the proposed NTCRA: to address threats to humans and the environment posed by the contaminated soil-waste/fill materials in the Study Area. The EE/CA will consider alternatives that meet the identified RAOs:

- Prevent direct human contact with contaminants in soil-waste/fill materials.
- Prevent, to the extent practicable, the further release of contaminants from soil-waste/fill materials into the soil, groundwater, surface water, and sediments.
- Prevent, to the extent practicable, the release of contaminants from the soil-waste/fill into the Housatonic River that occurs through flooding.
- Prevent, to the extent practicable, continued ecological impacts from the release of contaminants from the soil-waste/fill into the Housatonic River and nearby wetlands.

Pursuant to EPA guidance on performing EE/CAs, alternatives will be evaluated based on relative effectiveness, implementability, cost, and compliance with ARARs to the extent practicable. Further, alternatives that exceed $2 million dollars will be evaluated to determine their consistency with future remedial actions to be taken at the site.

2.3 Area and Volume of Materials to Be Addressed

The area and volume of materials requiring a removal action were established using site screening levels for lead (greater than 400 ppm), asbestos (greater than 1 percent), PCBs (greater than 1 ppm), and dioxin (greater than or equal to 1 μg/kg TEQ) developed and used by EPA to identify areas to be addressed by the removal actions conducted from 1993 to 1996. EPA has agreed that these site screening levels should be used as the cleanup levels for the Study Area NTCRA.

As discussed in Section 1.5.3, the estimated area of materials exceeding the site screening levels is 170, 800 square feet (see Figure 4-1). The estimated volume of material to be cleaned up, based on various volume estimates (different depths of excavation), ranges from 12,650 cubic yards to 34,786 cubic yards.

The volume of material to be considered under this cleanup action was developed based on the evaluation of the nature and extent of contamination (see Section 1.6) and on compliance with published laws and regulations (see Section 2.4). The proposed cleanup alternatives are detailed in Section 4.0.

2.4 ARARs and TBCs

40 CFR 300.415(i) requires that fund-financed removal actions at CERCLA sites must meet ARARs (Applicable or Relevant and Appropriate Requirements) to the extent practicable, considering the urgency of the situation and the scope of the removal. ARARs are promulgated, enforceable federal and state, environmental or public health

requirements that are determined to be legally applicable or relevant and appropriate to the hazardous substances, cleanup actions, or other circumstances at a CERCLA site.

ARARs are divided into two categories: "applicable" requirements and "relevant and appropriate" requirements. "Applicable" requirements are those environmental or public health requirements that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. "Relevant and appropriate" requirements are those requirements that, while not "applicable" to the contaminants or conditions at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to a particular site.

TBCs (standards and guidance To Be Considered) are non-promulgated advisories or guidance issued by federal or state government that are not legally binding, but may be considered during the development of alternatives. TBDs (standards and guidance to be determined) may be applicable once all the particulars of the selected option are known.

There are three types of ARARs and TBCs that must be considered in planning CERCLA actions: chemical-specific, action-specific and location-specific. These categories are briefly described below. Detailed discussions of the potential ARARs and TBCs for specific removal alternatives are provided in Section 4.

Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs are typically health- or risk-based numerical values that are used to establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the environment. In general, chemical-specific requirements are set for a single chemical or a closely-related group of chemicals. Typical chemical-specific ARARs are federal and state drinking water standards and ambient water quality standards (see Table 2-1).

TABLE 2-1
POTENTIAL CHEMICAL-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements	Connecticut Cleanup Standard Regulations (22a-133 CGS)	To Be Determined	The regulations define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site-specific cleanup standards.	The regulations will be adhered to when determining soil cleanup standards under the capping scenario.
	Disposition of PCBs (22a-467 CGS)	To Be Determined	This section requires that PCBs be disposed under a permit issued by the Commissioner or with written approval of the Commissioner in a manner not inconsistent with the federal Toxic Substances Control Act (40 CFR 761).	The disposal of PCB contaminated soil will comply with the substantive provisions of this section.
	Connecticut Coastal Management Act (22a - 90 to 112)	To Be Determined	This statute establishes Connecticut's enforceable coastal zone policies in accordance with the federal Coastal Zone Management Act.	Activities performed in coastal areas would conform to these requirements.
Criteria, Advisories, and Guidance	TSCA PCB Spill Clean-up Policy (40 CFR 761.120-135)	To Be Determined	This policy applies to recent PCB spills and establishes clean-up levels for PCB spills of 50 ppm or greater at 10 ppm for non-restricted access areas and 25 ppm for restricted access areas.	Standards may be used as guidelines for soil cleanup if PCB contamination must be addressed.
	EPA Risk Reference Doses (RfDs)	To Be Determined	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic effects of exposure to toxic substances.	EPA RfDs were used to assess health risks due to exposure to noncarcinogenic contaminants present at the site. RfDs will be used in development of Preliminary Remediation Goals for facility soils.
	Proposal for the Connecticut Cleanup Standard Regulations (22a-133K CGS)	To Be Determined	The proposed regulations would define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site-specific cleanup standards.	The proposed regulations will be considered in determining soil cleanup standards.

TABLE 2-1
POTENTIAL CHEMICAL-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Criteria, Advisories, and Guidance	EPA Carcinogen Assessment Group Potency Factors	To Be Determined	EPA Carcinogenic Potency Factors (CPFs) are used to compute the individual incremental cancer risk resulting from exposure to carcinogens.	CPFs were used to assess health risks due to exposure to carcinogens present at the site. These factors will also be used in development of PRGs for site soils.
	Guidance on Remedial Actions at Superfund Sites with PCB Contamination (EPA/540/G-90/007, August 1990)	To Be Determined	Describes various scenarios and considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve protection of human health and the environment.	This guidance will be considered in determining the appropriate level of PCBs that may be left in the soil.

Notes:

(1) Determination of the status of the requirement (i.e., applicable, relevant and appropriate, or to be considered) will be made for the individual alternatives and will be indicated on the alternative-specific ARARs tables in Section 4.0.

Action-Specific ARARs and TBCs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are generally focused on actions taken to remediate, handle, treat, transport, or dispose of hazardous wastes. Most action-specific ARARs fall into three broad categories: federal and state regulations pertaining to RCRA, the Clean Water Act (CWA), and the Clean Air Act (CAA). RCRA ARARs typically establish design, operating, and monitoring requirements for hazardous waste treatment facilities. CWA ARARs generally regulate treated effluent discharged to a surface water. CAA requirements typically pertain to air emissions from hazardous waste treatment operations (see Table 2-2).

Location-Specific ARARs and TBCs

Location-specific ARARs and TBCs are restrictions placed on the conduct of activities solely because they are in specific areas. Wetland and floodplain regulations are common location-specific ARARs for CERCLA cleanup actions. Additional potential location-specific ARARs include state and federal regulations that protect endangered species, fish and wildlife, and historical and archaeological resources (see Table 2-3).

2.5 Statutory Limits on Removal Actions

40 CFR 300.415(b)(5) and CERCLA Section 104(c)(1) set limits of $2 million and 12 months for fund-financed removal actions. Exemptions from the limits on cost and implementation time may be granted in situations where EPA determines that the removal action is required to mitigate an immediate risk to public health, welfare, or the environment or that the removal action is otherwise appropriate and consistent with the anticipated long-term remedial action.

Because the proposed NTCRA is anticipated to exceed the 2 million dollar limitation, it will need to obtain an exemption.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements	RCRA - General Facility Standards (40 CFR 264.10 - 264.18	To Be Determined	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Any on-site treatment, storage, or disposal facility will be constructed, fenced, posted and operated in accordance with the substantive provisions of this requirement.
	RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.37)	To Be Determined	Outlines requirements for safety equipment and spill control.	Safety and communication equipment will be maintained at the site and local authorities will be familiarized with the site operations, in accordance with the substantive provisions of these requirements.
	RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)	To Be Determined	Outlines requirements for emergency procedures to be used following explosions, fires, etc.	Contingency plans will be developed and response activities will be implemented in accordance with the substantive provisions of these requirements.
	RCRA - Groundwater Monitoring (40 CFR 264.90 - 264.93)	To Be Determined	Details requirements for groundwater monitoring and responding to releases from Solid Waste Management Units.	A groundwater monitoring program must be developed in accordance with the substantive provisions of these requirements for any alternative which involves an on-site surface impoundment, landfill, or land treatment facility.
	RCRA - Closure and Post-Closure (40 CFR 265.110 - 264.120)	To Be Determined	Details requirements for closure and post-closure of hazardous waste facilities.	Any containment remedy will be designed to meet the substantive provisions of this requirement.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements (Continued)	RCRA - Land Treatment (40 CFR 264.271 - 264.282)	To Be Determined	These regulations detail the requirements for conducting land treatment of RCRA hazardous waste.	Alternatives that involve on-site land treatment of contaminated soil must comply with the substantive provisions of these regulations.
	RCRA - Closure of Landfill (40 CFR 264.310)	To Be Determined	This regulation details the closure and post-closure requirements for a landfill.	Alternatives that include on-site landfilling must meet the substantive closure requirements of this regulation.
	RCRA - On- site Landfills (40 CFR 264.300 - 264-309	To Be Determined	Includes requirements for the design, construction, operation and maintenance of an RCRA Landfill	The disposal of RCRA in an on-site landfill must meet these requirements
	RCRA - Incineration (40 CFR 264.341 - 264.345)	To Be Determined	These regulations detail operating and monitoring requirements and impose performance standards for hazardous waste incinerators.	Alternatives that include incineration of contaminated soil must comply with the substantive provisions of these regulations. These standards may be applicable to alternatives including thermal desorption of soils or thermal oxidation of air emissions from soil treatment.
	RCRA Miscellaneous Treatment Units (40 CFR 264.601)	To Be Determined	This regulation details design and operating standards for units in which hazardous waste is treated.	Hazardous waste treatment units used for on-site treatment of contaminated media must meet the substantive provisions of these requirements.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements (Continued)	Land Disposal Restrictions (40 CFR 268)	To Be Determined	This regulation establishes "treatment standards" (concentration levels or methods of treatment) which wastes must meet in order to be eligible for land disposal.	Contaminated soil must be treated to attain applicable "treatment standards" prior to placement in a landfill, or other land disposal facility outside the area of contamination where placement occurs.
	TSCA - PCB Storage and Disposal (40 CFR 761.60, .75, .79)	To Be Determined	This regulation establishes standards for the storage, disposal, and incineration of PCBs at a concentration greater than 50 ppm.	Storage, incineration, and disposal of PCB contaminated soil must be conducted in conformance with the substantive provisions of these regulations.
	CWA National Pollutant Discharge Elimination System (NPDES) (40 CFR 122, 125)	To Be Determined	Any point-source discharge must meet NPDES requirements which include compliance with corresponding water quality standards; establishment of a discharge monitoring system; and completions of regular discharge monitoring records.	If an alternative involves treatment, and discharge of process water or groundwater collected during dewatering, discharges to surface water will need to comply with the substantive provisions of these regulations.
	CWA Pre-treatment Regulations (40 CFR 403)	To Be Determined	These regulations impose restrictions on the discharge of pollutants to Publicly Owned Treatment Works (POTW) and mandate that discharges must comply with the local pretreatment program.	If an alternative involves treatment and discharge of an aqueous waste stream from treatment process operation or dewatering, discharges to a POTW must comply with these regulations.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements (Continued)	RCRA - Air Emission Standards for Process Vents (40 CFR 265 Subpart AA)	To Be Determined	Standards for air emissions from process vents associated with selected processes including solvent extraction, and air or steam stripping operations that treat RCRA substances and have total concentrations of 10 ppm or greater.	Alternatives involving solvent extraction of facility soils will comply with the substantive portions of these regulations if threshold organic concentrations are met.
	RCRA, Air Emission Standards for Equipment Leaks, (40 CFR, 265, Subpart BB)	To Be Determined	Standards for air emissions for equipment that contains or contacts RCRA waste with organic concentrations of at least 10% by weight.	All remedial alternatives which include equipment for treatment of organics will comply with substantive portions of the regulation if the threshold organic concentration is met.
	RCRA, Air Emissions from TSDFs, (40 CFR, Part 265, Subpart CC) (Proposed 56 Fed Reg. 33490-33598, 7/22/91)	To Be Determined	Proposed standards for air emissions from treatment, storage, disposal facilities with VOC concentration equal to or greater than 500 ppm.	Proposed standards will be considered for all remedial alternatives if threshold VOC concentrations are met.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements (Continued)	CAA NAAQS for Particulate Matter (40 CFR 50.6)	To Be Determined	The particulate matter NAAQS specifies maximum primary and secondary 24 hour concentrations for particulate matter in the ambient air. These ambient air concentrations are not designed to apply to specific sources; rather, states may promulgate State Implementation Plan emission limits applicable to sources, which will result in attainment and maintenance of the NAAQS. Connecticut has not promulgated any particulate matter emission limits applicable to this source.	Fugitive dust emissions from site excavation and handling activities will be minimized with dust suppressants, if necessary. These measures should be sufficient to prevent any exceedences in the ambient air of the 150 $\mu g/m^3$ 24 hour primary standard for particulate matter.
	CAA NESHAPS (40 CFR 61 Subpart M (61.145, 61.150, 61.151, 61.154)	To Be Determined	These regulations specify requirements regarding removal, management, and disposal of asbestos.	Handling, treatment, and disposal of soils containing asbestos and building demolition debris containing asbestos must comply with the substantive provisions of these regulations.
State Regulatory Requirements	Connecticut Air Pollution Regulations - Stationary Sources (Sec. 22a-174-3 RCSA)	To Be Determined	Requires that stationary sources of air pollutants meet specified standards prior to construction and operation. Prohibits operation of sources that interfere with attainment of Air Quality Standards.	For alternatives that may result in air emission (i.e., thermal treatment, solvent extraction, capping), and constitute a stationary source, the gas collection and treatment system will be designed to meet substantive standards established under these regulations.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements (Continued)	Connecticut Air Pollution Regulations (Sec. 22a-174-4, 22a-174-5, and 22a-174-7 RCSA)	To Be Determined	These sections specify air emissions monitoring requirements, emissions sampling and analysis methods, and general air pollution control equipment operation requirements.	Operation and monitoring of alternatives that include emission controls systems will be conducted in accordance with the substantive requirements of these regulations.
	Connecticut Air Pollution Regulations - Fugitive Dust Emissions (RCSA 22a-174-18b)	To Be Determined	Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne during demolition and construction activities and material handling operations.	Activities involving building demolition, soil excavation or handling, and cap construction must be conducted in a manner to minimize fugitive dust emissions from the Facility.
	Connecticut Air Pollution Regulations - Incineration (RCSA 22a-174-18c)	To Be Determined	Establishes regulations and emission rates for incinerators.	For alternatives that include thermal treatment, the vapor collection and treatment system will be designed to meet substantive standards established under these regulations.
	Connecticut Air Pollution Controls - Control of Odors (Sec. 22a-174-23 RCSA)	To Be Determined	This regulation prohibits emission of substances that constitute nuisances because of objectional odors. Several compounds have specific concentration limits.	Alternatives that result in the emission of regulated compounds would need to comply with the substantive requirements of the regulation.
	Connecticut Air Pollution Regulations - Hazardous Air Pollutants (RCSA 22a-174-29)	To Be Determined	Establishes testing requirements and allowable concentrations for any stack emission for the constituents listed.	Alternatives that include treatment processes that result in air emissions must include emissions control systems designed and operated to meet the substantive requirements of these regulations.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements	Connecticut Hazardous Waste Site Management Regulations (Sec. 22a-449 (c) - 105, RCSA)	To Be Determined	These regulations outline requirements for the management and disposal of hazardous wastes, and the construction, location, operation, and closure of hazardous waste treatment, storage, and disposal facilities. These regulations incorporate by reference substantial portions of 40 CFR 265 (RCRA).	Alternatives would comply with those portions of the regulations that are more stringent than the corresponding federal RCRA regulations cited herein.
	Connecticut Cleanup Standard Regulations (22a-133 CGS)	To Be Determined	The regulations define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site specific cleanup standards.	Alternatives would comply with portions of these regulations.
	Connecticut Water Quality Standards (issued pursuant to Sec. 22a-426 CGS)	To Be Determined	Establishes designated uses for groundwater and identifies the criteria necessary to support these uses.	Alternatives would comply with water quality standards since actions are taken to minimize further degradation of groundwater.
	Connecticut Hazardous Waste Site Management Regulations (Sec. - 22a-449(c)-105 RCSA)	To Be Determined	These regulations outline requirements for the management and disposal of hazardous wastes, and the construction, location, operation, and closure of hazardous waste treatment, storage, and disposal facilities. These regulations incorporate by reference substantial portions of 40 CFR 264 (RCRA).	Those portions of the regulations that are more stringent than the corresponding federal RCRA regulations cited herein will be complied with.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
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AUTHORITY	REQUIREMENT	STATUS(1)	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements (Continued)	Connecticut Hazardous Waste Management: Land Disposal Restrictions (RCSA 22a-449(c)(108))	To Be Determined	This section incorporates by reference the federal Land Disposal Restrictions (40 CFR 268).	RCRA waste must be treated to attain applicable standards prior to placement in a landfill outside the area of contamination.
	Connecticut Water Quality Standards (Issued Pursuant to Sec. 22a-426 CGS)	To Be Determined	Establishes designated uses for groundwater and surface water and identifies the criteria necessary to support these uses.	Remedial alternatives will be designed to minimize further degradation of groundwater and surface water. If an alternative involves discharge of an aqueous waste stream from soil treatment or dewatering, discharges to surface water will be treated to prevent degradation of surface water.
	Connecticut Discharge of Storm Water (Sec. 22a-430-1 to -8, RCSA; Sec. 22a-430b, 22a-430, CGS)	To Be Determined	These regulations establish permitting and monitoring requirements for discharges to surface water, groundwater, and POTWs.	Alternatives involving discharge of an aqueous waste stream will need to comply with the substantive provisions of these regulations. If the discharge is considered "off-site", permitting requirements will have to be met.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements (Continued)	Connecticut - Discharge of Stormwater Associated with Industrial Activity (Sec. 22a-430-1 to -8, RCSA; Sec. 22a-430b, 22a-430, CGS)	To Be Determined	Establishes permit, monitoring, and reporting requirements for the management and discharge of storm waters.	Alternatives that result in discharge of surface run-off or precipitations will need to comply with the substantive requirements of the regulation.
Criteria, Advisories, Guidance	TSCA PCB Spill Clean-up Policy (40 CFR 761.120-135)	To Be Considered	This policy applies to recent PCB spills and establishes cleanup levels for PCB spills of 50 ppm or greater at 10 ppm for non-restricted access areas and 25 ppm for restricted access areas.	These clean-up levels may be used as guidelines for soil cleanup at the Raymark facility.
	Guidance on Remedial Actions of Superfund Sites with PCB Contamination (EPA/540/G-90/007, Aug. 1990)	To Be Considered	Describes various scenarios and considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve protection of human health and environment.	This guidance will be considered in determining the appropriate level of PCBs that will be left in the soil. Management of PCB contamination residuals will be designed in accordance with the guidance.

TABLE 2-2
POTENTIAL ACTION-SPECIFIC ARARs AND TBÇs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK – SHORE ROAD
STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Criteria, Advisories, Guidance	U.S. EPA Technical Guidance - Final Covers of Hazardous Waste Landfills and Surface Impoundments (EPA/530-SW-89-047)	To Be Considered	Provides technical specifications for the design of multi-layer covers at landfills where hazardous wastes were disposed.	This guidance will be considered in designing any cap and associated systems.
	Proposal for the Connecticut Cleanup Standard Regulations (22a-133K CGS)	To Be Considered	The proposed regulations would define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site specific cleanup standards.	The proposed regulations will be considered in determining soil cleanup standards.

Notes:

1) Determination of the status of the requirement (i.e., applicable, relevant and appropriate, or to be considered) will be made for the individual alternatives and will be indicated on the alternative-specific ARARs tables in Section 4.0.

CGS - Connecticut General Statutes
RCSA - Regulation of Connecticut State Agencies

TABLE 2-3
POTENTIAL LOCATION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Federal Regulatory Requirements	Protection of Wetlands (Executive Order 11990), 40 CFR 6.302(a) and 40 CFR 6, App. A (Policy on Implementing E.O. 11990)	To Be Considered	Federal agencies are required to avoid undertaking or providing assistance for new construction located in wetlands unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.	Removal alternatives that involve excavation or deposition of materials in the lagoon/ wetland system would include all practicable means of minimizing harm to wetlands. Wetlands protection consideration would be incorporated into the planning and decision-making for removal alternatives.
	Floodplain Management (Executive Order 11988, 40 CFR 6.302(b) and 40 CFR 6, App. A (Policy on Implementing E.O. 11988)	To Be Considered	Federal agencies are required to avoid impacts associated with the occupancy and modification of a floodplain and avoid support of floodplain development wherever there is a practicable alternative.	The potential effects on the floodplain will be considered during the development and evaluation of removal alternatives. All practicable measures would be taken to minimize adverse effects on floodplains.
	RCRA Floodplain Restrictions for Hazardous Waste Facilities (40 CFR 264.18(b))	To Be Considered	A hazardous waste facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.	The removal alternatives must ensure that the hazardous waste facilities located in the floodplain would comply with these requirements.
	CWA - Dredge and Fill Regulations (40 CFR 230; 33 CFR 320-330)	To Be Considered	These regulations, also known as the CWA Section 404(b)(i) Guidelines, outline requirements for the discharge of dredged or fill materials into surface waters, including wetlands. Under these requirements, no activity that impacts a wetland shall be permitted if a practicable alternative which would have less adverse impact exists.	Controls would be used to minimize adverse impacts to the wetlands.

TABLE 2-3
POTENTIAL LOCATION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Federal Regulatory Requirements (cont'd)	Fish and Wildlife Coordination Act (16 U.S.C. 661)	To Be Considered	This regulation requires that any Federal agency that proposes to modify a body of water must take action to prevent, mitigate or compensate for project-related losses of fish and wildlife resources.	Controls would be used to minimize adverse impacts to the wetlands. EPA would ensure that losses to fish and wildlife resources are prevented, mitigated or compensated and that the U.S. Fish and Wildlife Service would be consulted.
	Endangered Species Act (16 USC 1531 et seq.; 40 CFR 6.302(h))	To Be Considered	This statute requires that Federal agencies avoid activities which jeopardize threatened or endangered species or adversely modify habitats essential to their survival. Mitigation measures should be considered if a listed species or habitat may be jeopardized.	Construction of the collection and containment systems would be conducted to ensure that any listed species or habitat identified in the area of the site would not be adversely affected.
	An Act Relating to the Preservation of Historical and Archeological Data (16 USC 469a-1)	To Be Considered	This statute requires that, whenever any Federal agency finds or is made aware that its activity in connection with any construction project or federally licensed project, activity or program may cause irreparable loss or destruction of significant scientific, prehistorical, historical, or archeological data, such agency shall undertake the recovery, protection and preservation of such data or notify the Secretary of Interior. The undertaking could include a preliminary survey (or other investigation as needed) and analysis and publication of the reports resulting from such investigation.	If significant scientific, prehistorical, historical, or archeological data are encountered during soil excavation, steps would be implemented to recover, protect and preserve such data.

TABLE 2-3
POTENTIAL LOCATION-SPECIFIC ARARs AND TBCs
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK - SHORE ROAD
STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Federal Regulatory Requirements (cont'd)	Archeological Resources Protection Act (16 USC 470aa-mm, 36 CFR 296, 32 CFR 229, 43 CFR7, and 18 CFR 1312)	To Be Considered	This regulation develops procedures for the protection of archeological resources.	If archeological resources are encountered during soil excavation, they would be reviewed by Federal and State archaeologists. This requirement is applicable to any excavation onsite.
Criteria, Advisories, Guidance	U.S. EPA Memorandum, "Policy on Floodplains and Wetland Assessments for CERCLA Actions" (Aug. 6, 1985)	To Be Considered	This guidance discusses situations that require preparation of a floodplains or wetlands assessment, and the factors which should be considered in preparing an assessment, for response actions undertaken pursuant to section 104 or 106 of CERCLA.	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of floodplains or wetlands.
	Memorandum of Agreement (MOA) between EPA and the U.S. Department of the Army	To Be Considered	This notice provides clarification and general guidance regarding the level of mitigation necessary to demonstrate compliance with the Clean Water Act section 404(b)(1) Guidelines.	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of wetlands.
	Guidance on Flexibility of the 404(b)(1) Guidelines	To Be Considered	This document provides guidance on the flexibility that the U.S. Army Corps of Engineers should be utilizing when making determinations of compliance with the Section 404(b)(1) Guidelines, and guidance on the use of mitigation banks as a means of providing compensatory mitigation for Corps regulatory decisions.	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of wetlands.

2.6 Planned Remedial Activities

40 CFR 300.415(c) mandates that, to the extent practicable, removal actions must contribute to the efficient performance of any anticipated long-term remedial action. EPA has determined that the proposed NTCRA (in conjuction with the institutional controls) will be the final remedy for the Study Area. The Study Area only addresses contaminated fill at the site. Groundwater, river sediments and adjacent wetlands are outside the Study Area and may require treatment at a later date.

The RI/FS process will identify necessary long-term remedial actions for the Study Area. Evaluation of available data indicates that remedial actions will likely be necessary to address groundwater impacted by contaminated fill. Wetland and river sediments contaminated by impacted groundwater and contaminated soil-waste/fill may also require treatment.

The proposed NTCRA to address contaminated fill is consistent with any future long-term remedial actions to address Study Area groundwater or wetland and river sediments. Because the contaminated fill is a concentrated continuing source of contamination to the groundwater, contaminated fill removal in the vicinity of the water table would be a likely first step in any groundwater remediation strategy. Similarly, remediation of wetland and river sediments would first require that contaminated fill migration into the wetland be prevented. The proposed NTCRA will meet these goals.

2.7 Removal Action Schedule

The proposed schedule of activities for selecting the NTCRA is presented below.

ACTIVITY	DATE
Issue Final EE/CA Report	June 30, 1999
Present EE/CA at Public Meeting/Hearing	July 14, 1999
Schedule Public Comment Period	July 15, 1999 - August 16, 1999
Issue Responsiveness Summary	August 7, 1999
Sign Action Memorandum	September 30, 1999

3.0 DEVELOPMENT OF REMOVAL ACTION ALTERNATIVES

This section identifies the general response actions that may be implemented to address the soil-waste/fill contamination present at the Study Area, presents a summary of the evaluation of criteria, identifies the potential technologies and process options for addressing this soil contamination, and identifies the removal action alternatives that will be evaluated in Section 4.0.

3.1 General Response Actions

General Response Actions (GRAs) describe categories of actions that may be taken to satisfy the RAOs for the site. Typically, in developing removal alternatives, combinations of GRAs may be identified to fully address the Response Action Objectives (RAOs, see Section 2.2). The GRAs are media-specific actions that will satisfy the RAOs. A summary of GRAs for this Study Area are shown on Table 3-1. The GRAs identified as applicable for achieving the RAOs for Study Area soils include:

- No action
- Limited action
- Removal
- Disposal

3.2 Screening and Evaluation Criteria

The criteria used to preliminarily screen technology and process options include effectiveness, implementability, and cost. Brief descriptions of the criteria are as follows:

TABLE 3-1
SUMMARY TECHNOLOGIES AND PROCESS OPTIONS
DRAFT FINAL ENGINEERING EVALUATION / COST ANALYSIS
RAYMARK-SHORE ROAD SITE
STRATFORD, CONNECTICUT

General Response Action (GRA)	Technology	Process Option	Description	Comments
No Action	None	Not Applicable	No activities conducted to address contamination.	Eliminated. EPA has determined a removal action is warranted, see Approval Memorandum - Appendix A.
Limited Action	Institutional Controls	Use Restrictions (Deed Restrictions & Local Ordinances)	Implementation of administrative action to restrict recreational use.	Retained for protection of human health. Not protective of ecological receptors. Does not reduce contaminant migration.
	Access Restrictions	Fencing/Signs/ Enforcement	Placement of fencing and posting of warning signs to inform the public of use restrictions and to deter access.	Eliminated. This technology would not reduce exposure to trespassers or ecological receptors and does not address contaminant migration.
	Long-Term Monitoring	Monitoring	Periodic soil and groundwater sampling and analysis to assess potential contaminant migration. Provides information to evaluate existing exposure risks.	Eliminated since it would not reduce existing risk.
Containment	Permeable Cap	Natural Cap	Placement of natural materials (silts, fill, sand, gravel, and/or crushed stone) and stone/rock bedding over contaminated soil to prevent direct contact and minimize erosion/ contaminant migration.	Eliminated due to the potential source of groundwater contamination via rainfall infiltration.
		Multi-Media Cap	Placement of multi-media cap (natural materials and geotextiles) over contaminated soil. Provides greater protection than does natural cap.	Eliminated due to the potential source of groundwater contamination via rainfall infiltration.

TABLE 3-1
SUMMARY TECHNOLOGIES AND PROCESS OPTIONS
DRAFT FINAL ENGINEERING EVALUATION / COST ANALYSIS
RAYMARK-SHORE ROAD SITE
STRATFORD, CONNECTICUT

General Response Action (GRA)	Technology	Process Option	Description	Comments
Containment (Cont'd)	Impermeable Cap	Natural (Clay) Cap	Placement of natural materials (clay) and stone/rock bedding over contaminated soil to prevent direct contact and minimize erosion and contaminant migration.	Eliminated. The use of an impermeable cap is not appropriate due to the potential for frequent flooding of the area which could compromise this option.
		Multi-Media Cap	Placement of multi-media cap (natural material, geomembrane, and bedding material) over contaminated soil to prevent direct contact and minimize erosion and contaminant migration.	Eliminated. The use of an impermeable cap is not appropriate due to the potential for frequent flooding of the area which could compromise this option.
Removal (in combination with Disposal or Treatment and Disposal)	Excavation	Mechanical Excavation	Use of mechanical force to dislodge contaminated soil. Includes backhoe, excavator, scraper, bulldozers.	Retained. Potentially applicable. Erosion control measures may be required.
Disposal	Off-Site Disposal	Off-Site Landfill or TSDF	Transport and disposal of excavated soil at off-site landfill or TSDF licensed to accept the contaminant types detected.	Retained. Potentially applicable.
Treatment (In-Situ)	Chemical Treatment	Oxidation	Injection of treatment reagents into contaminated media to convert the contaminants to a less toxic form through chemical reactions. Reagents are typically chosen for treatment of specific contaminants. Toxic byproducts may form.	Eliminated. Difficult to ensure treatment reagents are thoroughly mixed with contaminated soil. Reagents are not typically suited for treatment of all contaminants present.
	Biological Treatment	Aerobic/Anaerobic Treatment	Biodegradation of contaminants by injection of nutrients and/or organisms into contaminated media. Effective for destruction of VOCs and SVOCs. Ineffective for inorganics.	Eliminated. Difficult to ensure complete mixing of nutrients. Not effective in treating all site contaminants. Lack of nutrients and low temperature may impede degradation process.
	Physical Treatment	Solidification/ Stabilization	Immobilization of soil and contaminants by treatment with reagents to solidify/fix them. Most suitable for treatment of inorganics in a controlled environment.	Eliminated. Solidification/stabilization became unattractive because contaminant quantity is not reduced.

TABLE 3-1
SUMMARY TECHNOLOGIES AND PROCESS OPTIONS
DRAFT FINAL ENGINEERING EVALUATION / COST ANALYSIS
RAYMARK-SHORE ROAD SITE
STRATFORD, CONNECTICUT
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General Response Action (GRA)	Technology	Process Option	Description	Comments
Treatment (Ex-Situ; On-Site) (in combination with Removal and Disposal)	Thermal Treatment	Thermal Desorption	Volatilization of organic contaminants by an externally-fired rotary dryer and removal as a condensed liquid. Proven for treatment of VOCs. Limited applicability to remove SVOCs, and PCBs. Not applicable for inorganics or contaminants with low vapor pressures.	Eliminated: Does not address inorganic contaminants. Would require pilot testing. Aroclor 1262-1268 PCBs were tested during OU1 activities and found to be resilient to thermal treatment.
		Pyrolysis	Pyrolysis of organic contaminants using near infrared radiation. Not effective for treating inorganics. Most applicable to low BTU soils and homogeneous waste streams.	Eliminated. Does not address inorganic contaminants. Not cost effective; simpler processes available to treat contaminants.
		Vitrification	Contaminated soil is melted into a glassy, crystalline monolith using electric current. Applicable to treatment of both inorganics and organics.	Eliminated. Contaminant quantity is not reduced.
	Chemical/Physical Treatment	Soil Washing	Particle-size separation process to reduce volume of materials requiring aggressive treatment. Fraction containing fines is separated from coarse by washing process; fines containing majority of contaminants require additional treatment. Contaminant removal using extractant solution. Solutions used include water, surfactants, acids, and/or oxidizing or reducing agents. Can remove both organics and inorganics in multiple extraction process.	Eliminated. Residual solvents and surfactants may be difficult to remove from treated soil.

TABLE 3-1
SUMMARY TECHNOLOGIES AND PROCESS OPTIONS
DRAFT FINAL ENGINEERING EVALUATION / COST ANALYSIS
RAYMARK-SHORE ROAD SITE
STRATFORD, CONNECTICUT
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General Response Action (GRA)	Technology	Process Option	Description	Comments
Treatment (Ex-Situ; On-Site) (in combination with Removal and Disposal) (Cont'd)	Chemical/Physical Treatment (Cont'd)	Solvent Extraction	Preferential dissolution of contaminants from soil into solvent. Most effective for organic contaminants. Can treat soils in slurry form. Solvent requires further processing or disposal. Treated material requires dewatering prior to disposal.	Eliminated. Residual solvents may be difficult to remove from treated soil. Requires bench-scale testing. Not cost effective; simpler processes available to treat contaminants.
		Wet Air Oxidation	Oxidation of organic and inorganic contaminants in an aqueous reactor using molecular oxygen at elevated temperatures/ pressures. Effectiveness proportional to soil particle size; less effective on large grain sizes and heterogeneous waste streams.	Eliminated. Not effective in treating asbestos.
		Solidification/ Stabilization	Mixing of soil with Portland cement, siliceous materials, lime, and/or proprietary agents, to form a chemically-stable matrix of limited permeability. Most suitable for immobilizing inorganics. Not proven effective for many organic contaminants. May be used for bulking agents to reduce free liquids in dewatered soil.	Eliminated. Contaminant quantity is not reduced.
		Dechlorination	Stripping of chlorine atoms from hazardous halogenated hydrocarbons using alkali metals or alkali metal/polyethylene glycol. Effective for destruction of chlorinated organics, dioxin, and PCBs. Ineffective for treatment of inorganics.	Eliminated. Not effective for treatment of metals. Effective for treatment of PCBs only.
	Biological Treatment	Landfarming	Aerobic biodegradation of contaminants in soil applied to the ground surface and amended with nutrients. Effective for destruction of VOCs. Ineffective for inorganics. Limited effectiveness for PCBs.	Eliminated. Not effective in treating site contaminants.

TABLE 3-1
SUMMARY TECHNOLOGIES AND PROCESS OPTIONS
DRAFT FINAL ENGINEERING EVALUATION / COST ANALYSIS
RAYMARK-SHORE ROAD SITE
STRATFORD, CONNECTICUT
PAGE 5 OF 5

General Response Action (GRA)	Technology	Process Option	Description	Comments
Treatment (Ex-Situ; Off-Site) (in combination with Removal and Disposal)	Thermal/Physical/ Chemical/Biological Treatment	Multiple Processes	Treatment to be determined by off-site disposal facility, as necessary for acceptance in licensed landfill.	Retained. Potentially applicable.

☐ Eliminated on basis of technology screening (see "Comments").

- Effectiveness focuses on the potential ability of the technology and specific process option to handle the estimated areas or volumes of media, the potential impacts to human health and the environment during construction and implementation, and the technical reliability (effectiveness of innovative technologies versus proven technologies) with respect to the contaminants and conditions at the Study Area.

- Implementability encompasses both the technical and institutional feasibility of implementing a process. The preliminary screening of technology types and specific process options was based on an evaluation of technical implementability in order to eliminate options that were clearly ineffective or unworkable at the Study Area.

- Cost plays a limited role in screening process options. Options are evaluated based on relative capital and O&M costs (whether the costs are high, medium, or low relative to the other options in the same technology type). For this preliminary screening, the cost analysis is based on engineering judgment and not on detailed cost estimates. Detailed cost estimates will be prepared during the design phase of the project.

A discussion of the preliminary screening is provided in the following section.

3.3 Identification and Preliminary Screening of Technologies and Process Options

A variety of technologies and specific process options exist for each GRA identified in Section 3.1. A summary of the identification and preliminary screening of technologies and specific process options associated with remediating soil at the site is provided in Table 3-1. Many options are eliminated based on technology screening alone. These eliminated options are shown on Table 3-1 in the shaded areas. Table 3-1 also presents the results of the screening and recommended action, i.e. eliminating or retaining the alternative for further evaluation. These technologies were identified and screened for similar areas in Stratford, in the vicinity of the Study Area, that had also received Raymark soil-waste. This evaluation of technologies and specific process options is presented in the report entitled "Draft Technical Memorandum, Preliminary Screening of Remedial Options," Raymark-OU3, 1999. The technologies and process options in the report address soil-waste/fill contaminated with asbestos, lead, PCBs, and dioxins. Technologies that were retained include limited action, containment, removal (excavation), and treatment (in combination with removal and disposal). The evaluation detailed in the report included development of relative costs. Excavation was identified as the recommended alternative for addressing contaminated soil. Since the media and contaminants evaluated in the Study Area are similar, the excavation recommendation was retained. Technologies retained for further evaluation were combined into the removal alternatives that are evaluated in Section 4.0.

Many options are eliminated based on technology screening alone. These eliminated options are shown on Table 3-1 in the shaded areas. Table 3-1 also presents the results of the screening and recommended action, i.e. eliminating or retaining the alternative for further evaluation. Technologies retained for further evaluation were combined into the removal alternatives that are evaluated in Section 4.0.

3.4 Preliminary Technology Screening Summary

As shown in Table 3-1, most of the technologies were eliminated due to ineffectiveness. The technologies and process options for soil remediation that have been retained for further consideration are as follows:

- Limited Action - Deed Restrictions
- Removal - Excavation and Temporary Storage at an In-Town Location
- Disposal at an Out-of-Town location

The limited action alternative (deed restrictions) is included in the potential alternatives; it is not considered alone. This is appropriate since each proposed alternative is likely to leave contamination above action levels behind. The excavation alternative was evaluated as three alternatives, each with two options that include different approaches to the disposition of excavated material. Alternatives 1 and 2 were developed to specifically address the "direct exposure" criteria. Connecticut defines "inaccessible soil" as soil that is 4 feet below ground surface (bgs) in an unpaved area, and 2 feet bgs in a paved area. Alternative 3 was developed to meet the CTDEP's pollutant mobility criteria, which, for a GB aquifer, requires contamination to be removed to the mean high water table (5.5 feet bgs) for the Study Area in order to eliminate the source of continued groundwater contamination.

These GRAs were combined into three potential removal alternatives: excavation of 2 or 4 feet of soil-waste/fill (depending on existing site conditions) and site restoration; excavation of 2 feet of soil-waste/fill and paving of entire Study Area and site restoration; and excavation to a 5.5 foot depth and site restoration. Each of these three alternatives involves excavation and includes two cost options: one for in-town temporary storage (ultimately to be finally disposed of in-town; costs to be borne in the disposal area cost estimate), and one for out-of-town disposal (transfer out-of-town for disposal, no temporary in-town storage, costs included in this cost estimate).

These alternatives are evaluated in detail in Section 4.0. Two cost estimates were generated for each of the three excavation options. One for temporary storage of excavated soil-waste/fill at an in-town's location (no final disposal costs included), and a second cost estimate for out-of-town disposal for excavated soil-waste/fill (final disposal costs only included). Relative costs and a detailed list of assumptions for each remedial option are included in Appendix E.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives provides information to facilitate selection of a specific removal treatment option. This analysis was developed in accordance with the EPA *Guidance on Conducting Non-Time-Critical Removal Actions (NTCRAs) under CERCLA* (EPA/540-R-93). Section 4.1 describes the development of the removal action alternatives. Section 4.2 provides an overview of the evaluation criteria used in the detailed analysis. Section 4.3 provides a detailed description and evaluation of each removal alternative. Section 4.4 compares each alternative to another. Section 4.5 presents the recommended alternative.

4.1 Development of Removal Action Alternatives

Removal alternatives were developed for the Study Area by combining the technologies retained in the screening discussed in Section 3.3. The three alternatives developed combine the same GRAs, but include different removal approaches to provide a range of alternatives.

The first alternative evaluated involves excavation to 4 feet bgs in unpaved areas, and to 2 feet bgs in paved areas and restoring the site to preconstruction conditions (see Section 4.3.1). The second alternative evaluated involves excavation to 2 feet bgs across the site, while paving the entire site during restoration (see Section 4.3.2). The third alternative involves excavation to 5.5 feet bgs across the site and restoring the site to preconstruction conditions (see Section 4.3.3). Costs were estimated for temporary storage of the excavated material at an in-town location; and off-site disposal only for the out-of-town location.

4.2 Alternatives Evaluation Criteria

In conformance with the NTCRA guidance document, the following three criteria and their components were used to evaluate each alternative during the detailed analysis:

1. Effectiveness

   - Overall Protection of Human Health and the Environment
   - Compliance with ARARs
   - Reduction of Toxicity, Mobility, or Volume Through Treatment
   - Short-Term Effectiveness
   - Long-Term Effectiveness and Permanence

2. Implementability

   - Technical Feasibility
   - Administrative Feasibility
   - Availability of Services and Materials
   - State Acceptance
   - Community Acceptance

3. Cost

   - Direct and Indirect Capital Costs
   - Annual Post-Removal Site Control Costs
   - Present Worth

Brief discussions of these evaluation criteria, as described in the NTCRA guidance document, are presented in the following subsections.

4.2.1 Effectiveness

This criterion focuses on the alternative's ability to meet the removal action objectives within the scope of the removal action. Each alternative is evaluated against the scope of the removal action and against each specific objective for final disposition of the wastes and the level of cleanup desired. These objectives are discussed in terms of protectiveness of human health and the environment.

4.2.1.1 Overall Protection of Human Health and the Environment

The evaluation of overall protection of human health and the environment assesses the ability of the alternative to eliminate, reduce, or control current and potential future risks to human and ecological receptors. The evaluation draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

The evaluation focuses on how each alternative achieves protection and describes how the alternative will reduce, control, or eliminate risks at the site through the use of treatment, engineering, or institutional controls. This evaluation identifies any unacceptable short-term impacts.

4.2.1.2 Compliance with ARARs

This criterion assesses whether the alternatives comply with ARARs under federal environmental laws, and state environmental or facility siting laws. NTCRA alternatives must comply with ARARs to the extent practicable.

The detailed analysis summarizes which requirements are applicable or relevant and appropriate to an alternative and describe how the alternative meets those requirements.

4.2.1.3 Reduction of Toxicity, Mobility, or Volume Through Treatment

This evaluation assesses the degree to which alternatives employ treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site. Factors considered, as appropriate, include:

- The treatment processes the alternatives employ and materials they treat.

- The amount of hazardous materials that will be destroyed or treated.

- The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment.

- The degree to which the treatment is irreversible.

- The type and quantity of residuals that will remain following treatment.

- Whether the alternative will satisfy the preference for treatment.

4.2.1.4 Short-Term Effectiveness

This criterion addresses the effects of the alternative on human health and the environment during implementation. The short-term impacts of the alternatives are assessed considering:

- Short-term risks that might be posed to the community during implementation of an alternative.

- Potential impacts on workers during the removal action and the effectiveness and reliability of protective measures that would be taken.

- Potential environmental impacts of the removal action and the effectiveness and reliability of mitigative measures during implementation.

- Time until protection is achieved.

4.2.1.5 Long-Term Effectiveness and Permanence

This evaluation assesses the long-term effectiveness of the alternative, its contribution to future remedial actions at the site, and the degree of certainty that the alternative will prove successful. The following components are considered for each alternative:

- The magnitude of residual risk remaining from untreated wastes or treatment residuals remaining at the conclusion of the site activities. This criterion also evaluates whether the alternative contributes to future remedial objectives. This evaluation focuses on the alternative's effectiveness and consistency with any future remedial actions.

- Adequacy and reliability of controls that are necessary to manage untreated wastes or treatment residuals remaining at the conclusion of the site activities.

4.2.2 Implementability

The implementability criterion assesses the ease or difficulty of implementing the alternatives by considering, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, the ease of undertaking additional response actions, the ability to monitor the effectiveness of the remedy, and the extent to which the removal action contributes to the efficient performance of any long-term remedial action.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies, the ability to obtain necessary approvals and permits from other agencies (for off-site actions), and compliance with statutory limits on removal actions.

- Availability of services and materials, including the availability of adequate off-site treatment, temporary storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; and the availability of prospective technologies for full-scale application.

- State acceptance and assessment of state concerns will not be completed until comments on the EE/CA are received. The State of Connecticut is providing input to this EE/CA and the recommended removal action.

- Community acceptance will not be evaluated in the EE/CA. Community concerns will be assessed following receipt of public comments on the Final EE/CA. Community acceptance and concerns will be considered in the final selection of the removal action.

4.2.3 Cost

The types of costs that will be assessed include the following:

- Capital costs, including both direct and indirect costs.

- Annual costs, which include operations and maintenance, materials and energy monitoring, residual disposal, and post-removal site control costs.

- Net present worth of capital and post-removal site control costs for the duration of the operating period, based on a 7 percent discount rate.

4.3 Individual Analysis of Removal Action Alternatives

Three removal alternatives were developed to address the lead, asbestos, dioxin, and PCB contaminated soil-waste/fill present at the Study Area. Detailed descriptions and evaluations of each alternative using the criteria described in Section 4.2 are presented in this section. To minimize repetition, identical components are described in detail in Alternative 1 and are referenced thereafter. The state and community acceptance criteria will be further addressed following the receipt of comments during the public comment period. Summary of the costs are presented on Table 4-1.

4.3.1 Alternative 1 – Excavation (2 feet for paved areas and 4 feet for unpaved areas) and Site Restoration

This section includes a description of the conceptual design and the detailed analysis of Alternative 1.

4.3.1.1 Detailed Description of Alternative 1

This alternative was developed to remove soil-waste/fill impacted with lead, asbestos, PCBs, and dioxins from the Study Area. Contaminant removal would be accomplished by excavating the entire area that exceeds any one of the soil action levels (greater than 400 ppm lead, greater than 1 percent asbestos, greater than 1 ppm PCBs, or greater than or equal to 1 TEQ). Figure 4-1 shows the proposed limits of excavation. Excavated material would be transported to an in-town location for storage (Option 1) or out-of-town disposal (Option 2). Clean fill would be imported to be used as backfill material to restore all areas to their original elevations. Restoration activities would include returning the Study Area to its pre-excavation condition (including rip rap on the slopes abutting the river) and reinstalling new utilities. Actual Study Area and final grade restoration would be subject to negotiation, and included as part of any post-remediation plan. For the purposes of this document and cost estimation, pre-excavation elevations and conditions were assumed for site restoration activities. Finally, at the completion of these activities institutional controls would be implemented to restrict future use of the Study Area and limit human contact with contamination that may be left in place.

TABLE 4-1
COST ESTIMATE SUMMARY
DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
RAYMARK- SHORE ROAD, STRATFORD, CONNECTICUT

Alternative	Description	Capital Costs	O&M Costs	Present Worth
1	Excavation (4' in unpaved areas/2' in paved areas) and Site Restoration			
	Option 1 ˜ In-Town Storage	$3,717,736	$24,783	$3,819,351
	Option 2 ˜ Out-of-Town Disposal	$68,438,089	$16,154	$68,504,323
2	Excavation (2' over entire Study Area) and Paving			
	Option 1 ˜ In-Town Storage	$2,890,076	$24,783	$2,991,690
	Option 2 ˜ Out-of-Town Disposal	$38,965,399	$16,154	$39,031,633
3	Excavation to 5.5 Foot Depth (Mean High Water Table) and Site Restoration			
	Option 1 ˜ In-Town Storage	$5,187,179	$24,783	$5,288,793
	Option 2 ˜ Out-of-Town Disposal	$104,807,210	$16,154	$104,873,444

Excavation, Transport, and Disposal

It has been estimated that the excavation of contaminated material would encompass an area of 170,400 square feet, of which 36,500 square feet is currently paved. Pursuant to Connecticut regulations, paved areas would be excavated to a depth of 2 feet below grade, and unpaved areas to 4 feet below grade. These excavation depths satisfy the State of Connecticut regulatory requirements for direct exposure criteria and do not comply with the State of Connecticut regulatory requirements for pollutant mobility criteria. The estimated volume of soil that would be excavated, transported, and stored is 22,600 cubic yards. Using a bulking factor of 1.15 to account for compaction, it was estimated that 26,000 cubic yards of clean fill would be needed to restore the site to its previous elevation.

To facilitate removing the Boat Club's embankment abutting the Housatonic River and minimizing contaminant transport into the river, a barrier would be required along the eastern slope of the Housatonic Boat Club, from the boat crane approximately 300 feet south. For the purposes of cost-estimation, sheet piling was included in the analysis of the alternatives. Other alternatives may be more economical or feasible. It is anticipated that soils would be removed to a distance of 30 feet beyond the top of the existing parking lot wall, where the toe of the rip rap bank meets the riverbed. Sheet piling would be extracted and salvaged on completion of backfilling activities, and riprap placed on the embankment to provide slope stability. In areas along the Housatonic River shoreline, where sheet piling would not be required, erosion and sedimentation controls would be implemented.

Excavation activities would also include removing a concrete wall along the shoulder of Shore Road bordering the wetlands, removing timber cribbing beneath the boat crane at the north end of the boat club property, and closing the on-site sewerage system. The concrete blocks would be moved across the Study Area with excavating equipment and used to rebuild the cribbing at the base of the boat crane. Construction debris, including surplus concrete blocks, removed asphalt, and concrete, would also be disposed with the contaminated soil-waste/fill.

For Option 1, excavated contaminated soil-waste/fill would be loaded onto dump trucks and transported to an in-town location for temporary storage. Excavated material would be stored in a temporary cell to be designed and constructed as part of Alternative 1. A decision on where to build the storage cell would be based on the availability and location of the in-town property. For the purpose of cost-estimation under this EE/CA, it was assumed that a storage cell would be a 400 foot long, 88 foot wide stressed membrane structure designed to house 26,000 cubic yards of contaminated soil-waste/fill. The structure would consist of a series of extruded aluminum arches, integrally connected to an outer membrane of PVC coated polyester scrim. The floor would be made with an impermeable geotextile membrane to prevent contamination of the in-town location property. No assessment of the conditions at an in-town location was made under this EE/CA.

For Option 2, excavated contaminated soil-waste/fill would be loaded onto dump trucks and transported to an out-of-town location for disposal. No in-town storage or disposal is contemplated under Option 2.

Site Restoration

For both options, once contaminated soil-waste/fill is removed, restoration activities would include backfilling the excavation to agreed upon elevations, repaving Shore Road and the parking area at the north end of the Study Area, reseeding lawn areas, planting trees and shrubs, restoring the gravel surface at the center of the Study Area, re-installing a chain-link fence around the perimeter of the Study Area, rebuilding sidewalks, replacing rip rap at the shoreline, replacing the timber cribbing, and reinstalling the utilities at the boathouse. Site restoration would generally include returning the Study Area to its pre-excavation condition.

Approximately 1,350 linear feet of Shore Road and 6,400 square feet of pavement would be removed and replaced under Alternative 1. For the purpose of cost-estimation, reconstruction of Shore Road includes a 12-inch crushed stone base and 3-inch binder course topped by a 1-inch thick wearing course. Actual reconstruction will be consistent with Town of Stratford specifications. All other paved areas would be restored to a 6-inch stone base and 2-inch binder course with a 1-inch topping.

All landscaped areas would be returned to their pre-construction state. Lawns would be reseeded, and any trees or shrubs removed during excavation would be replanted to create a neatly landscaped configuration. The hard-packed gravel surfaces that make up the driveway and parking lot at the center of the Study Area would be restored and covered with a 6-inch layer of ¾-inch stone. All sidewalks would be rebuilt with a 6-inch stone base and 2-inch thick layer of concrete. Site restoration activities will comply with local building codes or existing conditions.

Approximately 800 linear feet of 6-foot high industrial chain-link fence would be installed along the inland boundary of Study Area. A 12-foot wide sliding gate would be installed at the entrance of the Study Area near Shore Road for automobile access, and a 3-foot wide swinging gate installed for individual access. The piling/rope fence that bounds the driveway and some other paved areas would also be replaced with an equivalent structure.

Restoration of the shoreline areas of the Study Area would involve a number of additional activities. The rip rap material present along the shoreline at the southern end of the site would be replaced with 360 tons of new rip rap that would be put in place using excavating equipment. The concrete blocks that had been part of the wall along the wetlands area would be moved to the opposite end of the Study Area and serve as replacement for the timber cribbing at the base of the boat crane.

Utilities Replacement

Once excavated contaminated soil-waste/fill is removed, to restore the Housatonic Boat Club to full operation the electric service, water, and sewer lines would be reworked. It is anticipated that 10 power poles would be removed during the excavation process. All would be replaced during site restoration, connecting the boat club to the power lines along Shore Road. Utility pipe trenching would run west from the boat club to the edge of Shore Road, then along Shore Road to the existing water and sewer hookups southwest of the site. Trenching would extend to 4.5 – 5 feet below ground surface to ensure 4 feet of clean cover above the new utilities to protect them from freezing. Each line would be approximately 1,100 feet long. Water pipes are expected to be 1-inch diameter copper pipe. The sewer system would be powered by an Environment One model GP 2014-129 grinder pump discharging into a 1½-inch diameter PVC pipe. Four-inch diameter PVC pipe would be used as a containment sleeve for the sewerage piping. An alarm/disconnect panel would be installed to enable electrical disconnect in the case of emergency.

Institutional Controls

Institutional controls would be implemented for all alternatives and options at the Study Area to restrict future activities and limit human contact with contaminants left in place. These controls would likely be deed restrictions limiting future excavation at the Study Area and prohibiting the use of the groundwater as a drinking water supply.

4.3.1.2 Detailed Analysis of Alternative 1

This section provides the detailed evaluation of Alternative 1 using the criteria described in Section 3.2.

Effectiveness

Alternative 1 would meet the overall goals of the NTCRA since removal objectives would be met.

Overall Protection of Human Health and the Environment – A risk assessment has been performed to identify the areas of the Study Area that provide the greatest current and potential risks to human health and the environment. The excavation of contaminated soil-waste/fill under Alternative 1 would reduce the potential human health and ecological risks from direct contact, incidental ingestion, or inhalation of the COCs, while decreasing the volume of material that could leach into the groundwater or Housatonic River.

This alternative would reduce the volume of contamination present at the Study Area by removing contaminated soil-waste/fill within the boundaries of the high-risk area and backfilling the excavation with clean fill. The contaminants remaining in the soils following excavation would provide minimal risk to human health and the environment via direct contact with contaminants.

For Option 1, steps would be taken to reduce the mobility of contaminants once they were relocated to an in-town storage location. The soil-waste/fill would be stockpiled prior to final disposal at an in-town location. The stockpile would be covered to prevent migration of contaminants via precipitation and runoff. Adequate controls would be instituted to minimize fugitive dust emissions from the contaminated stockpile.

For Option 2, excavated contaminants would be transported to an out-of-town location in compliance with all appropriate regulations.

Compliance with ARARs – The proposed ARARs, which must be complied with during this removal action, are shown on Tables 4-2a, b, and c. Final ARARs are subject to agreement between EPA and CTDEP.

TABLE 4-2a
CHEMICAL-SPECIFIC ARARs AND TBCs
EXCAVATION
DRAFT FINAL ENGINEERING EVALUATION AND COST ANALYSIS
RAYMARK-SHORE ROAD, STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION
Criteria, Advisories, and Guidance	EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic effects of exposure to toxic substances.	EPA RfDs will be used to assess health risks due to exposure to noncarcinogenic contaminants present at the site.
	EPA Carcinogen Assessment Group Potency Factors	To Be Considered	EPA Carcinogenic Potency Factors (CPFs) are used to compute the individual incremental cancer risk resulting from exposure to carcinogens.	CPFs were used to assess health risks due to exposure to carcinogens present at the site.
	Guidance on Remedial Actions at Superfund Sites with PCB Contamination (EPA/540/G-90/007, August 1990)	To Be Considered	Describes various scenarios and considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve protection of human health and the environment.	This guidance was considered in determining the appropriate level of PCBs that may be left in the soil.
	Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to assessing risks associated with adult exposures to lead in soil.	To Be Considered	This report describes a methodology for assessing risks associated with non-residential adult exposures to lead in soil.	This report was considered in the assessment of human health risks from lead exposure.

TABLE 4-2b
ACTION-SPECIFIC ARARs AND TBCs
EXCAVATION
DRAFT FINAL ENGINEERING EVALUATION AND COST ANALYSIS
RAYMARK-SHORE ROAD, STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements	TSCA - PCB Storage and Disposal (40 CFR 761.60, .65, .75, .79)	Applicable	This regulation establishes standards for the storage, disposal, and incineration of PCBs at a concentration greater than 50 ppm.	This would comply with the exception of certain landfill requirements which would be waived under TSCA. Site would be covered, not capped, after excavation.
	CAA NESHAPS (40 CFR 61 Subpart M (61.1, 61.151) Subpart M, 61.145, 61.150, 61.154	Applicable Relevant and Appropriate	These regulations specify requirements regarding removal, management, and disposal of asbestos.	Handling and disposal of soils containing asbestos would comply with the substantive provisions of these regulations.
	RCRA - General Facility Standards (Sec. 22a-449(c) - 104, RCSA, incorporating 40 CFR 264.10 - 264.18)	Applicable	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Removal actions conducted would be constructed and operated in accordance with the substantive provisions of this requirement.
	CAA NAAQS for Particulate Matter (40 CFR 50.6)	To Be Considered	The particulate matter NAAQS specifies maximum primary and secondary 24-hour concentrations for particulate matter in the ambient air. These ambient air concentrations are not designed to apply to specific sources; rather, states may promulgate State Implementation Plan emission limits applicable to sources, which would result in attainment and maintenance of the NAAQS. Connecticut has not promulgated any particulate matter emission limits applicable to this source.	Fugitive dust emissions from soil-waste handling activities would be minimized with temporary enclosures and dust suppressants, if necessary. These measures should be sufficient to prevent any exceedances in the ambient air of the 150 ug/m^3 24-hour primary standard for particulate matter.

TABLE 4-2b
ACTION-SPECIFIC ARARs AND TBCs
EXCAVATION
DRAFT FINAL ENGINEERING EVALUATION AND COST ANALYSIS
RAYMARK-SHORE ROAD, STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements	RCRA - Preparedness and Prevention (Sec. 22a-449(c) - 104, RCSA, incorporating 40 CFR 264.30 - 264.37)	Applicable	Outlines requirements for safety equipment and spill control.	Safety and communication equipment would be maintained at the site and local authorities would be familiarized with the site operations, in accordance with the substantive provisions of these requirements.
	RCRA - Contingency Plan and Emergency Procedures (Sec. 22a-449(c) - 104, RCSA, incorporating 40 CFR 264.50 - 264.56)	Applicable	Outlines requirements for emergency procedures to be used following explosions, fires, etc.	Contingency plans would be developed and response activities would be implemented in accordance with the substantive provisions of these requirements.
	RCRA - Closure and Post-Closure (Sec. 22a-449(c) - 104, RCSA, incorporating 40 CFR 264.110 - 264.120)	Applicable	Details requirements for closure and post-closure of hazardous waste facilities.	Removal actions implemented under this alternative would be designed to meet the substantive provisions of this requirement.
	RCRA - Closure of Landfills (Sec. 22a-449(c)-104,RCSA, incorporating 40 CFR 264.310)	Applicable (except for 40 CFR 264.310(b)(2)	Includes requirements for the closure and post-closure of landfills.	This would comply since a final cover would be designed and constructed to meet the ARAR. Site would be covered, not capped.
	Disposition of PCBs (22a-467 CGS)	Applicable	This section requires that PCBs be disposed under a permit issued by the Commissioner or with written approval of the Commissioner in a manner not inconsistent with the federal Toxic Substances Control Act (40 CFR 761).	The disposal of PCB contaminated soil will comply with the substantive provisions of this section.
	Well Drilling and Abandonment (Sec. 25-128-44 to 64, RCSA)	Applicable	These regulations apply to the drilling and abandonment of wells.	Any wells that are closed as part of the removal action [illegible] be closed in accordance with the substantive provisions of these regulations.

TABLE 4-2b
ACTION-SPECIFIC ARARs AND TBCs
EXCAVATION
DRAFT FINAL ENGINEERING EVALUATION AND COST ANALYSIS
RAYMARK-SHORE ROAD, STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements Cont'd	Connecticut Remediation Standard Regulations (22a-133k CGS)	Applicable	The regulations define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site-specific cleanup standards.	The excavation alternative would meet these regulations.
	Connecticut Air Pollution Regulations - Fugitive Dust Emissions (RCSA 22a-174-18b)	Applicable	Requires that reasonable precautions to be taken to prevent particulate matter from becoming airborne during demolition and construction activities and material handling operations	Activities involving soil excavation or handling, and cover construction would be conducted in a manner to minimize fugitive dust emissions.
	TSCA PCB Spill Clean-up Policy (40 CFR 761.120-135)	Relevant and Appropriate	This policy applies to recent PCB spills and establishes cleanup levels for PCB spills of 50 ppm or greater at 10 ppm for non-restricted access areas and 25 ppm for restricted access areas.	The excavation alternative would meet these regulations.
Criteria, Advisories, Guidance	U.S. EPA Technical Guidance - Final Covers of Hazardous Waste Landfills and Surface Impoundments (EPA/530-SW-89-047)	To Be Considered	Provides technical specifications for the design of multi-layer covers at landfills where hazardous wastes were disposed.	This guidance would be considered in the design of the cover and associated systems after excavation.

TABLE 4-2c
LOCATION-SPECIFIC ARARs AND TBCs
EXCAVATION
DRAFT FINAL ENGINEERING EVALUATION AND COST ANALYSIS
RAYMARK-SHORE ROAD, STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements	RCRA - Floodplain Restriction for Solid Waste Disposal Facilities and Practices (40 CFR 257.3-1)	Applicable	Solid waste practices must not restrict the flow of a 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste, so as to pose a hazard to human life, wildlife, or land or water resources.	This would apply because the site is in the flood plain.
	Floodplain Executive Order (EO 11988) Statement of Procedures on Floodplain Management and Wetlands Protection, (40 CFR Part 6, Appendix A)	Applicable	Under this order, federal agencies are required to reduce the risk of flood loss, minimize the impact of floods, and to restore and preserve the natural and beneficial value of floodplains.	The potential effects on the floodplain will be considered during the development and evaluation of excavation alternatives. All practicable measures will be taken to minimize adverse effects on floodplains.
	RCRA - Floodplain Restrictions for Hazardous Waste Facilities (40 CFR 264.18 (b))	Applicable	A hazardous waste facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.	This ensures that any proposed hazardous waste facility located in the portion of the site which is in the floodplain will comply with these requirements.
Criteria, Advisories, Guidance	U.S. EPA Memorandum, "Policy on Flood plains and Wetland Assessments for CERCLA Actions" (Aug. 6, 1985)	To Be Considered	This guidance discusses situations that require preparation of a floodplains or wetlands assessment, and the factors which should be considered in preparing an assessment, for response actions undertaken pursuant to section 104 or 106 of CERCLA	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of floodplains or wetlands.
State Regulatory Requirements	Tidal Wetlands (Sec. 22a-30-1 to 17 RCSA)	Applicable	These regulations govern activities in tidal wetlands.	Removal actions that impact tidal wetlands will be constructed and operated in accordance with the substantive provisions of these regulations.

TABLE 4-2c
CHEMICAL-SPECIFIC ARARs AND TBCs
EXCAVATION
DRAFT FINAL ENGINEERING EVALUATION AND COST ANALYSIS
RAYMARK-SHORE ROAD, STRATFORD, CONNECTICUT
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AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION
State Regulatory Requirements	Coastal Management Act (Sec. 22a-90 to 112 CGS)	Applicable	This establishes Connecticut's coastal zone policies.	The removal action will be consistent with the substantive portions of applicable coastal management policies.

This discussion focuses on CTDEP's remediation standard regulations, Section 22a-133. The remediation standard regulations require polluted soil to be remediated to a concentration that meets direct exposure criteria, and pollutant mobility criteria. Based on contaminant concentrations at the Study Area, the direct exposure criteria require excavation to 4 feet bgs if the surface is unpaved, or excavation to 2 feet bgs if the surface is paved. These criteria are applicable when land use restrictions are implemented to limit access to the subsurface soils. Without land use restrictions, polluted soil must be removed to 15 feet bgs. Alternative 1 would comply with the direct exposure criteria.

The objective of pollutant mobility criteria is to eliminate the source of continued groundwater contamination. These criteria require remediation/removal of soil to the mean high water table since the Study Area is located in a GB groundwater area. Since the Study Area borders the Housatonic River and groundwater is tidally influenced, excavation to the mean low water table is not practicable. The mean high water table has been estimated to be 5.5 feet bgs. Therefore, since Alternative 1 only excavates to depths of 2 or 4 ft bgs, Alternative 1 would not meet the pollutant mobility criteria.

Other known applicable ARARs include wetland and floodplain restrictions and fugitive dust emissions. All other ARARs presented in Tables 4-2a, b, and c will be considered for compliance or partial compliance.

Reduction of Toxicity, Mobility, or Volume Through Treatment - Alternative 1 would not satisfy the NCP preference for treatment since the contaminated soil-waste/fill to be removed would simply be transported off site to an in-town storage location or disposed of at an out-of-town location. There would be no treatment or destruction of hazardous materials.

Short-Term Effectiveness – For both options, implementation of Alternative 1 would not pose significant risks to the local community or to workers. During excavation and site restoration activities, engineering controls would be instituted to minimize noise and fugitive dust concerns. Workers would be protected from risks (exposure to lead, asbestos, PCBs, dioxins, and other contaminants) through the use of appropriate personal protective equipment (PPE) and implementation of proper safety practices.

No adverse impact to the environment is anticipated during implementation of this alternative. Engineering controls including installation of erosion and sedimentation controls along the shoreline and installation of sheet piles along the eastern slope of the Housatonic Boat Club would be used during excavation to prevent impacts to the Housatonic River and the wetlands adjacent to Study Area.

For Option 1, following the excavation and transport of contaminated soil-waste/fill from the Study Area, materials would be stored at an in-town location. The temporary storage cell would be designed to control the spread of contaminants from the stockpile to the air, water, and soil. Finally, the Study Area would be backfilled with clean material and surface conditions restored, reducing the threat of human exposure to residual contamination left at Study Area.

For Option 2, excavated contaminated soil-waste/fill would be loaded onto dump trucks and transported to an out-of-town location for disposal.

Some increase in heavy vehicle (dump trucks, excavator) traffic into and out of the Study Area would be expected during construction. Vehicular access into the Study Area would be via Shore Road, which might cause some inconvenience to local residents or patrons of the Shakespeare Theater. Traffic controls would be implemented as needed to minimize inconvenience. The Housatonic Boat Club would be shut down, with boats removed and stored off site for the duration of the construction period.

An increase in noise levels during the construction process would be anticipated. Efforts would be made to minimize the potential impact to the local community by working during regular hours and coordinating with the nearby residents.

Long-Term Effectiveness – Excavation and either in-town storage or out-of-town disposal of contaminated soil-waste/fill would significantly reduce the volume of contaminants at the Study Area, minimizing future risks to human health and the environment. Some contamination that is present below the depth of excavation would remain after the removal action, and could pose risks in the long term.

As discussed above, Alternative 1 would comply with the direct exposure criteria. The excavation depths specified in this alternative are 4 feet bgs for existing unpaved areas and 2 feet bgs for existing paved areas. Therefore, it is assumed that residual risks posed by human contact with contaminants left at the Study Area would be minimal. It is assumed that Alternative 1 would be effective in the long term because 2 foot excavation in paved areas and 4 foot excavation in unpaved areas would effectively prevent human contact, and effectively minimize migration of contaminants into the surficial aquifer.

The reliability of this alternative is high, provided that institutional controls are implemented to restrict future excavation at the Study Area. Any residual contamination would remain "inaccessible" as long as the clean fill overlying it remained undisturbed.

Implementability

Alternative 1 is implementable. No technical difficulties or uncertainties are anticipated in excavating, transporting and storing soil-waste/fill, backfilling, or restoring the Study Area to its previous surface condition. Many companies exist with the trained personnel, equipment, and materials to perform the proposed removal action. The technologies are proven and are available for full-scale application.

All necessary approvals and permits should be able to be obtained from the appropriate agencies. Proper service and materials are available to implement this alternative, including adequate space for safe storage of excavated material. Two elements of uncertainty are the decisions of where to locate the in-town storage and/or disposal areas.

Cost

The costs for Alternative 1 are presented on Table 4-1 and detailed in Appendix E.

4.3.2 Alternative 2 – Excavation (2 feet for entire site) and Paving Areas Previously Unpaved

This section includes a description of the conceptual design and a detailed analysis of Alternative 2. Alternative 2 is similar to Alternative 1, and will be described in terms of its similarities to and differences from Alternative 1.

4.3.2.1 Detailed Description of Alternative 2

The surface area of excavation would be the same as for Alternative 1, but all areas would be excavated only to a depth of 2 feet below grade. Excavated materials would be transported to an in-town location for temporary storage (Option 1) or out-of-town disposal (Option 2). Subsequent to the removal of contaminated materials, the entire area would be backfilled and compacted with clean fill to restore all areas to their original elevations, then covered with a layer of pavement, except for shore line banking, which would be replaced with a rip rap cover as detailed in Alternative 1. Finally, utilities would also be reworked as in Alternative 1, and similar institutional controls would be implemented.

Excavation, Transport, and Disposal

It was previously estimated that the excavation of contaminated materials at the Study Area would encompass an area of 170,800 square feet. Alternative 2 would require an excavated depth of 2 feet below grade throughout this area, resulting in a volume of approximately 12,700 cubic yards of excavated material. Roughly 14,600 cubic yards of clean fill would be needed to restore the Study Area to its original elevation. As described in Alternative 1, a 300-foot length of sheet piles would still be necessary to facilitate excavating embankment soils to a distance of 30 feet into the river. Also, in areas where sheet piling would not be required, erosion and sedimentation controls would be implemented.

As in Alternative 1, Alternative 2 would require removal of the concrete wall bordering the wetlands area and reuse of the concrete blocks under the boat crane. The timber cribbing beneath the boat crane and septic system at the Housatonic Boat Club would also require demolition. Construction debris would also be disposed of with the contaminated soil-waste/fill.

As in Alternative 1, contaminated material excavated under Alternative 2 would be removed by dump trucks for in-town storage (Option 1) or out-of-town disposal (Option 2).

Paving

The most significant difference between Alternatives 1 and 2 is in the post-excavation activities at the Study Area. Under Alternative 2, any excavated area would be paved (to a 6-inch stone base and 2-inch binder course with a 1-inch wearing course) rather than restored to existing site conditions as in Alternative 1. Any trees at the site would be removed. All shore line excavated areas would be backfilled with rip rap material similar to activities under Alternative 1.

The chain-link fence would be replaced, and the concrete blocks would be used to replace the timber cribbing under the boat crane.

Utilities Replacement

For both options, the utility work conducted under Alternative 2 would be identical to that described in Alternative 1.

Institutional Controls

For both options, institutional controls for Alternative 2 would be the same as those proposed for Alternative 1.

4.3.2.2 Detailed Analysis of Alternative 2

This section provides the detailed evaluation of Alternative 2 using the criteria described in Section 3.2.

Effectiveness

For both options, Alternative 2 would meet the overall goals of the NTCRA. All removal action objectives would be met.

Overall Protection of Human Health and the Environment – For both options, the overall protection of human health and the environment provided by Alternative 2 would be identical to that of Alternative 1. The boundaries of excavation would be the same, and all areas would be excavated and backfilled in such a manner as to render contaminants "inaccessible" under the direct exposure criteria outlined in CTDEP regulations. Similar to Alternative 1, Alternative 2 would not satisfy the pollutant mobility criteria. Alternative 2 significantly increases the paved surface area of the site which in turn would increase surface runoff. This increase in stormwater runoff may adversely impact the surrounding environment.

Compliance with ARARs – For both options, compliance with ARARs would be the same as Alternative 1. This alternative would not satisfy the pollutant mobility criteria, however, it is assumed that it would be effective in the long term for the same reasons as stated for Alternative 1.

Long-Term Effectiveness – For both options, the long-term effectiveness of Alternative 2 would be similar to that of Alternative 1. A smaller volume of contaminated soil-waste/fill would be removed from the Study Area under this alternative, but the depth of excavation would be 2 feet below grade, large enough to classify the soil beneath newly paved surfaces as "inaccessible" according to CTDEP regulations. Alternative 2 would be reliable provided that institutional controls are implemented to restrict future excavation at the Study Area.

Reduction of Toxicity, Mobility, or Volume Through Treatment – For both options, similar to Alternative 1, there would be no treatment or destruction of contaminants under Alternative 2, although the proposed boundaries of excavation would reduce the volume of contaminants present at the Study Area. Despite the smaller volume of soil-waste/fill to be removed from the Study Area, a similar reduction in the mobility of contaminants would be expected beneath paved areas.

The design of the temporary storage cell under Alternative 2, while smaller, would be exactly the same as for Alternative 1, providing the same reduction of mobility of contaminants within the contaminated soil-waste/fill.

Short-Term Effectiveness – For both options, the short-term effectiveness of Alternative 2 would be identical to that of Alternative 1, except that Alternative 2 would take less time to implement.

Implementability

For both options, the implementability of Alternative 2 would be identical to that of Alternative 1.

Cost

The costs for Alternative 2 are shown on Table 4-1 and detailed in Appendix E. The difference in cost is mostly the result of the volume of soil being excavated for each alternative. Since the majority of the Study Area would be covered by pavement under Alternative 2, only a 2-foot excavation depth would be necessary to provide adequate risk reduction. As a result, a smaller volume of soil would be handled, resulting in a cost savings.

4.3.3 Alternative 3 – Excavation to 5.5 Foot Depth and Site Restoration

This section includes a description of the conceptual design and a detailed analysis of Alternative 3. Alternative 3 is identical to Alternative 1, except for the depth of excavation, and will be described in terms of its similarities and differences from Alternative 1.

4.3.3.1 Detailed Description of Alternative 3

Most of the activities proposed for Alternative 3 are identical to those discussed for Alternative 1. The surface area of excavation would be the same as Alternative 1, but all areas would be excavated to a depth of 5.5 feet below grade. Excavated materials would be transported to an in-town location for temporary storage (Option 1) or out-of-town disposal (Option 2). Subsequent to the removal of contaminated materials, the entire Study Area would be backfilled and compacted with clean fill, and all site features would be restored to pre-excavation conditions. Finally, utilities would also be reworked as in Alternative 1, and similar institutional controls would be implemented.

Excavation, Transport, and Disposal

The surface area of the proposed excavation at Study Area is approximately 170,770 square feet. Alternative 3 would require an excavation depth of 5.5 feet, resulting in a volume of 34,786 cubic yards of excavated material. 40,004 cubic yards of compacted, clean fill would be necessary to restore the site to its original elevation. As described in Alternative 1, a 300-foot length of sheet piles will also be necessary to excavate embankment soils to a distance of 30 feet into the river. Also, in areas where sheet piling would not be required, erosion and sedimentation controls would be implemented.

Alternative 3 requires removing the concrete wall bordering the wetlands area and reusing the concrete blocks beneath the boat crane. The timber cribbing currently beneath the boat crane and the septic system at the Boat Club would also require demolition. Construction debris would be disposed of with the contaminated soil-waste/fill. Alternative 3, as in Alternative 1, would remove the excavated contaminated material and site debris by dump trucks for in-town storage (Option 1) or out-of-town disposal (Option 2).

Site Restoration

Site restoration activities under Alternative 3 would be identical to those discussed for Alternative 1.

Utilities Replacement

For both options, utilities reconstruction under Alternative 3 would be identical to those discussed for Alternative 1.

Institutional Controls

For both options, institutional controls under Alternative 3 would be identical to that discussed for Alternative 1.

4.3.3.2 Detailed Analysis of Alternative 3

This section provides the detailed evaluation of Alternative 3 using the criteria described in Section 3.2.

Effectiveness

For both options, Alternative 3 would meet the overall goals of the NTCRA since all removal objectives would be met.

Overall Protection of Human Health and the Environment – For both options, the overall protection of human health and the environment provided by Alternative 3 would be greater than that of the previous two alternatives since no contaminated soil-waste/fill would be left above the mean high water table (5.5' bgs).

Compliance with ARARs – For both options, Alternative 3 must comply with the proposed ARARs identified on Tables 4-2a, 4-2b, and 4-2c. As stated in Alternative 1, final ARARs are subject to agreement between EPA and CTDEP. Alternative 3 would comply with both the direct contact and pollutant mobility criteria.

As required by CTDEP regulations, contamination would be removed to the depth of the mean high water level at the site, 5.5 feet bgs. This would satisfy state regulations for reducing pollutant mobility, a standard that would not be met by in the first two alternatives. Adherence to this pollutant mobility criteria, as well as the regulations governing the definition of "inaccessible soils", would provide a significant reduction in potential human health or ecological risks due to contact with contamination left in place.

Long Term Effectiveness – For both options, Alternative 3 would be considered effective in the long term due to its compliance with Connecticut regulations for direct exposure and pollutant mobility for contaminants left in place. An excavation depth of 5.5 feet would provide minimal residual risk from wastes left at the Study Area for the same reasons as stated for Alternative 1.

Reduction of Toxicity, Mobility, or Volume through Treatment - For both options, similar to the first two alternatives, there would be no treatment or destruction of contaminants under Alternative 3. Steps similar to those discussed for Alternatives 1 and 2 would be taken in constructing the temporary storage cell to reduce the mobility of contaminants being stockpiled at an in-town location.

Short Term Effectiveness - For both options, the short-term effectiveness of this alternative would be identical to Alternative 1, except for the project duration.

Implementability

For both options, the implementability of Alternative 3 would be identical to that of Alternative 1 except additional space would be needed to accommodate the larger volume of soil in the storage cell. This is a concern that must be addressed.

Cost

The costs for Alternative 3 are shown on Table 4-1 and detailed in Appendix E.

4.4 Comparative Analysis of Removal Action Alternatives

As part of the alternatives analysis, the three excavation alternatives were compared to identify differences between the alternatives and how site contaminant threats would be addressed. Alternatives 1 and 2 are similar in that they provide equivalent degrees of protection from contamination left in place after the excavation. Both address the entire Study Area that has been identified by the risk assessment, and propose a depth of excavation and surface restoration design that would satisfy the direct exposure criteria outlined by CTDEP regulations. However, Alternative 3 is the only alternative that complies with the pollutant mobility criteria regulations set forth in the CTDEP regulations. Either option (in-town storage or out-of-town disposal) is equally protective of the Study Area. The cost difference between the options is significant for all three alternatives.

4.5 EPA Recommended Alternative

Based on the detailed analysis presented in the preceding sections, the EPA recommended alternative is Alternative 3 - Excavation to 5.5 Foot Depth and Site Restoration with in-town storage. As described above, this is the only alternative that addresses all of the Connecticut state regulations for leaving contamination in place. Despite the extra costs that would be incurred due to the greater excavation depth, this alternative has been recommended because it is the most protective of human health and the environment in the long term. Option 1, in-town storage, is more cost effective than out-of-town disposal.

Figures
are available
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REFERENCES

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Appendix A
EPA Approval Memorandum and Human Health Risk
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Appendix B
Summary of Analytical Data
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Appendix C
Boring Logs
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Appendix D
Risk Evaluation Data
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Appendix E
Detailed Cost Data
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