RI051224F

REMEDIAL INVESTIGATION

RAYMARK – OU9
SHORT BEACH PARK AND STRATFORD LANDFILL
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. 135-RICO-01H3
TtNUS Project No. GN1369

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ACRONYMS

ACOE	U. S. Army Corps of Engineers
ATSDR	Agency for Toxic Substances and Disease Registry
BCA	bias-corrected accelerated
bgs	below ground surface
BHC	Benzenehexachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CLT	central limit theorem
cm	centimeter
COPC	Contaminant of Potential Concern
CSF	cancer slope factor
CTDEC	Connecticut Direct Exposure Criteria
CTDEP	Connecticut Department of Environmental Protection
CTDPH	Connecticut Department of Public Health
CTPMC	Connecticut Pollutant Mobility Criteria
CTE	Central Tendency Exposure
CTRSRs	State of Connecticut Remediation Standard Regulations
DABS	Dermal Absorption Factors
DDD	dichloro diphenyl dichloroethane
DDE	dichloro diphenyl dichloroethylene
DDT	dichloro diphenyl trichloroethane
dL	deciliter
DNAPL	dense non-aqueous phase liquid
ELI	Environmental Laboratories, Inc.
EPA	United States Environmental Protection Agency
EPC	exposure point concentrations
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
GA/GAA	State of Connecticut Classification for Drinking Water source
GB	State of Connecticut Classification for Non-drinking Water source
GC/ECD	Gas chromatograph with electron capture detection
GPS	Global Positioning System
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HNUS	Halliburton NUS Corporation
HQ	hazard quotient
ID	inner diameter
IEUBK	Integrated Exposure Uptake Biokinetic model
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
K_d	Adsorption coefficient
kg	kilogram
K_{OC}	Adsorption partitioning coefficient
K_{OW}	Octanol-water partitioning coefficient

ACRONYMS (cont.)

LOAEL	Lowest observed adverse effect level
μg	microgram
μg/dL	micrograms per deciliter
μg/kg	micrograms per kilogram
μg/l or μg/L	micrograms per liter
mg	milligram
mg/cm^2	milligram per square centimeter
mg/kg	milligrams per kilogram
mg/l or mg/L	milligrams per liter
mm Hg	millimetres of Mercury
mph	miles per hour
MVUE	Minimum variance un-biased estimator
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	National Emission Standard for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPL	National Priorities List
OABS	Oral Absorption Factors
OSWER	Office of Solid Waste and Emergency Response
OU1	Operable Unit No. 1
OU2	Operable Unit No. 2
OU3	Operable Unit No. 3
OU4	Operable Unit No. 4
OU5	Operable Unit No. 5
OU6	Operable Unit No. 6
OU7	Operable Unit No. 7
OU8	Operable Unit No. 8
OU9	Operable Unit No. 9
OU	Operable Unit
PACM	Potential asbestos-containing material
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo dioxins
PCDF	polychlorinated dibenzo furans
pH	hydrogen-ion concentration
ppm	parts per million
PRG	Preliminary Remediation Goal
RAC	Response Action Contract
RAGS HHEM	Risk Assessment Guidance for Superfund: Human Health Risk Evaluation Manual
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure

ACRONYMS (cont.)

ROD	(EPA's) Record of Decision. Documents the selection of a cost-effective Superfund remedy.
SAEP	Stratford Army Engine Plant
SARA	Superfund Amendments and Reauthorization Act of 1986. Amended CERCLA. Also known as the Superfund law.
SPLP	Synthetic Precipitation Leaching Procedure
SSL	Soil Screening Level
SVOC	semi-volatile organic compound
TAL	(CLP) Target Analyte List for Inorganics
2,3,7,8 TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalent
TERC	Total Environmental Restoration Contract
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper Concentration Limit
VOC	volatile organic compound
Weston	Roy F. Weston, Inc.
XRF	X-Ray fluorescence

1.0 INTRODUCTION

This Remedial Investigation Report (RI Report) evaluates the nature and extent of Raymark waste contamination in the soils that resulted from past disposal practices of the Raymark Industries, Inc. Facility (former Raymark Facility), located in Stratford, Fairfield County, Connecticut (Figure 1-1). Tetra Tech NUS, Inc. (TtNUS) prepared this RI Report for the U.S. Environmental Protection Agency (EPA) under Response Action Contract (RAC) Contract No. 68-W6-0045, Work Assignment No. 135-RICO-01H3, to partially fulfill the requirements for Raymark Operable Unit No. 9 (OU9) – Short Beach Park and Stratford Landfill study area (study area). This RI Report was developed based on the approved Draft Work Plan, dated January 2004, and approved Draft Work Plan, Amendment No. 1, dated June 2004. This RI Report summarizes historical activities and presents the results of sampling that occurred at Raymark OU9 from December 2003 to February 2004.

1.1 Purpose of Report

This RI Report documents the investigations performed, and evaluates the nature and extent of soil contamination, and associated public health and environmental risks, within Short Beach Park and the Stratford Landfill, where waste from the former Raymark Facility has come to be located. The purpose of this RI Report is to provide the documentation necessary to support a Feasibility Study (FS) and the selection of a source control remedy in a Record of Decision (ROD).

The overall objectives of this RI Report are to:

- Compile and evaluate applicable soil data needed to characterize the conditions at Short Beach Park and the Stratford Landfill and to determine the nature and extent of contamination in the soil impacted by waste from the former Raymark Facility;

- Evaluate the risks to human health and the environment at Short Beach Park and the Stratford Landfill;

- Use existing information to summarize ecological conditions at both properties; and

- Serve as the data resource for developing, screening, and evaluating a range of potential alternative remedial actions that address the Raymark waste contamination within the OU9 study area and develop a Feasibility Study Report.

1.2 Report Organization

This RI Report contains a discussion of investigation activities, results, interpretations, and references, tables, figures, and appendices. Appendix A contains the boring logs; Appendix B contains the analytical data used to produce this report; Appendix C contains supplemental and backup data for the Human Health Risk Assessment; Appendix D contains the "Evaluation of Surface Soil Data from Short Beach Park (OU9)" prepared by Connecticut Department of Public Health (CTDPH); and Appendix E contains a site diagram and description and the as-built drawing of the interim cap.

This report is organized as follows:

- Executive Summary, provides an overall summary of RI Report.

- Section 1, Introduction, discusses the purpose and scope of the report, summarizes the background and history of the Raymark Industries, Inc. Superfund Site, and presents the physical characteristics of the overall Raymark OU9 Superfund site.

- Section 2, Field Investigations, presents a summary of the field investigation activities conducted within the OU9 study area.

- Section 3, Physical Characteristics of the study area, presents a discussion of the physical characteristics of both properties in the OU9 study area, including a description of the study area, geology (surface and subsurface, as known from the drilling), and meteorology.

- Section 4, Nature and Extent of Contamination, discusses contaminant presence and contaminant distribution within the soil of the OU9 study area.

- Section 5, Fate and Transport, discusses movement of contaminants within the soil at the OU9 study area.

- Section 6, Human Health Risk Assessment, includes the identification of human receptors and exposure pathways, selection of contaminants of potential concern (COPCs), and a discussion of the human health effects associated with the COPCs. The results of the evaluation are used to characterize the human health risk.

- Section 7, Ecological Risk Evaluation, presents a summary of the environmental setting and identifies areas of potential ecological concern. The results are used to characterize ecological risk.

- Section 8, Summary and Conclusions, summarizes the nature and extent of contamination, the fate and transport of contaminants, and the risks to human health and the environment associated with the OU9 study area.

1.3 Background

This section summarizes the history of the former Raymark Facility, describes the Raymark Superfund Site, and identifies other activities associated with the former Raymark Facility. Refer to the *OU1 Final Remedial Investigation Report* (HNUS, 1995) for further details on Facility operating history, environmental activities, permits, and compliance history.

1.3.1 History of Raymark Facility and Environs

The Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut, at latitude 41°_12'_02.5"_N and longitude 73°_07'_14.0"_W (see Figure 1-1). The Raymark Facility operated from 1919 until 1989, when the manufacturing plant was shut down and permanently closed; however, the clean up was not completed until 1997. A Remedial Investigation and Feasibility Study (RI/FS) for the Raymark Facility was completed in 1995 (HNUS, 1995). Subsequent to the completion of the RI/FS, EPA designated the facility as Operable Unit No. 1 (OU1). In 1996 and 1997, as part of the property cleanup activities, the Facility buildings were demolished and a permanent cap was placed over the contaminated areas on the property. Based on Stratford tax map information, the Facility occupied 33.4 acres. Raymark manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were

gasket material, sheet packing, and friction materials including clutch facings, transmission plates, and brake linings.

As a result of these activities, the Raymark Facility generated waste materials that were contaminated primarily with asbestos, lead, copper, and polychlorinated biphenyl compounds (PCBs).

During the facility's 70 years of operation, it was common practice to dispose of manufacturing waste as "fill" material both at the Raymark Facility, as well as at various locations in Stratford. The manufacturing wastes from various plant operations were used to fill low-lying areas on-site to create additional space for facility expansion. Based on aerial photographs and reported knowledge of site activities, on-site disposal occurred between 1919 and 1984, and progressed essentially from north to south, across the Raymark Facility. As a result of disposal of these manufacturing wastes on the property, soils at the facility became contaminated primarily with asbestos, lead, copper, and PCBs. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded. Raymark also offered manufacturing wastes as "free fill" to employees, residents, and the town.

The Raymark Facility was underlain by an extensive manmade drainage network. Water and wastes from the manufacturing operations were collected and diverted into the on-site drainage system, which also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and then discharged off-site to Ferry Creek.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4. Lagoon No. 4 discharged directly into Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These lagoons were closed in December 1992 and January 1993. During the fall of 1994, stormwater drainage that had exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm sewer. The storm sewer ultimately discharged to Ferry Creek. Lagoon No. 4 was closed in early 1995, prior to the placement of the permanent cap over the property.

EPA proposed adding the former Raymark Facility and properties that contain waste from the Raymark Facility to the National Priorities List (NPL) on January 18, 1994. Listing on the NPL

authorizes the expenditure of CERCLA funds. The listing was final on April 25, 1995. This OU9 study area is included under this listing.

The Short Beach Park and Stratford Landfill study area was reported to have historically received Raymark waste. This was confirmed during the December 2003 to February 2004 sampling effort. Based on this sampling effort, these properties now comprise the Operable Unit No. 9 described in this RI Report.

1.3.2 OU9 Study Area History

The OU9 study area has been used as a disposal site since the 1930s. The Town of Stratford used the study area as its municipal waste disposal area from the 1940s to 1970s. The study area accepted materials which were not accepted by the town incinerator, including other industrial waste, and the ash from the incinerator. In the 1940s and 1950s, the site was also reportedly used by the Army Corps of Engineers (ACOE) as a dredging spoils disposal area. Material also came from local industry, such as the Stratford Army Engine Plant to the northwest, which disposed of approximately 7,000 gallons of sludge from 1957 to 1968; and from the former Raymark facility, which was permitted to dispose of material until June of 1979 (NUS, 1991, Harding ESE, 2003).

Short Beach Park and the Stratford Landfill were originally considered to be a single landfill. A 1928 photo indicates that the site consisted of a tidal wetland, with cottages located along the shore. By the late 1950s, the southern portion of the wetland (Short Beach Park) was filled in with landfill material, including Raymark waste, and the northern portion of the wetland (Stratford Landfill), was filled in to the marine basin by 1968. After the early 1970s, limited waste disposal records were kept as the active fill area shifted north of Dorne Drive, to the present Stratford Landfill. In 1972, the ACOE deposited sand dredged from the Housatonic River and Bridgeport Harbor at the “old” Stratford Landfill (the present Short Beach Park area). In 1974, the material was used as “clean, stable” cover on the southern portion of the Short Beach Park area. No information on the extent of fill is known (NUS 1991, Town of Stratford, 1994).

The current Stratford Landfill was closed in 1979 except to agricultural materials, brush, and leaf litter, which continue to this day. Development of Short Beach Park began after landfilling in the southern portion of the area ceased; in 1976, Dorne Drive was constructed; in 1980, a sanitary sewer was added along the south side of Dorne Drive. Short Beach Park officially opened in 1987,

with a small golf course, beach and bathhouse facility. The park was further developed later, with a 9-hole golf course, parking lots, a soccer field, a baseball field, administration building, snack stand, tennis courts, and basketball courts. In 1993, the Connecticut Department of Environmental Protection (CTDEP) oversaw the construction of an interim cover over the soccer field area, which had been found to contain asbestos and other waste. The interim cover consisted of a geotextile overlain by 9 to 12 inches of clean fill.

The interim cover was augmented in 1995, when an additional 4 feet of material was added (CTDEP 1979 and 1993, Town of Stratford 1994, Weston 1989 and 1994). Refer to Section 2 for a discussion of previous site investigation activities.

1.4 Definition of Raymark Waste

Soils at OU9 were screened for contaminants characteristic of waste from the former Raymark Facility. All determinations of the presence or absence of Raymark waste were based on the following definition of Raymark waste: Raymark waste in soil is defined as a single soil sample at the same depth interval containing lead above 400 parts per million (ppm) (milligrams per kilogram (mg/kg)) **and** asbestos (chrysotile only) greater than 1 percent **and either** copper above 288 ppm (mg/kg) **or** polychlorinated biphenyls (PCBs) (Aroclor 1268 only) above 1 ppm (mg/kg). This definition was developed by EPA, in consultation with CTDEP, and reviewed by the Raymark Advisory Committee's consultant, prior to an evaluation of sampling data from the properties. Details of the development of the Raymark waste definition are as follows:

1. **Lead** - Lead was selected as an identifying contaminant of Raymark waste as it was used in the fabrication of various brake and friction materials in the Raymark manufacturing process. Raymark acknowledged in its Resource Conservation and Recovery Act (RCRA) "Part A application" that up to 2.5 billion gallons of lead-contaminated waste liquid flowed through its on-site lagoons on an annual basis. The on-site lagoons were routinely dredged and the spoils were disposed of on the facility property and at other locations throughout the town. The soils and sediments on the former Raymark Facility, in particular the on-site lagoons, contained high levels of lead.

   Lead was identified as a contaminant of concern because it appeared in most samples collected during the 1992 – 1994 sampling on the former Raymark Facility (elevated lead

concentrations were found in process waste, imported fill, and native fill – the latter two assumed to be the result of leachate or cross contamination).

In addition, based on the samples collected on the former Raymark Facility and during the 1993 to 1995 removal actions, 400 mg/kg lead was selected by EPA and approved by the Agency for Toxic Substances and Disease Registry (ATSDR) as a conservative permanently protective cleanup level for residential properties. This value was consistent with EPA's 1992 draft *Soil Screening Level Guidance and Revised Interim Soil Lead Guidance* document (EPA, 1992c). This document was later published in July 1994 as *Revised Interim Guidance on Establishing Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA, 1994b). This value was also consistent with the sample data obtained from the former Raymark Facility itself.

Currently, the 400 mg/kg lead standard remains because it meets the new proposed Connecticut Remediation Standard Regulations (CTRSRs) for residential properties. In an effort to differentiate this contaminant from lead paint from a home or business, the presence of lead and asbestos in the same sample will further identify it as Raymark waste.

2. **Asbestos** - Asbestos was selected as an identifying contaminant of Raymark waste by EPA in 1993 because of its dominance in the waste materials from the 1993 to 1995 removal actions and from samples collected at the former Raymark Facility. The 1 percent definition was set because it meets the National Emission Standards for Hazardous Air Pollutants (NESHAP) definition for an asbestos-containing material (EPA, 1990a). Currently, the Raymark waste definition remains at 1 percent, identifying the asbestos as chrysotile asbestos. Chrysotile asbestos was selected as the specific asbestos of concern because of its dominance in the samples collected at the former Raymark Facility. From the hundreds of samples collected at the former Raymark Facility, chrysotile asbestos was the only form of asbestos identified.

3. **PCBs** – PCBs were selected as an identifying contaminant of Raymark waste because of their predominance in samples collected at the former Raymark Facility and given that PCBs do not occur naturally in the environment. A concentration of 1 mg/kg total PCB was adopted by EPA for use in previous removal actions since unrestricted exposure to

1 mg/kg or less of total PCBs has been deemed safe by EPA Office of Solid Waste and Emergency Response ((OSWER) Directive: *Remedial Actions for Superfund Sites with PCB Contamination*) (EPA, 1990b). Based on historical sampling, EPA further believes that the majority of PCBs at the former Raymark Facility resemble Aroclor 1268 rather than the other PCB Aroclors (including Aroclor 1262 which was also found consistently at the Raymark Facility). As such, EPA has refined the definition of Raymark waste from the general term "total PCBs" to the more descriptive term "Aroclor 1268" as noted below. Samples collected at the former Raymark Facility, and during the 1993 to 1995 removal actions, indicated that PCBs were contained in the waste materials. Using this information, PCBs were selected as an identifying contaminant of Raymark waste. In 1993, the 1 mg/kg total PCB standard was selected based on the OSWER directive from August 1990, *Remedial Actions for Superfund Sites with PCB Contamination* (EPA, 1990b). Pursuant to this guidance, samples from properties collected from 1993 to 1995 with PCBs greater than 1 mg/kg were considered above the action level, which is protective of human health in a residential exposure scenario without institutional controls.

Currently, the definition of Raymark waste has been refined to state that the PCBs action level is greater than 1 mg/kg Aroclor 1268, for the reasons described below. Aroclor 1262 was dismissed because it was not considered exclusively unique to the former Raymark Facility samples.

- Wipe samples, taken within the former Raymark Facility buildings that contained processes that most likely used PCBs, had Aroclor 1268.

- Samples collected by former Raymark Facility consultants, from the sediments and soils on the facility property where off-specification process waste was dumped to fill in low spots on the property, contained Aroclor 1268.

- Knowledge that PCB usage was probable in manufacturing processes such as Raymark's (plasticizers in phenolic resins and as wax extenders).

- No other known users of 1268 Aroclors have been identified in the area (either to jointly dump materials on the properties throughout Stratford and/or to provide

disposal materials to Raymark as imported fill material. EPA assumes that any fill materials brought onto the Raymark property would have been from local sources as a cost savings to the company).

- Samples taken from known Raymark waste disposal areas around Stratford over the past 10 years contained Aroclor 1268.

4. **Copper** - Copper was selected as an identifying contaminant because of its predominance in the Raymark waste from samples collected from the 1993 to 1995 removal actions and from the former Raymark Facility. The 288 mg/kg standard was selected by EPA as the identifying benchmark as it is ten times greater than average background concentrations (see Table 2-2, Final OU6 Remedial Investigation dated April 2004).

1.5 Raymark Superfund Site Description and Setting

Contaminated areas associated with Raymark Superfund Site have been divided into nine operable units. EPA created these nine operable units (OUs) to help manage the cleanup process. The nine operable units are as follows:

OU1 Raymark Facility
OU2 Groundwater
OU3 Upper Ferry Creek and Surrounding Wetlands
OU4 Raybestos Memorial Field
OU5 Shore Road Area
OU6 Additional Properties study area
OU7 Lower Ferry Creek, Selby Pond, and Housatonic River wetlands
OU8 Beacon Point Area and Elm Street Wetlands
OU9 Short Beach Park and Stratford Landfill

This RI Report addresses the area identified as the OU9 study area, which includes Short Beach Park and the Stratford Landfill. The OU9 study area encompasses a total of 93.9 acres abutting Long Island Sound near the mouth of the Housatonic River (see Figure 1-1).

1.5.1 Other Raymark Related Activities

On-going activities in the vicinity of the Raymark Superfund Site that are related to the investigations conducted to support this RI include:

- Raymark Facility Closure (OU1) – Raymark waste from residential properties was brought back to the former Raymark Facility and placed under a permanent cap by EPA under the U.S. Army Corps of Engineer's Total Environmental Restoration Contract (TERC) in 1997. A soil vapor extraction system is in place to capture the bulk of the volatile organic contaminants (VOCs), especially toluene, remaining under the cap. A dense non-aqueous phase liquid (DNAPL) extraction system is removing separate phase NAPL (predominately 1,1,1-trichloroethane), which is collected in the sump portion of several extraction wells. This property is now privately owned, and has been redeveloped as a shopping center. Operation and maintenance activities are being conducted by the CTDEP. A five-year review was conducted in 2000 and a second five-year review is being conducted in 2005.

- Groundwater RI Activities (OU2) – An RI was completed for Raymark - OU2 in January 2005 (TtNUS, 2005). This RI evaluates groundwater contamination under and downgradient of the former Raymark Facility.

- Raymark Ferry Creek RI Activities (OU3) – This OU3 operable unit encompasses the areas also known as OU7 and OU8. Three RIs (OU3 (Final), OU7 (Draft Final), and OU8 (Draft Final)) were completed in 1999, 2000, and 2000, respectively (TtNUS, 1999b, 2000a, and 2000b).

- Raybestos Memorial Ballfield Activities (OU4) – EPA issued the Final RI Report (TtNUS, 1999a).

- Raymark Shore Road Activities (OU5) – An Engineering Evaluation and Cost Analysis was released in 1999 (TtNUS, 1999c). A cap was completed in 2001. A Draft RI was released in 2002.

- Additional Properties (OU6) – EPA has identified 24 properties that received Raymark waste primarily through disposal of fill on the properties. EPA released the Draft RI in 2002; the Final OU6 RI was released in 2004 (TtNUS, 2004).

1.5.2 Raymark Waste Area

Based on the Raymark waste definition identified in Section 1.4, the areas containing Raymark waste within the OU9 study area were calculated (see Figure 3-1). These areas are shown on Figure 3-1 as the "Estimated Area of Raymark Waste" and are presented in both square feet and acres below.

	Total Area of Property (acres)	Total Area of Property (sf)	Estimated Area of Raymark Waste (acres)	Estimated Area of Raymark Waste (sf)
Short Beach Park	64.1	2,797,889	6.3	274,717
Stratford Landfill	29.8	1,298,056	29.8	1,298,056

The area of Raymark waste defines the portion of each property for which risks to human health have been estimated. The area of the property outside of the defined Raymark waste area also contains contamination. Some of this contamination even exceeds safe levels established by the state or federal governments. However, because these areas do not meet the definition of Raymark waste, they were not evaluated for risk effects within this document. Information on all contaminants both within and outside the estimated areas of Raymark waste are described in Section 4.

The landfill was sampled initially because of historical information indicating that Raymark waste had been placed there on numerous occasions throughout the years. The areas of placement were unknown, therefore, an assumption was made that the fill was placed in the active portions of the landfill at the time of disposal. Because the active filling areas varied throughout the years, the entire landfill was suspected of containing Raymark waste.

This assumption was taken into account in the development of the sampling program for the landfill. Sampling results identified Raymark waste in at least one sample from 23 out of 57 different locations within the landfill area (see Figures 2-1, 4-3, and 4-4). Because the sampling was conducted in either easily accessible areas or in areas suspected of containing Raymark waste

(based on visual or historical information), the characterization outcome resulted in large areas of the landfill not being sampled. However, all evidence indicates that additional sampling would have resulted in confirming the presence of Raymark waste at many additional landfill locations. For this reason, the entire landfill is considered an area of Raymark waste.

The following steps were used to determine the estimated lateral extent of Raymark waste, shown as the green area on Figure 3-1.

- All of the soil sample analytical data available were assembled in a database.
- The database was queried to display soil sampling data for Raymark waste constituents (lead, asbestos, Aroclor 1268, and copper).
- The analytical data for each soil sample were evaluated to determine which sample locations met the Raymark waste definition.
- Sample locations for which data were available were shown on Figure 2-1.
- Sample locations where Raymark waste was present were noted on Figures 4-1 to 4-4.
- The entire area of the interim cap was presumed to contain Raymark waste based on 1993 and 1995 sampling and was included in the Raymark waste area south of Dorne Drive. See Figure 3-1.
- At each sample location containing Raymark waste, the halfway point between the location and any adjacent sample locations that did not contain Raymark waste was measured and noted.
- After all of the halfway points had been noted, these points were connected and an assumed limit to Raymark waste was developed.

Some of the limitations of the method used to determine the Raymark waste areas are noted below; however, this is not a comprehensive list of limitations:

1. Assuming that all data were valid and complete, the accuracy of lateral extent lines was partially a function of the density of sample points on a particular property. The existence of a sparse or irregular distribution of sample points tended to assign greater significance to those sample points over other points that were located within an area that was densely populated with sample points.

2. Soil samples were evaluated without regard to the depth from which the soil sample was collected.

3. If a soil sample did not meet the Raymark waste definition as described under Section 1.4, then it was not considered Raymark waste. This limitation has ramifications for future estimates of Raymark waste or actual measurements of Raymark waste during implementation of a remedial action. For example, if a soil sample did not satisfy the criteria for Raymark waste, but came close (i.e. lead=390 ppm), it was not considered Raymark waste. Please note that areas not comprehensively sampled for identification of Raymark waste may be re-sampled and characterized during the pre-design and design stages of the Superfund remedial action.

4. The analytical results were compared to the Raymark waste criteria definition without consideration of the accuracy and precision of the analytical method used. For most of the soil samples, x-ray fluorescence (XRF) screening was performed for lead and copper and gas chromatograph with electron capture detection (GC/ECD) screening was performed for PCBs as Aroclors. Confirmatory samples were sent for laboratory analysis of lead, copper, and PCBs using EPA-approved methods. When screening and confirmatory results were available for one sample, the confirmatory results were used.

Once the assumed lateral extent line was drawn onto a map of the property, AutoCAD was used to measure the area of Raymark waste. The estimated areas of Raymark waste for the OU9 study area include both Short Beach Park and the Stratford Landfill.

2.0 STUDY AREA INVESTIGATIONS

Section 2.0 presents a brief description of the investigations performed to evaluate and characterize the nature and extent of contamination at the OU9 study area associated with the former Raymark Facility and environs. Information collected during these investigations was used to meet the objectives presented in Section 1.1. Investigations pertinent to this RI report are presented in additional detail below.

2.1 Site Screening Inspection, Stratford Landfill

In September 1989, a Screening Site Inspection was conducted by EPA at the Stratford Landfill. Work conducted included a file search, and soil and sediment collection at the landfill. Seven shallow soil samples (including a background sample) and two sediment samples were collected and analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides, PCBs (not Aroclor 1268), and metals. Investigation results are summarized in the Final Screening Site Inspection. Analytical results are included in Appendix B-1; however, these data were not used to determine the area of Raymark waste because the samples were not analyzed for asbestos and Aroclor 1268. Appendix B-1 also includes a memorandum discussing results of previous investigations.

2.2 CTDEP Short Beach Park Soil Sampling

In April of 1993, the CTDEP collected 173 surface soil samples (3 to 6 inches) at the Short Beach Park soccer field. In May 1993, CTDEP collected an additional 54 surface samples at the golf course and baseball fields. The samples were screened for lead, asbestos, and PCBs, with additional confirmatory Contract Laboratory Protocol (CLP) samples sent to an off-site laboratory. These surface soil samples were not analyzed for human health risk assessment purposes because coordinates were not available. Refer to Appendix B for analytical results.

2.3 EPA Short Beach Park Soil Sampling

In June of 1993, Roy F. Weston, Inc. TAT (Weston) collected surface soil samples at Short Beach Park for the EPA. Samples were located at the islands of the beach parking lot, the

northern and southern beach area, and two drainage swales along Dorne Drive. Samples were screened for lead, asbestos, and PCBs. Confirmatory samples were analyzed at an off-site laboratory for metals, pesticides, PCBs, and/or SVOCs, and dioxin. Data from these surface soil samples were used in this RI Report to establish the Raymark waste area, in addition to data from the 2003/2004 field investigation (Section 2.6). Refer to Section 4 for a discussion of the results of this investigation and Appendix B-2 for analytical results.

2.4 CTDEP Cap Installation

Based on the April 1993 sampling effort, in June of 1993, the CTDEP oversaw the construction of a temporary (interim) cap over the last portions of Raymark Waste accepted by the landfill at Short Beach Park. According to drawings, the cap extended along Dorne Drive, covering the northern half of the soccer field and extending to the present mini-golf course. The geotextile cap was covered with 8 to 10 inches of gravel fill, which was covered by 4 to 6 inches of topsoil and grass.

In March of 1995, 41 soil samples were collected in the area of the CTDEP cap. Samples were collected to a depth of 4 feet using a geoprobe rig. Thirty-six samples were collected from 18 locations and analyzed for lead, PCBs, and asbestos. Analytical results are presented in Appendix B-1. In response to the results of the fieldwork, 4 feet of cover was added to the capped area. These samples were not used in the nature and extent discussion or in the human health risk assessment because of a lack of location coordinates. See Figure 3-1 for the location of the interim cap.

2.5 Short Beach Park Soil Sampling

In May 1996, EPA personnel collected 24 soil samples at the Short Beach Park baseball fields and softball field in order to determine whether dugouts could be installed without impacting potential contamination below ground level. Samples were collected using stainless steel 1.5-inch inner diameter (ID) split-spoon sampler, which was manually driven using a sledgehammer. The soil in the split spoon was divided into a 0-6-inch sample interval and a 6-12-inch sample interval for analysis. A total of 24 samples were collected from 12 locations and analyzed for asbestos. Investigation results are presented in the *Trip Report for Asbestos Sampling of Short Beach Park Little League Baseball Fields*. Analytical results are also

presented in Appendix B-1; however, these data were not used to determine the area of Raymark waste because the samples were not analyzed for lead, copper, or PCBs.

2.6 OU9 Soil Sampling

From December 2003 to February 2004, TtNUS collected 1,307 soil samples at the Short Beach Park and the Stratford Landfill, to identify the presence or absence of wastes originating from the former Raymark Facility.

Short Beach Park and the Stratford Landfill were originally divided into seven areas (five in the park and two in the landfill) with varying sample densities based on land use and suspected Raymark fill locations (see Appendix E-1 for figure and descriptions). The original sample locations and sample densities were adjusted based on conditions discovered in the field. For example, in several areas of Short Beach Park, samples that fit the Raymark waste definition were encountered in an area with a larger sample grid pattern (200 foot interval). In these areas, additional samples were taken at 50-foot intervals in order to refine the suspected Raymark waste area.

Soil samples at Short Beach Park were collected based on a grid. Coordinates for each sample location were calculated prior to fieldwork. Once in the field, hand-held Global Positioning System (GPS) units were used to locate each point. Coordinates were given flag numbers in order to identify each point after it was staked. Locations with utilities or other obstructions were moved; if a location was moved more than 4 feet from its plotted location, the new location was re-surveyed with GPS. Each boring advanced was given a new sequential number, which became the sample and boring identification.

The landfill was sampled initially because of historical information indicating that Raymark waste had been placed there on numerous occasions throughout the years. The areas of placement were unknown, therefore, an assumption was made that the fill was placed in the active portions of the landfill at the time of disposal. Because the active filling areas varied throughout the years, the entire landfill was suspected of containing Raymark waste. This assumption was taken into account in the development of the sampling program for the landfill. Sampling results identified Raymark waste in at least one sample from 23 out of 57 different locations within the landfill area (see Figures 2-1, 4-3, and 4-4). Because the sampling was

conducted in either easily accessible areas or in areas suspected of containing Raymark waste (based on visual or historical information), the characterization outcome resulted in large areas of the landfill not being sampled. All evidence indicates that additional sampling would have resulted in confirming the presence of Raymark waste at many additional landfill locations and depths.

Sample screening methodology and analysis performed was consistent in all areas evaluated. At each sample location, the initial objective was to determine the presence or absence of Raymark waste. This was accomplished by sampling in 2-foot intervals from 0 to 4 feet and screening for lead, copper, PCBs, and asbestos. If Raymark waste was not confirmed, sampling at that location was complete. If, however, Raymark waste was confirmed through screening analyses, then sampling in 2-foot intervals was repeated from 0 to 4 feet. Further, sampling continued in 2-foot intervals from 4 feet bgs until groundwater was encountered. These samples were sent to an off-site laboratory and analyzed for a more complete set of parameters.

Soil samples at Short Beach Park were collected from soil borings using direct-push technology. Refer to Figures 2-1, 4-1, and 4-2 for sample locations. At Short Beach Park, Phase I soil samples were collected from 0 to 4 feet in 2-foot intervals and screened for lead and copper. If lead concentrations were below 400 ppm, then no additional analysis was performed. However, if lead concentrations exceeded 400 ppm, the soil samples were screened for PCBs (Aroclor 1268) and asbestos. In the Phase II sampling effort, locations identified as containing Raymark waste in Phase I samples (0 to 2 feet and 2 to 4 feet) were re-sampled and the samples sent for a more extensive set of analyses, including VOCs, SVOCs, pesticides, PCBs, total metals, dioxin, and/or Synthetic Precipitation Leaching Procedure (SPLP) metals. Further, under Phase II, samples were also collected from 4 feet to the water table at locations where Raymark waste was identified in 0 to 4 feet soil samples. Twelve locations with Raymark waste within the upper 2 feet of soil were additionally analyzed in the top 6 inches of soil for VOCs, SVOCs, pesticides, PCBs, total metals, and/or dioxins in order to support risk management decisions. One hundred ninety-four Phase II soil samples were collected from 0 to 12 feet.

Analytical soil samples at the Stratford Landfill were collected from seven test pits and from 12 soil borings advanced using hollow-stem augers. Thirty-six borings were advanced on the

southern flank of the landfill using direct push technology to a depth of 4 feet. Three additional borings were advanced using hollow-stem augers for geotechnical purposes; no analytical samples were collected from these borings. The analytical soil samples were collected from intervals containing fill materials below the top compost layer, and were screened for lead and copper. If lead concentrations exceeded 400 ppm, the soil samples were screened for PCBs (Aroclor 1268) and asbestos. Ten percent of the samples were sent to an off-site commercial laboratory for confirmatory analysis by EPA-approved standard analytical methods.

Results from the sampling at Short Beach Park and the Stratford Landfill are presented in Appendix B-2 and are included in this RI Report.

3.0 PHYSICAL CHARACTERISTICS OF THE OU9 STUDY AREA

This section presents a summary of the physical characteristics of the OU9 study area. This section includes:

- Section 3.1 – Description of the study area
- Section 3.2 – Regional Geology
- Section 3.3 – Study Area Geology
- Section 3.4 – Hydrogeology
- Section 3.5 – Climate and Meteorology

Throughout this report, all elevations are stated in feet with respect to the National Geodetic Vertical Datum (NGVD) 1929.

3.1 Description of the Study Area

The OU9 study area is divided into Short Beach Park and the Stratford Landfill.

Short Beach Park was previously composed of low-lying marshes. Over the years, this property operated as a municipal landfill and was systematically filled in with rubbish. In addition to the municipal rubbish, the former Raymark Facility also dumped its manufacturing seconds (irregular or defective product) at the landfill. In the early 1980s, a large portion of the landfill was excavated and six disposal cells were created to accept Raymark waste. This cell area has been capped with a geotextile membrane (See Figure 3-1) as an interim measure. Today these manufacturing seconds are considered Raymark waste, when they meet the definition of Raymark waste (Section 1.4). After filling in the property, the Town of Stratford decided to develop it into a municipal park. The 64.1-acre park currently has a soccer field, baseball fields, nine-hole golf course, mini-golf course, and tennis and handball courts, as well as a beach and picnic areas.

The **Stratford Landfill** consists of 29.8 acres and was also operated as a municipal landfill accepting town rubbish as well as wastes from the former Raymark Facility and other firms.

Today this property still operates as a municipal landfill accepting leaves, as well as a small quantity of construction waste (concrete and asphalt).

The OU9 study area is shown on Figure 1-2 as “Stratford Landfill Area of Interest” and “Short Beach Park Area of Interest”. Long Island Sound borders the study area to the east. The Sikorsky Regional Airport is located on the northwest side of the study area; the landfill is an approach zone for the airport and has a height restriction in place to prevent obstruction of airplane flight paths. There are residences located to the west and south of the study area. The OU9 study area is bounded to the north by the Marine Basin.

As shown on Figure 3-1, the southern portion of Short Beach Park and areas adjoining Long Island Sound are within the 100-year floodplain, as observed from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Stratford, Connecticut (FEMA, 1992). The 100-year frequency base flood elevation ranges from 10 to 12 feet. The remainder of the OU9 study area is outside the floodplain.

The study area receives approximately 44 inches of precipitation (rainfall, snow, etc.) per year (NOAA, 2002). Short Beach Park is covered mostly with grassed playing fields and a golf course, with some cover in the form of parking areas, playing courts, and facility buildings. The Stratford Landfill is almost entirely vegetated, with the exception of a dirt access road. Precipitation that is not absorbed into the ground discharges to the Marine Basin to the north and to Long Island Sound to the east.

3.2 Regional Geology

This section provides a brief overview of the regional geology surrounding the OU9 study area. This discussion of the regional geology is divided into two subsections: overburden and bedrock. The regional overburden geology is defined as the unconsolidated deposits of sand, silt, gravel, clay, and peat. The overburden is underlain by bedrock consisting of metamorphic rock, mainly schist and gneiss.

3.2.1 Regional Overburden Geology

The OU9 study area is located in Stratford, Connecticut. Stratford, Connecticut is generally located within the Stratford outwash plain, on the western Housatonic River valley floor, within the lower Housatonic River Basin. Natural overburden deposits in the vicinity of Stratford consist of glacial deposits (outwash sediments, ice-contact stratified drift, and till) and recent swamp and marsh deposits. The regional surficial geology within this basin was shaped by glaciation. The State of Connecticut was covered by glacial ice at least two times. During the last retreat of the ice, glaciers deposited a thin mantle of till overlying bedrock. Glacio-fluvial outwash deposits formed thicker, highly stratified sequences of silty sand to gravelly sand that overlies till, and filled bedrock valleys. Windblown sand and silt were also deposited on valley floors; however, these deposits are indistinguishable from present day organic topsoil deposits (Flint, 1968).

Glacial till was deposited by glacier ice, is variable in thickness, and forms a discontinuous mantle over bedrock. The till consists of a non-stratified, poorly sorted mixture of coarse (pebbles/cobbles/boulders) and fine (sand/silt/clay) fractions, with the coarse fraction generally not exceeding 20 percent. In the lower Housatonic River Basin, the median till thickness is 30 feet (Wilson et al., 1974). Till is commonly exposed in areas of relatively high elevation, and is generally covered by sediments of post-till age within the valleys.

Most of the sediments overlying till in the region consist of stratified drift and outwash sediments. Ice-contact stratified drift includes sand, gravel, silt, and clay, frequently poorly sorted with abrupt changes in grain size. These deposits were formed during glaciation in streams and local ephemeral lakes in close proximity to melting glacier ice, and often grade into outwash sediments. Stratified drift covers 16 percent of the area of the lower Housatonic River Basin, and generally occurs as narrow belts in stream valleys and lowlands (Wilson et al., 1974). Glacial outwash deposits are predominant in the stream valleys, and consist of highly stratified sand, silty sand, and gravelly sand. Beds are not persistent, and individual lenses attain thicknesses of tens of feet, and thin out or are truncated over short distances. Outwash units in the vicinity of Stratford, Connecticut, generally consist primarily of sands with up to 50 percent gravel.

Swamp and marsh deposits are present in low-lying areas and consist of silt, sand, and clay-sized particles interbedded with organic fragments and peat deposits up to 10 feet thick. Swamp and marsh deposits, where present, commonly overlie stratified drift. As a result of the practice of filling in lowland areas, fine-grained swamp and marsh deposits, including peat, are commonly found underlying fill deposits.

Fill deposits consist of a mixture of natural and manmade materials. A large portion of the Stratford, Connecticut region is composed of manmade fill according to the quadrangle map created by Flint, 1968. These deposits are often found at lowland areas of the region and are often overlying swamp and marsh deposits. These deposits also overlie stratified drift and ice contact deposits, such as sands and gravels. Fill materials frequently include manufacturing, household, and construction debris usually mixed with natural materials, including various amounts of clay, silt, sand, and gravel, as well as organic soils. Other fill materials that do not contain visual evidence of manmade debris are present throughout the region, including soils from dredging operations and other soils brought in to fill low-lying areas. This fill is frequently more difficult to distinguish from natural deposits. A further description of fill and underlying overburden material in the study area is discussed in Section 3.3.

3.2.2 Regional Bedrock Geology

The Stratford, Connecticut region is located in the Connecticut Valley Synclinorium of Connecticut's Western Uplands, according to the "Bedrock Geological Map of Connecticut" (CT GNHS, 1985). The regional bedrock setting consists of a series of generally foliated meta-sedimentary and meta-volcanic rocks of the Early and Middle Paleozoic Age, with foliation trending northeast-southwest, in a large syncline. These rocks are mainly schists and gneisses. The sequence was tightly folded and subjected to progressive regional metamorphism ranging from chlorite to kyanite metamorphic grade. A high angle fault is mapped east of the study area, across the Housatonic River, generally trending southwest to northeast (CT GNHS, 1985). The implication of this fault and any related splay faulting to local geology was not evaluated for the OU9 study area impacts.

3.3 Study Area Geology

The description of the OU9 study area overburden materials is based on data collected during soil boring and test pit activities conducted during the investigations summarized in Section 2.6. Earlier investigations did not include physical descriptions of the material encountered. Short Beach Park and the Stratford Landfill are discussed separately in this section. Deep overburden and bedrock geology have not been investigated at the OU9 study area; therefore, descriptions from investigations at the Stratford Army Engine Plant nearby have been used. All 2003/2004 borings in the OU9 study area were advanced to collect samples to determine the presence or absence of Raymark waste; with three of these borings continuing to be drilled for geotechnical purposes.

3.3.1 Short Beach Park

Borings were advanced at a total of 446 locations at Short Beach Park. The borings at Short Beach Park were advanced either to 4 feet only (Phase I) or to the water table, as demonstrated by free water in the boring (Phase II). Refer to Appendix A for boring logs. Boring log observations from visual examination of sampled material generally correlated well with laboratory and screening contaminant analysis; refer to Section 4 for contaminant nature and extent details. All borings were advanced to collect samples to determine the presence or absence of Raymark waste.

Historical photos of the Short Beach Park area, in particular a 1943 photograph, indicate that it was originally composed of low-lying marshes. It is likely that present fill extends to the water table or lower because of compaction and re-working of fill material. For this reason, borings without man-made materials most likely contain natural fill soils rather than native soils. As a result of the discontinuous nature of the landfill, materials encountered in one boring cannot be used to extrapolate subsurface conditions across an area. At several locations, a boring with only natural materials (i.e. soils) was surrounded by borings containing potential Raymark waste and other fill materials. However, a few observations can be made about general fill types in the park. Boring log observations generally correlated well to contaminants found from laboratory and screening analysis; refer to Section 4 for contaminant nature and extent details.

A particular area of interest at Short Beach Park is the cap installed by CTDEP over what is reported to be the last deposit of Raymark manufacturing waste. Borings and soil profile descriptions in this section are described in feet bgs rather than elevation, as most of Short Beach Park is between 5 and 15 feet NGVD and none of the locations were surveyed vertically. No deep borings below the fill were advanced in this area. The information in this section was interpreted from field notes and boring logs.

3.3.1.1 Fill Materials

The fill at Short Beach Park consists of both manmade and natural fill materials. Manmade materials were found across the site and included construction and household debris, as well as numerous burn layers. The man-made material with the largest horizontal extent was glass, which appeared in more than 150 borings across Short Beach Park. Other materials encountered in more than 50 borings included, in decreasing quantities, wood (including burnt and processed wood), plastic, metal, and paper products (mainly cardboard and newspaper). Burn zones, including cinders, ash, charcoal, and/or charred material, were encountered in approximately 20 percent of the 446 boring locations at Short Beach Park. Other materials scattered throughout Short Beach Park included asphalt, brick, ceramic, cloth, concrete, rubber, slag, and tiles. The man-made materials were commonly mixed in with well-graded fine-coarse sand and gravel, reworked native marsh and swamp deposits (mostly sandy organic silts), and poorly graded fine to medium sand.

Material with non-organic fibers was noted on boring logs as PACM (potential asbestos-containing material). Over 50 borings encountered PACM, most of which were concentrated within and west of the baseball fields. The PACM noted on the boring logs generally fell into two categories: a felt-like pad or fabric, or a dark reddish spongy silty material with shiny or needle-like fibers throughout. For both categories, the material was noted as a discrete layer in the soil column. Many of these samples met the definition of Raymark waste. There were two exceptions to these categories; one sample had a fibrous hard (cement-like) white material with fibers visible on broken edges, and one had tile fragments with fibers at the edges. Neither of the exceptions met the definition of Raymark waste. Refer to Section 4 for a discussion of the nature and extent of Raymark waste at Short Beach Park.

Borings in Short Beach Park often encountered numerous well-defined layers of clean fill. Some of these layers were present over large areas of the study area and could be mistaken for native material, except that man-made debris was consistently encountered below these layers.

One common clean fill layer is the soil described as a gray or tan-gray fine to medium sand, often encountered with seashells. Gravel fragments were encountered less frequently in this layer. Although gray fine to medium sand was encountered in thin layers throughout the site, areas with layers over 6 inches thick (up to 3 feet) included the baseball fields, the road parallel to Short Beach, and a few scattered borings in the soccer field area, the south side of Dorne Drive, and the golf course. The fine to medium gray sand was absent from the soils below the baseball field parking lot, which was otherwise surrounded by borings where the material was encountered. The thickest layers (3 feet or greater) were found mainly between the two western baseball fields.

Another common clean fill layer was gravel or crushed stone, most likely used as road base material or for drainage. Gravel and crushed stone layers were encountered at the soccer field, along Dorne Drive, and in the mini-golf course area, where the fill is part of the CTDEP cap (see Section 3.3.1.2 for details); and in the golf course, where the material was most likely part of the under drainage network.

Subsurface materials in a few areas were indistinguishable from the expected native material. Materials from some of the borings along an unnamed creek, which runs east of the mini-golf course and baseball parking lot, included mixtures of sand, silt, and organic material, especially reed fragments. However, these borings were advanced to only 4 feet; other borings along the creek contained man-made material, indicating that the creek sediments have either been reworked or deposited over older fill. Several borings near Long Island Sound to the east (near the handball courts) encountered clean sands after a maximum of 2 feet of fill. Clean sand is consistent with the high-energy environment of the shore of Long Island Sound. One of these borings, SBP-534A, was advanced to 10 feet and had clean sands (including a layer of garnet sand at 9 feet bgs) below 2 feet bgs, indicating that the sand in this area may be native material instead of fill.

3.3.1.2 CTDEP Cap Evidence

The final volumes of Raymark waste disposed of at Short Beach Park were reportedly placed into six cells along Dorne Drive, by the present day soccer fields. In the mid-nineties, CTDEP installed a cap over the cells. According to a design drawing for the cap (Metcalf & Eddy drawing, Appendix E-2), the cap consisted of geotextile placed over the waste, which was covered by 8 to 10 inches of gravel fill and up to 4 feet of clean fill. Both the geotextile and the gravel fill can be used to identify the location of the cap in the field. The area is now vegetated with grass.

During the soil sampling program performed from December 2003 to February 2004, the geotextile was not always encountered in the same area as the cap (Metcalf & Eddy drawing, Appendix E-2). Locations where geotextile was encountered include: SB-442, SB-444, and SB-624 on the eastern edge of the golf course parking lot; SB-359, SB-361, SB-369, SB-416, and SB-448, in the soccer field; SB-550, over 100 feet south of the expected edge of the cap; SB-451, along Dorne Drive; and SB-405, SB-408, and SB-409, in the corner of the mini-golf course. It is unknown whether the cap extends south to SB-550 or if the geotextile noted is of a different subsurface feature. Although most of the central capped area did not have any indications of the presence of geotextile, the geotextile could have torn when the boring was advanced instead of being punched through. In this case, the geotextile would not have been collected into the macro-core used to sample the soil.

Another component of the CTDEP cap encountered in the borings was the gravel layer below the topsoil. In the area of the cap, a clean gravel layer was found in seven borings in the soccer field (SB-509, SB-511, SB-512, SB-513, SB-515, SB-519, and SB-521); six borings north of the baseball field (SB-523, SB-527, SB-529, SB-531, SB-536, and SB-600); three borings west of the mini-golf course (SB-399, SB-403, and SB-544); and SB-391, south of the mini-golf course. The cap's geotextile was not noted in these borings, but it is likely that the borings did not penetrate deep enough to reach the geotextile.

Gravel or geotextile was not encountered in the other borings in the capped area. In most of the capped area, additional fill may have been added later, and the geomembrane and gravel layers may be more than 4 feet bgs (the depth of most of the samples collected at Short Beach Park).

3.3.2 Stratford Landfill

Sixteen deep borings and seven test pits were advanced at the Stratford Landfill. An additional 36 shallow borings (SB-499, SB-508, SB-514 through SB-532 (even numbers only), SB-694, SB-698, SB-735 through SB-737, SB-746 through SB-749, SB-753 through SB-757, SB-766 through SB-774, and SB-779) were advanced along the southern flank of the landfill. Boring log observations from visual examination of the material generally correlated well with laboratory and screening contaminant analysis; refer to Section 4 for contaminant nature and extent details. Fill materials ranged up to 45 feet thick at the landfill. Eleven of the 52 soil borings were advanced into native materials. Section 3.3.2.1 describes fill materials and visual observations of potential Raymark waste at the landfill. Section 3.3.2.2 describes the native materials encountered below the fill. Three borings (SL-SB-305, 306, and 308) were advanced for geotechnical purposes only and no samples were collected. All other borings were advanced to collect samples to determine presence or absence of Raymark waste. The information in this section was interpreted from field notes and boring logs.

3.3.2.1 Fill Materials

The Stratford Landfill area was originally at an elevation very close to sea level, as indicated by a 1941 aerial photograph. Presently, the elevation of the top of the landfill area is roughly 30 feet NGVD, indicating significant filling since that time. The fill is expected to extend below the water table because of compaction of the fill and underlying material.

The fill at the Stratford Landfill consists of mixed manmade and natural fill materials. The bottom of fill ranged from 20 to 45 feet bgs, with an elevation of 3 to -15 feet NGVD. Natural fill materials generally consisted of silty sand, with some sand/gravel mixtures, as well as yard/brush debris (mainly grass and wood). Manmade materials included household debris, with some construction materials and burn layers. The manmade materials with the largest horizontal extent was plastic, which was encountered in about half of the borings and test pits. Metal, glass, and paper were encountered in roughly a quarter of the borings. Other manmade materials encountered at the landfill included asphalt, brick, cloth, dried paint, rubber, slag, and tile. Evidence of petroleum contamination (a sheen and/or odor) was encountered in two of the soil borings. Burn layers, indicated by charred material, ash, and/or cinders, were encountered in 12 of the locations.

Potential asbestos-containing material (PACM) was noted in the landfill as fibrous material (in a mat or as loose fibers) or as brake pads. The fibrous material was encountered in samples from SB-526, SB-528, SB-532, SB-746, SB-753, SL-SB-302A, SL-SB-304, TP-02, and TP-04, and was generally described as a white or light brown spongy material. Brake pads were encountered at SL-SB-301, SL-SB-302A, TP-03, and TP-04, which were located in the same area, as well as in one boring, SL-SB-301, in the center of the northern portion of the landfill. The PACM was encountered mostly within 10 feet of the ground surface; however, at borings SL-SB-301 and SL-SB-304 it was encountered at 22 to 26 feet bgs. Most of these locations contained Raymark waste; refer to Section 4 for a discussion of analytical results.

3.3.2.2 Native Materials

Native material at the Stratford Landfill was assumed to be close to sea level, as aerial photographs from the 1940s indicate that the area of the present landfill was originally flat and marshy. Several borings and the test pits did not reach native material, as they either did not encounter clean material, or the bottom of the boring was above 5 feet NGVD. The borings included SL-SB-302, SL-SB-302A, SL-SB-311, and SL-SB-313; and the shallow DPT borings. The deepest borings at the Stratford Landfill ended at -28 feet NGVD and -27.5 feet NGVD (SL-SB-303 and SL-SB-308, respectively). The rest of the borings were shallower than -20 feet NGVD. Refer to Section 3.3.3 for a discussion of deep overburden and bedrock materials.

Four of the borings advanced at the landfill (SL-SB-300, SL-SB-301, SL-SB-306, and SL-SB-307) encountered an organic layer below fill. The organic material consisted of peat (SL-SB-300 and 307) and organic silt with roots (SL-SB-306), with a mixture of both materials at SL-SB-301. The organic materials, characteristic of marshy deposits, were located in the center and the eastern portion of the landfill.

The other materials encountered in the borings consisted of sand/silt mixtures (SL-SB-305, 308, 309, 312, and 314) or sand/gravel mixtures (SL-SB-303, 304, 305, 306, and 312), characteristic of glacial outwash deposits. In one boring (SL-SO-306), the sand and gravel mixtures were encountered below an organic layer. As several of the borings were advanced for geotechnical purposes and samples were logged every 5 feet below the fill, any organic layer below the fill may have been missed.

3.3.3 Deep Overburden and Bedrock Geology

The purpose of the OU9 field investigation conducted during December 2003 to February 2004 was to determine areas of potential Raymark waste; therefore, sampling efforts focused on the fill materials. The only borings advanced below -20 feet NGVD were SL-SB-303 and SL-SB-308, which were advanced to -28 and -27.5 feet NGVD, respectively. Bedrock was not encountered in any of the borings, and no outcrops were found in the OU9 study area during the course of the investigation. In order to present a more complete picture of the overburden and bedrock materials in the study area, information from the Stratford Army Engine Plant (SAEP), located northwest of the Stratford Landfill, was used to supplement the OU9 field investigation. Figure 1-2 depicts the SAEP and the OU9 study area. The geology of the SAEP is discussed in detail in the *Draft Remedial Investigation Report, Stratford Army Engine Plant, Stratford, Connecticut* (Harding ESE, 2003).

The SAEP is roughly 1500 feet northwest of the OU9 study area. Both areas are located along the western side of the Housatonic River, and are separated by the Marine Basin. The SAEP differs substantially from the OU9 study area in land usage, thus fill materials and thickness are different for the two locations. The material below fill at the SAEP was a thick silt deposit, which varied from as much as 30 feet thick in the Housatonic River tidal flats, to nonexistent toward the interior of the facility. Some silt was encountered at OU9. However, it was generally reworked and mixed with fill materials; very little clean silt was encountered. Peat was also noted from 3 to 20 feet bgs in discontinuous pockets, similar to the findings in the Stratford Landfill. Refer to Sections 3.3.1 and 3.3.2 for a detailed description of fill materials and shallow subsurface materials at Short Beach Park and the Stratford Landfill, respectively.

A thick zone of sand and gravel underlies the materials noted above and overlies bedrock at the SAEP. The sand and gravel, which was seen across the entire site, ranges in thickness from 10 feet to over 156 feet across the site and is divided into two units. The first is an alluvial deposit consisting of sand with trace amounts of coarser material and clay, silt and cobbles, with a bottom elevation of -14 to -36 feet NGVD (Harding ESE, 2003). This material is also found at the Stratford Landfill in boring SL-SO-303 at depth, indicating that the same alluvial deposit may underlie both sites. Below the alluvial material is a glacial outwash deposit which overlies bedrock at the SAEP. The glacial outwash material is a fine to medium sand with some silt and occasional lenses of silt, clay, and fine silty sand mixes (Harding ESE, 2003). This second,

deeper, unit was not encountered during the OU9 field investigations and cannot be compared to the deeper materials at the SAEP. The two sand and gravel units noted at the SAEP together are thicker toward the southeast as the top of bedrock drops and may continue under the Marine Basin to the OU9 study area. However, deep borings have not been advanced between the two areas to confirm this possibility. The USGS surficial materials map of Connecticut (Stone et al. 1992) indicates sand and gravel units overlying sand in the OU9 study area; additional, deeper borings would be required to confirm the presence of the glacial outwash unit beneath OU9.

Bedrock beneath the SAEP has been identified as a black to gray schist or phyllite. Bedrock cores retrieved from the area indicate minimal to moderate fracturing (Harding ESE, 2003). Both the SAEP and the OU9 study area are mapped as part of the Oronoque formation, with medium to fine-grained schist or phyllite (CTGNHS, 1985). The depth of bedrock ranges from 49 feet to 184 feet bgs or -50 to -175 feet NGVD. Seismic survey results indicated that the depth to bedrock is highly variable, even over relatively short distances. The bedrock surface dips to the northwest and southwest, with a bedrock high located in the southwest portion of the SAEP. However, since the depth to bedrock at the SAEP varies significantly, the depth to bedrock under the OU9 study area cannot be extrapolated from the SAEP data with any confidence.

3.4 Hydrogeology

The field investigation at OU9 did not include groundwater sampling and no monitoring wells are known to be present on the property; therefore, no specific information on groundwater beneath the OU9 study area is known. In reviewing historical aerial photographs, it appears that the OU9 study area was originally a low-lying swamp before it was filled in. Based on this fact and field data from boring logs, the water table is close to the level of the river (around 0 feet NGVD).

The entire OU9 study area has historically been used as a landfill, receiving fill from various sources over the years. Because of this, the potential for the area to impact groundwater was assumed. The objective of this investigation was to identify the presence or absence of Raymark waste through soil sampling. The results of this sampling identified Raymark waste at locations within both the Stratford Landfill and Short Beach Park.

This sampling also confirmed Raymark waste as only a very small component of the overall volume of fill within the landfilled area. Further, approximately 10 percent of the Short Beach Park area was found to contain Raymark waste. Therefore, while impacts to groundwater from the entire landfill are unknown, the relative impact to groundwater from just Raymark waste is likely to be small.

Fieldwork at the SAEP, located 1500 feet to the northwest, also indicated that groundwater elevations were between 1 foot and 3 feet NGVD, with small hydraulic gradients across the site. The groundwater flow direction at the SAEP is toward the Housatonic River to the north and northeast for the shallow wells and to the north and east for the deep wells (Harding ESE, 2003). Similarly, the flow direction under OU9 is most likely toward the Housatonic River to the east and the marine basin to the north. As indicated by Figure 1-2, the SAEP and the OU9 study area are separated by the marine basin and are most likely not hydraulically connected.

3.5 Climate and Meteorology

The OU9 study area is located in a temperate-humid climate, characterized by highly changeable weather and large daily and annual temperature variations. The most pronounced topographical effect is the land-sea breeze, an occurrence generally associated with the spring through early autumn months. In general, monthly temperatures during the summer months average 3 to 5 degrees lower than nearby inland locations. Temperatures during the fall and winter months are moderated because of the proximity of Long Island Sound. Winter snowfall is generally around 10 inches less than areas a few miles inland, also because of the proximity to Long Island Sound.

Low-lying areas are subject to flooding during periods of high tide (from hurricanes and storms). Tides 3 to 5 feet higher than normal may be encountered in the presence of slow-moving, deepening low pressure systems.

The local National Oceanic and Atmospheric Administration (NOAA) Climatological Station is located at the Bridgeport-Sikorsky Airport, which is next to the OU9 study area. For the past 30 years, data from this station have been used to describe the general climate in the area.

July is the warmest month with an average temperature of 74.0°F. The coldest month is January with an average temperature of 29.9°F. The maximum temperature observed from 1939 to 1998 was 103°F. The minimum temperature observed during this period was –7°F. Normal annual precipitation for the region is 44.2 inches, with between 3 and 4 inches of rain or water equivalent falling during each month. The area has an average annual snowfall of 25.8 inches, which generally occurs between November and April. However, most snowfall occurs in January and February. Snowfall averages for these two months are 7.4 inches and 7.6 inches, respectively.

Wind speed in the area varies between 9.3 and 13.0 miles per hour (mph) with an average of 11.4 mph. In the warmer months the prevailing wind direction is southwest. In the colder months the prevailing direction is west to northwest (NOAA, 2002).

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents the analytical results of sampling conducted within the OU9 Study Area (Short Beach Park and Stratford Landfill areas). As described in Section 2.0, from 1993 to 2004 investigations have been performed to evaluate and characterize the nature and extent of contamination in soils at Short Beach Park and the Stratford Landfill. In 1993, a limited number of sediment samples were collected in areas surrounding the Stratford Landfill. No sediment samples have been collected in or around Short Beach Park. To date, no groundwater, surface water, or air samples have been collected within the OU9 Study Area. Section 4 includes an overview of potential contaminant sources and a discussion of the nature and extent of contamination in soils at various depths at Short Beach Park and the Stratford Landfill.

The primary basis of the nature and extent of soil contamination is on samples collected by TtNUS for EPA during the 2003/2004 sampling effort. Soil boring logs from this effort are presented in Appendix A, and the locations of soil borings are shown on Figure 2-1. Also included in the nature and extent of soil contamination discussion are samples collected by EPA during June 1993. Samples collected in 1989, April and May 1993, 1995, and 1996 were not included in the nature and extent of soil contamination discussion because of either a lack of coordinates or a lack of analytical data for one or more of the contaminants necessary to identify the Raymark as defined.

Analytical results from all investigations are included in Appendix B. Appendix B-1 present analytical results from samples collected in 1989, April and May 1993, 1995, and 1996 that were not used in the nature and extent discussion. In September 1989, EPA collected surface soil and sediment samples from the Stratford Landfill. Soil samples were also collected in 1993 by the CTDEP as part of their evaluation for an interim cap in an area of Short Beach Park known to contain Raymark waste (refer to Section 2.2). In March 1995, soil samples were collected in the area of the cap (Section 2.4). Soil samples were collected by EPA in 1996 to evaluate an area of the baseball fields for placement of dugouts (refer to Section 2.5). Appendix B-1 includes a memorandum explaining why these samples were not used for the nature and extent discussion**.** Appendix B-2 presents analytical results from samples collected in June 1993 and the 2003/2004 sampling effort that were used to determine estimated areas of Raymark waste. See Sections 1.4 and 1.5.2 for an explanation of Raymark waste and the approach to determining estimated areas of Raymark waste. Samples identified as containing Raymark

waste are listed on Table 4-1[1]. The nature and extent discussion focuses on samples collected from estimated areas of Raymark waste only (see green areas on Figure 3-1). Within Appendix B-2, samples that fall within the estimated areas of Raymark waste are separated from samples that do not.

A qualitative discussion of contamination outside estimated areas of Raymark waste is presented in Section 4.5. Supporting tables are provided in Appendix B-3. Portions of the OU9 study area that are outside of the defined Raymark waste areas are not considered part of the Superfund site. For that reason, only the areas within the estimated areas of Raymark waste are evaluated in Section 4.4, Nature and Extent of Contamination in Soils.

4.1 Potential Sources of Contamination

The OU9 study area includes both the Stratford Landfill and the former landfill where Short Beach Park exists today. Sources of contamination that may have contributed to soil contamination in the OU9 study area include dumping of waste materials brought from the former Raymark Facility, dumping of unknown wastes, and disposal of drums and debris from sources other than the former Raymark Facility. Disposal of waste materials from the former Raymark facility has resulted in contaminant levels in soils from some locations of the study area that meet the definition of Raymark waste and exceed the CTRSRs.

4.2 Overview of Chemical Compounds Detected

Brief descriptions of the major classes of chemical contaminants detected in the soil in the OU9 study area are provided in Sections 4.2.1 through 4.2.6

4.2.1 Volatile Organic Compounds (VOCs)

The VOCs detected in environmental samples collected from the OU9 study area can be separated into three major groups: chlorinated hydrocarbons, aromatic hydrocarbons, and ketones. Many of these VOCs are organic solvents commonly used in industrial processes: to

[1] Raymark waste in soil is defined as a single soil sample at the same depth interval containing lead above 400 parts per million (ppm) (milligrams per kilogram (mg/kg)) **and** asbestos (chrysotile only) greater than 1 percent **and either** copper above 288 ppm (mg/kg) **or** polychlorinated biphenyls (PCBs) (Aroclor 1268 only) above 1 ppm (mg/kg).

degrease parts; to prepare metal surfaces prior to painting, coating, or bonding; as constituents of paint thinners and resins; and to extract organic compounds from materials. Additionally, some of the detected VOCs are common components of gasoline and petroleum fuels.

4.2.2 Semivolatile Organic Compounds (SVOCs)

The SVOCs detected in environmental samples collected from the OU9 study area can be separated into three major groups: phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates. Only a few other isolated SVOC compounds were detected. SVOCs are common constituents of various industrial products. Phenolic compounds are typically associated with fuels, coal, and petroleum products, and are also used to manufacture friction materials. PAHs are common components of coal tar (bitumen and asphaltic tars), petroleum products (motor and fuel oil), and combustion by-products. Phthalates are typically used as plasticizers in the manufacture of synthetic materials.

4.2.3 Pesticides

Pesticides are typically used to control the presence or population of unwanted insects in both residential and commercial areas, as well as to prevent crop destruction in agricultural settings. Pesticide formulations may include chlorinated and organophosphorous varieties.

4.2.4 Polychlorinated Biphenyls (PCBs)

The PCBs detected in the environmental samples collected from the OU9 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.

4.2.5 Metals

Many metals were detected in the environmental samples collected from the OU9 study area. Metals are naturally occurring components of soil and/or localized mineral deposits and occur

as a result of decomposition of weathered bedrock. Metals may also be introduced into the environment through various industrial activities including disposal of waste materials or process sludges, and fugitive emissions from various thermal or combustion processes.

4.2.6 Asbestos

Asbestos was detected in sediment and soil samples collected from the OU9 study area. Asbestos is a group of magnesium silicate minerals that contains 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; it was also used as a reinforcing agent in rubber and plastics.

4.3 Raymark Waste Areas

The portions of the OU9 study area where Raymark waste was identified were determined following the approach detailed in Section 1.5.2. The estimated areas of Raymark waste are shown on Figure 3-1. Human health risks from these areas have been estimated (refer to Section 6). Portions of the OU9 study area that are outside of the defined Raymark waste areas may also contain similar contamination, but are not considered part of the Superfund site. For that reason, only the areas within the estimated areas of Raymark waste are evaluated in Section 4.4, Nature and Extent of Contamination in Soils.

4.3.1 Chemical Compounds Used or Handled at the Former Raymark Facility

A number of chemical compounds and materials were handled, stored, and/or used in manufacturing processes at the former Raymark Facility during its operation. A list of these chemicals, presented in Table 4-2, was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and the Facility's RCRA Part A application (August 15, 1980). A Part B application was drafted, but never filed, for the former Raymark Facility. This section and Table 4-2 provide a summary of the specific chemicals known to have been stored, handled, or used at the former Raymark Facility during its operation and that may have contributed to contamination of the OU9 study area.

VOCs used at the former Raymark Facility consisted mainly of chlorinated hydrocarbons, aromatic hydrocarbons, and ketones used as organic solvents. Organic solvents were also used in various capacities at the former Raymark Facility.

SVOCs used at the former Raymark Facility included phenolic compounds, naphthalene, and phthalates. Phenolic resins were used in manufacturing friction materials, and were mixed with asbestos to manufacture brake pads and linings at the former Raymark Facility.

Pesticides may have been used at the former Raymark Facility to control insect populations. However, no documentation of their use has been identified. Pesticides also may have been used for similar reasons in the OU9 study area during landfill operations.

No information has been provided directly by the former Raymark Facility documenting the specific use of PCBs as part of their manufacturing process. However, there is literature indicating that PCBs were used in the manufacturing of brake linings. The former 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. Aroclor 1262 and 1268 were both identified in soils and groundwater at the former Raymark Facility. Aroclor 1268 is one of the indicator contaminants in Raymark waste.

Barium, copper, lead, tin, and zinc were the primary metals used at the former Raymark Facility to fabricate various brake and friction materials. Each metal was detected at elevated concentrations in the OU9 study area. Lead and copper are two of the indicator contaminants in Raymark waste.

4.3.2 Evaluation of Data

Analytical results of soil samples collected from within the estimated areas of Raymark waste at the OU9 study area during the June 1993 and 2003/2004 sampling efforts were evaluated to determine the usability of the data. If both screening and laboratory results were available for a single sample, the laboratory result for each sample was always used. For duplicate pairs, the maximum concentration of the two samples was used to represent one result for the sample. Samples collected from Short Beach Park and the Stratford Landfill were evaluated separately.

All samples collected at the Stratford Landfill were evaluated because the entire Stratford Landfill is an estimated area of Raymark waste. At Short Beach Park only samples collected from within the estimated areas of Raymark waste were evaluated in the nature and extent discussion and the risk assessment. The approach used for evaluating analytical results is detailed in Section 4.3.2.2.

4.3.2.1 Data Usability

Soil samples were collected over the past 10 years to determine if the sampled wastes were associated with the former Raymark Facility. The samples were analyzed using field screening techniques and/or by a fixed laboratory using EPA-approved methods. Sample results from samples collected within the estimated areas of Raymark waste during the June 1993 and the 2003/2004 sampling efforts were evaluated to determine whether the results of both field screening and fixed laboratory methods could be used interchangeably to evaluated nature and extent of contamination and risk for lead, copper, and PCB sample results. All asbestos data were considered useable because only one method was used to evaluate the samples.

The lead, copper, and PCB screening data were evaluated by statistical analysis (linear regression) to determine a potential correlation between the field screening data and the results by fixed laboratory methods. The linear regression analysis involved a point-by-point comparison of the data generated by the two methods. The correlation results are presented in Appendix B-4.

The results of the statistical analysis indicated that the screening data collected for copper, lead, and PCBs could be used with the same level of confidence as the data from the fixed laboratory. EPA, therefore, deemed the copper, lead, and PCB screening data acceptable for use quantitatively in the RI and risk assessment.

4.3.2.2 Approach for Evaluating Analytical Results

Analytical results from samples collected in June 1993 and 2003/2004 are presented in their entirety in Appendix B-2 of this document. Samples identified as containing Raymark waste are listed on Table 4-1. These samples were used to define the estimated areas of Raymark waste shown on Figure 3-1. Regulatory criteria are listed on Table 4-3. Summary statistics and

comparison of data from within the estimated areas of Raymark waste to regulatory criteria are presented on Tables 4-4 through 4-7. The statistical methods utilized to evaluate the results and the criteria utilized for comparison are explained below.

Summary Statistics. The analytical results are evaluated by looking at the central tendency of the data and the spread of the data. Measures of central tendency attempt to identify the most representative value in a set of data. Mean, median and mode give different perspectives of a data set's center, but a data description is not complete until the spread variability is also known.

Central tendency is the measure of location of the middle or the center of a distribution, and can refer to a wide variety of measures such as mean and median. The mean (average) is the most commonly used measure of central tendency. Both the mean and median (the value that has exactly half the data above it and half below) are used in this section to describe the central tendency of contaminant concentrations.

In general, one-half of the detection limit was used for non-detected results to calculate mean and median values. For asbestos, non-detected results were evaluated as 0.1 percent and trace amounts were evaluated as 0.9 percent. The value of 0.9 percent was assigned when the laboratory reported “trace” amounts because the NESHAP definition used 1 percent to define asbestos containing material.

Spread variability is measured by methods such as range and standard deviation. Range and standard deviation are used in this section to describe the spread of contaminant concentrations. The range is the difference between the largest and the smallest observed values in a data set. Thus, range, including any outliers, is the actual spread of data. Throughout this report, the range is represented by the maximum and minimum detected concentrations of contaminants. A great deal of information is ignored when computing the range, since only the largest and smallest data values are considered. The range value of a data set is greatly influenced by the presence of just one unusually large or small value (outlier). The disadvantage of using range is that it does not measure the spread of the majority of values in a data set—it only measures the spread between highest and lowest values. As a result, other measures are required in order to give a better picture of the data spread.

Standard deviation combines all the values in a data set to produce a measure of spread, and is the measure of spread most commonly used in statistical practice when the mean is used to calculate central tendency. Thus, it measures spread around the mean. Because of its close links with the mean, standard deviation can be greatly affected if the mean gives a poor measure of central tendency.

Standard deviation is also influenced by outliers; one value could contribute largely to the results of the standard deviation. In that sense, the standard deviation is a good indicator of the presence of outliers. Generally, the more widely spread the values are, the larger the standard deviation is.

Comparison Criteria. For purposes of evaluating the nature and extent of contamination, contaminants were compared to the CTRSRs, Regulations of Connecticut State Agencies Section 22a-133k-2, Standards for Soil Remediation (CTDEP, 1996); Pollutant Mobility Criteria (CTPMC) for GB Aquifers, and Direct Exposure Criteria (CTDEC) for soils. These criteria are listed on Table 4-3. Sample results from the Short Beach Park Area were compared to the CTDEC for residential soils and samples from the Stratford Landfill were compared to CTDEC for industrial soils. The CTDEC were used as screening values to help identify contaminants that may pose threats to human health through direct contact with soils. CTDECs are regulatory criteria for soil based predominantly on risk from exposures via the ingestion pathway, with consideration given to state-determined background concentrations, detection limits, and state-determined ceiling limits. These ceiling limits are maximum concentrations at which criteria will be set and are generally used for chemicals of very low toxicity.

CTPMCs are regulatory criteria for soil based on ambient water quality criteria and modeling the migration of contaminants from soil to groundwater. The comparison allows a preliminary evaluation of the chemicals' potential to migrate to groundwater and potentially impact the quality of groundwater.

Under the CTRSRs (CTDEP, 1996), concerns regarding the leachability of metals and PCBs are addressed using Toxicity Characteristic Leaching Procedure (TCLP) and/or Synthetic Precipitation Procedure (SPLP) data. A comparison of site-specific SPLP data to CTRSRs for pollutant mobility is provided in Tables 4-4 through 4-7, as appropriate.

There are no criteria in the CTRSRs for asbestos or dioxins and furans in soils. Because there are no health-based regulations for soils containing asbestos, greater than 1 percent asbestos was used to evaluate the presence or absence of asbestos. Asbestos-containing material is defined in 40 CFR Part 61 Subpart M, as material containing more than 1 percent asbestos. Tables 4-4 through 4-7 include the greater than 1 percent criterion for asbestos.

Soil samples from the former Raymark Facility contained detectable concentrations of dioxins and furans. Dioxins and furans are not manufactured commercially. Chlorinated dioxins and furans 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 and furans. The toxicities of all other dioxins and furans are expressed in relation to 2,3,7,8-TCDD. Concentrations of each individual dioxin and furan in a sample are multiplied by Toxicity Equivalent Factors (TEFs) to yield 2,3,7,8-TCDD equivalent concentrations. These values are then totaled to yield total dioxin Toxicity Equivalent (TEQ) concentrations.

Asbestos-containing materials were a primary component in the products manufactured at the former 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 transmission plates) and gaskets. Chrysotile asbestos is one of the indicator contaminants for Raymark waste.

4.4 Nature and Extent of Contamination in Soils

Soil sampling has been performed at Short Beach Park and the Stratford Landfill (Figure 2-1). Sample results for the two areas were evaluated separately, as these are two distinctly different areas. For both Short Beach Park and the Stratford Landfill, the results were evaluated to determine the estimated areas of Raymark waste and the following depth bgs intervals from which the samples were collected: 0 to 2 feet bgs and greater than 2 feet bgs. This Nature and Extent section only pertains to those sample locations within the “estimated area of Raymark waste” as shown on Figure 3-1. For those sample locations outside these areas, please see Section 4.5 and Appendix B-3.

Figures 4-1 through 4-4 depict sample locations, and identify estimated areas of Raymark waste, samples containing Raymark waste, and samples with contaminant concentrations exceeding CTRSRs. Tables 4-4 through 4-7 present the summary statistics for each of the compounds detected within the estimated area of Raymark waste.

The evaluation of the soil sample results for Short Beach Park and the Stratford Landfill is presented in Sections 4.4.1 and 4.4.2, respectively.

4.4.1 Short Beach Park

This evaluation of soil contamination at Short Beach Park includes surface soil samples collected by EPA in June 1993 and by EPA in 2003/2004. Soil samples were also collected in 1993 by the CTDEP as part of their evaluation for an interim cap in an area known to contain Raymark waste (refer to Section 2.2). In March 1995, soil samples were collected in the area of the cap. These sample results were not included in the statistical summaries provided in Tables 4-4 through 4-7, because location coordinates were not available. The CTDEP 1993 soil sample results can be found in Appendix B-1. Soil samples were also collected by EPA in 1996 to evaluate an area of the baseball fields for placement of dug outs (refer to Section 2.5). These samples were only analyzed for asbestos and were not included in the statistical summaries provided in Tables 4-4 through 4-7. The results are also provided in Appendix B-1.

A total of 188 soil samples were collected from 188 locations at the 64.1-acre Short Beach Park area during 1993 and 1,072 samples from 447 locations were collected during 2003/2004. Three hundred and two soil samples of the 1,260 soil samples collected during the June 1993 and 2003/2004 sampling events were collected from within the 6.3-acre estimated areas of Raymark waste and analyzed for asbestos, dioxins, metals, VOCs, SVOCs, pesticides, and PCBs. Two of the 302 samples were collected during 1993; all other samples were collected during 2003/2004. Results from those samples are evaluated below according to the depth interval from which the samples were collected. The estimated areas of Raymark waste are referred to as the northern and southern areas to help direct the reader to specific sample locations mentioned in the text.

As described in Section 4.3.2.2, sample results were evaluated against the CTPMC for GB Aquifers and Direct Exposure Criteria CTDEC for residential soils. The analytical results from

those samples that are located inside the estimated areas of Raymark waste are evaluated below by sample depth. Results of samples collected outside the estimated area of Raymark waste are summarized in Section 4.5 and Appendix B-3.

4.4.1.1 0 to 2 Feet Below Ground Surface

A total of 134 soil samples were collected from 0 to 2 feet bgs in areas determined to contain Raymark waste at Short Beach Park (Figure 4-1). Data used in this RI include 50 samples that were analyzed for asbestos; nine samples that were analyzed for dioxins and furans; a total of 134 samples that were analyzed for lead and 132 samples that were analyzed for copper; 36 samples that were analyzed for CLP target analyte list (TAL) metals; 35 samples that were analyzed for SVOCs, VOCs, and pesticides; a total of 50 samples that were analyzed for PCBs; and one sample that was analyzed for SPLP metals and PCBs. The sample results for each parameter are presented below. Refer to Table 4-4 for the summary of statistics for each analyte.

Asbestos. Fifty soil samples were collected and analyzed for asbestos. The amount of asbestos ranged from trace to 32 percent. More than 1 percent asbestos was found in 22 of the 50 samples. The highest amount of asbestos was found at SB-482 and SB-701, both located in the southern-most area of Raymark waste.

Dioxins and Furans**.** Nine samples were analyzed for dioxins and furans. Dioxins were detected in all nine samples. The TEQ concentrations ranged from 0.0032 J µg/kg to 0.047 J µg/kg. The highest concentration was found at SB-503.

Metals and SPLP Metals. A total of 134 samples were analyzed for lead and 132 samples were analyzed for copper, and 36 samples were analyzed for TAL metals at a fixed laboratory. Some metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered to be of low concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. All of these elements, except sodium, were detected in every sample at relatively low concentrations and will not be discussed further in this section. Of the remaining metals, antimony was not detected, while most others were detected frequently throughout the areas of Raymark waste.

Arsenic, beryllium, copper and lead are the only metals with concentrations exceeding the CTDEC for residential soils. Arsenic was detected in 21 of 36 samples, with concentrations ranging from 0.43 J mg/kg to 10.7 mg/kg. One sample, collected at SB-451 located along Dorne Drive in the northern area of Raymark waste, had arsenic concentrations exceeding the CTDEC of 10 mg/kg for residential soils. Beryllium concentrations ranged from 0.051 J mg/kg to 3.7 mg/kg in 25 of 36 samples. Three samples had concentrations exceeding the CTDEC for residential soils, 2 mg/kg. The highest concentration was detected at SB-569, in the northern area of Raymark waste.

Copper and lead, two of the indicator contaminants of Raymark waste, were detected in 64 of 132 and 87 of 134 samples, respectively. Copper concentrations ranged from 20.2 J mg/kg to 10,300 mg/kg, with a median concentration of 75 mg/kg, an average concentration of 54 mg/kg, and a standard deviation of 1473. The highest concentrations were typically found in the southern area of Raymark waste. Eight samples exceeded the CTDEC for copper in residential soils (2,500 mg/kg). Lead concentrations ranged from 7.3 J mg/kg to 3,520 mg/kg, with a median concentration of 33.4 mg/kg, an average concentration of 219 mg/kg, and a standard deviation of 513. The highest lead concentrations were also found in the southern area of Raymark waste. Concentrations from 20 samples exceeded the CTDEC for residential soils (400 mg/kg). No CTDEC for metals other than arsenic, beryllium, copper, and lead were exceeded.

One sample was analyzed for SPLP metals. None of the metals concentrations in the SPLP leachate exceeded the CTPMC for GB aquifers.

<u>SVOCs.</u> Thirty-five samples were analyzed for SVOCs at a fixed laboratory. Several SVOCS, primarily PAHs, phenols and phthalates, were detected. Concentrations of benzo(b) fluoranthene exceeded the CTDEC for residential soils (1,000 µg/kg) and the CTPMC for GB aquifers (1,000 µg/kg) at one location, SB-451 in the northern area of Raymark waste. Concentrations of dibenzo(a,h)anthracene also exceeded the CTDEC for residential soils (84 µg/kg) at SB-451, as well as at SB-407 and SB-504. The chrysene concentration at SB-451 exceeded the CTPMC for GB aquifers (1,000 µg/kg). No other contaminant concentrations exceeded CTRSRs.

VOCs. Thirty-five samples were analyzed for VOCs at a fixed laboratory. 2-Butanone and acetone were detected most frequently, though in less than half of the samples. Both are common laboratory contaminants and are likely the result of the analytical process rather than contamination found in the sampled medium. The remaining VOCs were detected infrequently, in both the northern and southern areas of Raymark waste. Highest concentrations were detected predominantly at SB-407 located along Dorne Drive. The CTDEC and CTPMC were not exceeded in any of the samples.

Pesticides. Thirty-five samples were analyzed for pesticides at a fixed laboratory. Several pesticides were detected, however, concentrations were low. The CTDEC for pesticides in residential soils were not exceeded in any of the samples. The CTPMC was exceeded for 4,4'-dichlorodiphenyldichloroethane (4,4'-DDD) (29 µg/kg) at one location, 4,4'-dichlorodiphenyl-dichloroethylene (4,4'-DDE) (21 µg/kg) at seven locations, and 4,4'-dichlorodiphenyl-trichloroethane (4,4'-DDT) (21 µg/kg) at one location, primarily in the southern area of Raymark waste.

PCBs. Fifty samples were analyzed for PCBs. Thirteen samples were screened for Aroclors 1262 and 1268 only, 35 samples were analyzed at a fixed laboratory for Aroclors 1262, 1268, as well as seven additional Aroclors, and two screening samples were also analyzed at a fixed laboratory to confirm the screening results.

In samples analyzed for PCBs, Aroclor 1262 and 1268 were detected most frequently. Aroclor 1254 was the only other Aroclor detected. Aroclor 1254 was detected just once at SB-451. Twenty-six of 50 samples contained detectable concentrations of Aroclors 1254, 1262, and/or 1268. Concentrations of Aroclor 1262 ranged from 32 J µg/kg to 4,000 µg/kg with a median concentration of 75 µg/kg, an average concentration of 380 µg/kg and a standard deviation of 815 µg/kg. Four samples contained concentrations of Aroclor 1262 higher than the CTDEC for residential soils of 1,000 µg/kg. Concentrations of Aroclor 1268 ranged from 56 µg/kg to 2,500 µg/kg with a median concentration of 23.3 µg/kg, an average concentration of 280 µg/kg, and a standard deviation of 533 µg/kg. Four samples contained concentrations of Aroclor 1268 higher than the CTDEC for residential soils of 1,000 µg/kg. The highest concentrations of both Aroclors were detected at SB-504 in the southern area of Raymark waste.

One sample was also analyzed for SPLP PCBS. No PCBs were detected in the SPLP leachate.

4.4.1.2 Depths Greater than 2 Feet Below Ground Surface

A total of 169 soil samples at 96 locations were collected from depths greater than 2 feet below ground surface in the areas determined to contain Raymark waste at Short Beach Park (Figure 4-2). The maximum depth from which a sample was collected was 12 feet below ground surface. Data used in this RI include 107 samples that were analyzed for asbestos; 13 samples that were analyzed for dioxins and furans; a total of 169 samples that were analyzed for lead and copper; 64 samples that were analyzed for TAL metals at a fixed laboratory; 64 samples that were analyzed for SVOCs, VOCs, and pesticides; a total of 108 samples that were analyzed for PCBs; and 13 samples that were analyzed for SPLP metals and PCBs. The sample results for each parameter are presented below. Refer to Table 4-5 for the summary of statistics for each parameter.

Asbestos. One hundred seven samples were collected and analyzed for asbestos. The amount of asbestos ranged from trace to 48 percent. The median amount of asbestos found was 7.7 percent, and the average amount was 12 percent. The standard deviation was 12.2 percent. More than 1 percent asbestos was found in 75 of the 107 samples. The highest amount of asbestos was found at SB-745 located in the northern area of Raymark waste in the middle of the interim cap area, from 4 feet to 6 feet below ground surface and at SB-480 in the southern area of Raymark waste from 2 to 4 feet below ground surface.

Dioxins and Furans. Thirteen samples were analyzed for dioxins and furans. Dioxins were detected in every sample. The TEQ concentrations ranged from 0.0011 J µg/kg to a maximum concentration of 0.38 J µg/kg detected at SB-480 from 2 to 4 feet below ground surface.

Metals and SPLP Metals. A total of 169 samples were analyzed for lead and copper, and 64 samples were analyzed for TAL metals at a fixed laboratory. Some of the detected metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered to be of low concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. All of these elements except sodium and potassium, were detected in every sample at relatively low concentrations, and none will be discussed further in this section. Of the remaining metals, most were detected frequently throughout the areas of Raymark waste.

Arsenic, barium, chromium, copper, lead, and vanadium concentrations exceeded the CTDEC for residential soils in samples located in both the northern and southern areas of Raymark waste. Antimony, beryllium, and thallium were each only detected once at concentrations higher than the CTDEC for residential soils (27 mg/kg, 2 mg/kg, and 5.4 mg/kg, respectively). Antimony concentrations ranged from 1.4 J mg/kg to 38.6 mg/kg in 3 of 59 samples with a median concentration of 0.47 mg/kg, an average concentration of 1.3 mg/kg, and a standard deviation of 4.98 mg/kg. Beryllium concentrations ranged from 0.068 mg/kg to 2.9 mg/kg in 29 of 63 samples with a median concentration of 0.15 mg/kg, an average concentration of 0.3 mg/kg, and a standard deviation of 0.42 mg/kg. Thallium was detected in only two samples at 0.86 J mg/kg and 5.7 J mg/kg. Arsenic concentrations ranged from 0.61 J mg/kg to 31.3 J mg/kg in 51 of 64 samples with a median concentration of 5.8 mg/kg, an average concentration of 6.6 mg/kg, and a standard deviation of 5.5. Concentrations in 11 samples, located primarily in the northern area of Raymark waste, exceeded the CTDEC for residential soils of 10 mg/kg for arsenic. The highest concentration was found at SB-451 from 2 feet to 4 feet below ground surface. Barium was detected in every sample. Concentrations ranged from 38.5 mg/kg to 9,900 mg/kg with a median concentration of 377 mg/kg, an average concentration of 1,770 mg/kg, and a standard deviation of 2,512 mg/kg. Concentrations of barium higher than the CTDEC for residential soils of 4,700 mg/kg were found in nine samples in both the northern and southern areas of Raymark waste. The highest concentration was found at SB-745 from 4 feet to 6 feet below ground surface. Chromium was detected in all 64 samples and concentrations ranged from 7.5 J mg/kg to 267 mg/kg. The median concentration was 32.5 mg/kg, the average concentration was 54.8 mg/kg and the standard deviation was 53.5 mg/kg. Concentrations of chromium exceeded the CTDEC for residential soils of 100 mg/kg in nine samples, throughout both the northern and southern areas of Raymark waste. The highest concentration was found at SB-355 from 2 to 4 feet below ground surface. Vanadium was detected in all 64 samples and concentrations ranged from 4.8 mg/kg to 1220 mg/kg. The median concentration was 21.3 mg/kg, the average concentration was 48.7 mg/kg and the standard deviation was 164 mg/kg. Concentrations of vanadium exceeded the CTDEC for residential soils of 470 mg/kg in two samples. The highest concentration was found at SB-480 from 2 to 4 feet below ground surface.

Copper and lead, two of the indicator contaminants of Raymark waste, were detected in 124 of 169 and 152 of 169 samples, respectively. Copper concentrations ranged from 13.6 J mg/kg to 32,500 mg/kg, with a median concentration of 295 mg/kg, an average concentration of

4,440 mg/kg, and a standard deviation of 7,918 mg/kg. The highest concentrations were found in both the northern and the southern areas of Raymark waste. Forty-nine samples exceeded the CTDEC for copper in residential soils (2,500 mg/kg), with the highest concentration found at SB-745 from 4 feet to 6 feet below ground surface. Lead concentrations ranged from 5.2 J mg/kg to 20,500 mg/kg, with a median concentration of 336 mg/kg, an average concentration of 1,920 mg/kg, and a standard deviation of 3,518 mg/kg. The highest lead concentrations were also found in both the northern and southern areas of Raymark waste. Concentrations from 82 samples exceeded the CTDEC for residential soils (400 mg/kg), with the highest concentration found at SB-745 from 4 feet to 6 feet below ground surface, similar to barium and copper.

Thirteen samples were analyzed for SPLP metals. Concentrations of lead exceeded the CTPMC for GB aquifers of 150 µg/L in nine samples, in areas of Raymark waste. Concentrations of lead in the SPLP leachate from the 13 samples ranged from 6.7J µg/L to 663 µg/L, with a median concentration of 245 µg/L, an average concentration of 294 µg/L and a standard deviation of 230 µg/L. The highest concentration of lead was found at SB-355 from 2 to 4 feet below ground surface. No other metals concentrations exceeded the CTPMC.

<u>SVOCs.</u> Sixty-four samples were analyzed for SVOCs. Several SVOCS, primarily PAHs, phenols and phthalates, were detected. Concentrations of the following SVOCs exceeded the CTDEC for residential soils: benzo(a)anthracene (1,000 µg/kg), benzo(a)pyrene (1,000 µg/kg), benzo(b)fluoranthene (1,000 µg/kg), benzo(k)fluoranthene (8,400 µg/kg), dibenzo(a,h)anthracene (84 µg/kg), indeno(1,2,3-cd)pyrene (840 µg/kg), and N-nitroso-di-n-propylamine (88 µg/kg). Concentrations of the following SVOCs exceeded the CTPMC for GB aquifers: benzo(a)anthracene (1,000 µg/kg), benzo(a)pyrene (1,000 µg/kg), benzo(b)fluoranthene (1,000 µg/kg), benzo(k)fluoranthene (1,000 µg/kg), dibenzo(a,h)-anthracene (1,000 µg/kg), indeno(1,2,3-cd)pyrene (1,000 µg/kg), 2-methylnaphthalene (9,800 µg/kg), bis(2-ethylhexyl)phthalate (11,000 µg/kg), carbazole (360 µg/kg), chrysene (1,000 µg/kg), dibenzofuran (5,600 µg/kg), fluoranthene (56,000 µg/kg), N-nitroso-diphenylamine (1,400 µg/kg), phenanthrene (40,000 µg/kg), and pyrene (40,000 µg/kg). Concentrations of the following SVOCs exceeded both the CTDEC for residential soils and the CTPMC for GB aquifers: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Concentrations of SVOCs higher than the CTRSRs were found in 38 samples from 18 locations. The highest concentrations of SVOCs exceeding the CTDEC or CTPMC were detected primarily at SB-480 in the southern Raymark

waste area. Three of the nine locations in the northern area of Raymark waste are either next to Dorne Drive or in the parking lot of the Recreation Department. Ten locations were found in the southern area of Raymark waste.

VOCs. Sixty-four samples were analyzed for VOCs. VOCs were detected infrequently, primarily in the southern area of Raymark waste. Highest concentrations were detected predominantly at SB-486, SB-482, and SB-519. The CTDEC and CTPMC were not exceeded in any of the samples.

Pesticides. Sixty-four samples were analyzed for pesticides. Several pesticides were detected, however, concentrations were low. The CTDEC for dieldrin in residential soils (38 µg/kg) was exceeded at SB-745 from 6 feet to 8 feet below ground surface. The CTPMC (7 µg/kg) was also exceeded for dieldrin, as well as 4,4'-DDD (29 µg/kg), 4,4'-DDE (21 µg/kg), 4,4'-DDT (21 µg/kg), aldrin (0.41 µg/kg), alpha-benzenehexachloride (BHC) (1.1 µg/kg), beta-BHC (3.9 µg/kg), and gamma-chlordane (66 µg/kg) at scattered locations throughout both areas of Raymark waste.

PCBs. A total of 108 samples were analyzed for Aroclors 1262 and 1268, and 67 samples were analyzed for seven additional Aroclors.

In samples analyzed for PCBs, Aroclor 1262 and 1268 were detected most frequently. Aroclors 1260, 1254, 1248, and 1242 were also detected. Aroclor 1262 was detected in 59 of 108 samples. Concentrations ranged from 50 µg/kg to 47,000 µg/kg with a median concentration of 250 µg/kg, an average concentration of 1,600 µg/kg and a standard deviation of 5,076. Twenty-five samples collected from throughout the Short Beach Park estimated areas of Raymark waste, contained concentrations of Aroclor 1262 higher than the CTDEC for residential soils of 1,000 µg/kg. Aroclor 1268, a Raymark waste indicator parameter, was detected in 53 of 108 samples. Concentrations ranged from 51 µg/kg to 44,000 µg/kg with a median concentration of 250 µg/kg, an average concentration of 1,200 µg/kg, and a standard deviation of 4,483 µg/kg. Twenty-two samples contained concentrations higher than the CTDEC criterion for residential soils of 1,000 µg/kg. Highest concentrations were detected at SB-697, located within the southern area of Raymark waste. One sample each of Aroclors 1242, 1248, and 1260 exceeded the CTDEC (1,000 µg/kg, 1,000 µg/kg, and 1,000 µg/kg). Three samples contained concentrations of Aroclor 1254 higher than the CTDEC for residential soils (1,000 µg/kg).

Thirteen samples were collected and analyzed for SPLP PCBs. No PCBs were detected in the SPLP leachate.

4.4.2 Stratford Landfill

This evaluation of soil contamination at the Stratford Landfill includes 226 surface and subsurface soil samples collected by TtNUS in 2003/2004 and one surface sample collected by EPA in June 1993. Samples were collected from a total of 119 soil borings throughout the 29.8-acre area. Soil boring logs are provided in Appendix A. The analytical results are provided in Appendix B-2. In September 1989, EPA collected surface soil and sediment samples from the Stratford Landfill. These sample results were not included in the statistical summaries provided in Tables 4-4 through 4-7; however, they are included in Appendix B-1.

Sample results were evaluated against the CTRSRs, Regulations of Connecticut State Agencies Section 22a-133k-2, Standards for Soil Remediation (CTDEP, 1996); Pollutant Mobility Criteria (CTPMC) for GB Aquifers, and Direct Exposure Criteria (CTDEC) for industrial soils. The entire Stratford Landfill is considered to be the estimated area of Raymark waste because of the presence of Raymark waste throughout the entire area at varying depths. The analytical results from those samples are evaluated below according to sample depth intervals.

4.4.2.1 <u>0 to 2 Feet Below Ground Surface</u>

Fifty-two samples were collected from the Stratford Landfill from 0 to 2 feet bgs (Figure 4-3). Data used in this RI include seven samples that were analyzed for asbestos; two samples that were analyzed for total metals, SVOCs, VOCs, and pesticides; a total of seven samples that were analyzed for PCBs; and a total of 52 and 51 samples that were analyzed for lead and copper, respectively. No samples from this depth range were analyzed for dioxins and furans. The sample results for each parameter are presented below. Refer to Table 4-6 for summary of statistics for each parameter.

<u>Asbestos.</u> Asbestos was detected in six of seven of the samples analyzed and found at greater than 1 percent in four of the seven samples. The amount of asbestos ranged from trace amounts (less than 1 percent) to 21 percent, which was found at location SB-774 located at the southeastern corner of the landfill. The median amount of asbestos found was 5 percent and

the average amount of asbestos (with non-detected amounts evaluated as 0.1 percent and trace amounts evaluated as 0.9 percent) was 7 percent with a standard deviation of 7.5 percent.

Metals. Two samples were analyzed for metals at a fixed laboratory using EPA-approved methods, and a total of 52 and 51 samples were analyzed for lead and copper, respectively. Some metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered to be of low concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. Each of these elements, except sodium, was detected in both samples at relatively low concentrations and will not be discussed further in this section. Of the remaining metals, antimony, arsenic, cadmium, mercury, silver and thallium were not detected, while most others were detected in both samples.

Copper and lead, two of the indicator contaminants of Raymark waste, were detected in 17 of 51 and 39 of 52 samples, respectively. Copper concentrations ranged from 27.2 J mg/kg to 4,650 mg/kg, with a median concentration of 75 mg/kg, an average concentration of 251 mg/kg, and a standard deviation of 683. The highest concentrations were typically found near the base of the landfill, primarily in the southeastern corner of the landfill at SB-774. No samples exceeded the CTDEC for industrial soils. Lead concentrations ranged from 13.3 J mg/kg to 2,420 mg/kg, with a median concentration of 73.5 mg/kg, an average concentration of 181 mg/kg, and a standard deviation of 396 mg/kg. The highest lead concentrations were also found near the base of the landfill along Dorne Drive, and at SB-774. Concentrations from two samples exceeded the CTDEC for industrial soils (1,000 mg/kg). No other CTDEC for industrial soils for metals were exceeded.

No samples were analyzed for SPLP metals.

Semivolatile Organic Compounds (SVOCs). Two samples were analyzed for SVOCs. Few SVOCs were detected, and those that were detected had low concentrations. PAHs were detected most frequently, and the location where PAHs were most often detected was at SB-528, located near the base of the landfill along Dorne Drive. The CTDEC for industrial soils and the CTPMC for GB aquifers were not exceeded for SVOCs.

VOCs. Two samples were analyzed for VOCs. Acetone was the only compound detected. It is a common laboratory contaminant and is likely the result of the analytical process and not contamination found in the sampled medium. The CTDEC for industrial soils and the CTPMC for GB aquifers were not exceeded for VOCs.

Pesticides. Two samples were analyzed for pesticides. None were detected.

PCBs. Two samples were analyzed for Aroclors 1262 and 1268 only. Four more samples were analyzed for seven additional Aroclors. Aroclors 1262 and 1268 were the only PCBs detected. Aroclor 1262 was detected at 7,000 µg/kg and 15,000 µg/kg. Aroclor 1268 was detected in three samples at concentrations ranging from 2,200 µg/kg to 7,900 µg/kg. Both Aroclors were found at SB-753 and SB-774. Aroclor 1268 was also found at SBB2 FF-250, which was analyzed for Aroclors 1254, 1260, and 1268. Concentrations of Aroclor 1262 at SB-774 were the only exceedance of the CTDEC for industrial soil of 10,000 µg/kg.

No samples were analyzed for SPLP PCBs.

4.4.2.2 Depths Greater Than 2 Feet Below Ground Surface

One hundred sixty-seven samples were collected from the Stratford Landfill from depths greater than 2 feet bgs (Figure 4-4). Data used in this RI include 55 samples that were analyzed for asbestos; five samples that were analyzed for total metals, SVOCs, VOCs, pesticides, and PCBs; a total of 46 samples that were analyzed for PCBs; a total of 167 samples that were analyzed for lead and copper; five samples that were analyzed for TAL metals; and two samples that were analyzed for dioxins and furans and SPLP metals and PCBs. The sample results for each parameter are presented below. Refer to Table 4-7 for the summary of statistics for each element.

Asbestos. Fifty-five samples were analyzed for asbestos, and asbestos was found at greater than 1 percent in 39 samples. The amount of asbestos ranged from trace amounts (less than 1 percent) to 48 percent, which was found at 2 to 4 feet below ground surface at location SB-528 at the base of the landfill along Dorne Drive. The median amount of asbestos was 4 percent, the average was 11 percent with a standard deviation of 12.7 percent.

Metals. Five samples were analyzed for TAL metals at a fixed laboratory using EPA-approved methods, and a total of 167 samples were analyzed for copper and lead. Some metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered to be of low concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. Each of these elements except sodium was detected in all five samples at relatively low concentrations and will not be discussed further in this section. Antimony and thallium were not detected, while most others were detected in all five samples.

Copper and lead, two of the indicator contaminants of Raymark waste, were detected in 83 of 167 and 157 of 167 samples, respectively. Copper concentrations ranged from 26.3 J mg/kg to 25,700 mg/kg, with a median concentration of 75 mg/kg, an average concentration of 693 mg/kg, and a standard deviation of 2,363 mg/kg. The highest concentrations were typically found in samples collected from test pits excavated in the northwest corner of the landfill, and at SB-528 located at the base of the landfill along Dorne Drive. No samples exceeded the CTDEC for copper in industrial soils. Lead concentrations ranged from 17.2 mg/kg to 28,700 mg/kg, with a median concentration of 148 mg/kg, an average concentration of 745 mg/kg, and a standard deviation of 2,725 mg/kg. The highest lead concentrations were found in the same locations as the highest copper concentrations: in samples collected from test pits excavated in the northwest corner of the landfill, and at SB-528 located at the base of the landfill along Dorne Drive. Concentrations of lead in 18 samples exceeded the CTDEC for lead in industrial soils of 1,000 mg/kg.

The concentrations of arsenic and chromium in one location, SB-528, also exceeded the CTDEC in industrial soils (10 mg/kg and 100 mg/kg).

Two samples were analyzed for SPLP metals. Several metals were detected in the SPLP leachate, however, only lead was detected at concentrations above the CTPMC for GB aquifers (150 ug/L). Lead was detected at 231 ug/L at SB-532, and at 296 ug/L at SB-528 in the SPLP leachate.

SVOCs. Five samples were analyzed for SVOCs. Several SVOCs were detected at low concentrations. PAHs were detected most frequently, and the location where PAHs were most often detected was from 2 to 4 feet below ground surface at SB-528 and SB-532, located near the base of the landfill along Dorne Drive. Concentrations of benzo(a)pyrene and

dibenzo(a,h)anthracene exceeded the CTDEC for industrial soils (1,000 ug/kg and 780 ug/kg, respectively) and the CTPMC for GB aquifers (1,000 ug/kg and 1,000 ug/kg, respectively). Concentrations of the following SVOCs exceeded the CTPMC for GB aquifers: benzo(a)anthracene (1,000 ug/kg), benzo(b)fluoranthene (1,000 ug/kg), benzo(k)fluoranthene (1,000 ug/kg), bis(2-ethylhexyl)phthalate (11,000 ug/kg), carbazole (360 ug/kg), chrysene (1,000 ug/kg), and indeno(1,2,3-cd)pyrene (1,000 ug/kg).

VOCs. Five samples were analyzed for VOCs. Few compounds were detected. The CTDEC for industrial soils and the CTPMC for GB aquifers were not exceeded for VOCs.

Pesticides. Five samples were analyzed for pesticides. Few pesticides were detected. No compounds were detected at concentrations exceeding the CTDEC for industrial soils. The CTPMC for GB aquifer (21 µg/kg) was exceeded only by 4,4'-DDT in one sample.

PCBs. A total of 46 samples were analyzed for Aroclors 1262 and 1268. Eight samples were analyzed for additional Aroclors at a fixed laboratory using EPA-approved methods. Aroclors 1242, 1254, 1262 and 1268 were detected. Of the 46 samples screened or analyzed for Aroclors 1262 and 1268, Aroclor 1262 was detected in 15 samples and Aroclor 1268 was detected in 16 samples. Concentrations of Aroclor 1262 exceeded the CTDEC for industrial soils of 10,000 µg/kg in five of the samples. Concentrations of Aroclor 1262 ranged from 600 µg/kg to 60,000 µg/kg, with a median concentration of 500 µg/kg, and average concentration of 3,300 µg/kg, and a standard deviation of 9,328. Concentrations of Aroclor 1268 exceeded the CTDEC for industrial soils of 10,000 µg/kg in one of the samples. Concentrations of Aroclor 1268 ranged from 290 µg/kg to 41,000 µg/kg, with a median concentration of 500 µg/kg, and average concentration of 2,000 µg/kg, and a standard deviation of 6,097 µg/kg. The highest concentrations of both Aroclors were detected in test pit samples collected from the northwest corner of the landfill, as well as at SB-528.

Two samples were analyzed for SPLP PCBs. No PCBs were detected in the SPLP leachate.

4.5 Outside Estimated Areas of Raymark Waste

Areas of the OU9 Study Area that are outside of the defined Raymark waste areas are not considered part of the Superfund site. For that reason, the areas outside the estimated areas of

Raymark waste at Short Beach Park are discussed qualitatively in this section. This discussion of soil contamination at Short Beach Park outside of the defined Raymark waste areas includes surface soil samples collected by EPA in June 1993 and by TtNUS for EPA in 2003/2004. The data used in this discussion are included in Appendix B-2. Appendix B-3 presents the summary statistics for each of the compounds detected in the OU9 Study Area outside of the defined Raymark waste areas.

Some of the contamination outside the defined Raymark waste areas at Short Beach Park exceed safe levels established by the state or federal governments. However, because these areas do not meet the definition of Raymark waste, they were not evaluated for risk effects within this RI Report.

4.5.1 0 to 2 Feet Below Ground Surface

Over 500 samples were collected from outside the estimated areas of Raymark waste at Short Beach Park from 0 to 2 feet bgs (Figure 2-1). Data used in this discussion include 191 samples that were analyzed for asbestos; 21 samples that were analyzed for total metals, and pesticides; two samples that were analyzed for SVOCs and VOCs; a total of 194 samples that were analyzed for PCBs; and a total of 538 and 372 samples that were analyzed for lead and copper, respectively. No samples were analyzed for dioxins and furans. No samples were analyzed for SPLP metals or PCBs.

Asbestos was found at greater than 1 percent in 2 of 191 samples. Concentrations of the following contaminants exceeded the CTDEC for residential soils in a few samples: copper (2,500 mg/kg), lead (400 mg/kg), benzo(a)anthracene (1,000 µg/kg), benzo(a)pyrene (1,000 µg/kg), benzo(b)fluoranthene (1,000 µg/kg), dibenzo(a,h)anthracene (84 µg/kg), and PCBs (1,000 µg/kg). No other CTDEC for residential soils were exceeded. Concentrations of the following contaminants from a few samples exceeded the CTPMC: benzo(a)anthracene (1,000 µg/kg), benzo(a)pyrene (1,000 µg/kg), benzo(b)fluoranthene (1,000 µg/kg), chrysene (1,000 µg/kg), 4,4-DDE (21 µg/kg), and 4,4-DDT (21 µg/kg). Refer to Appendix B-3 for summary of statistics for each parameter.

4.5.2 Depths Greater Than 2 Feet Below Ground Surface

Over 400 samples were collected from outside the estimated areas of Raymark waste at Short Beach Park from depths greater than 2 feet bgs (Figure 2-1). Data used in this discussion include 29 samples that were analyzed for asbestos; six samples that were analyzed for total metals, SVOCs, VOCs, and pesticides; a total of 28 samples that were analyzed for PCBs; and a total of 419 samples were analyzed for lead and copper. No samples were analyzed for dioxins and furans. No samples were analyzed for SPLP metals or PCBs.

Concentrations of the following contaminants from a few samples exceeded the CTDEC for residential soils: arsenic (10 mg/kg), chromium (100 mg/kg), copper (2,500 mg/kg), lead (400 mg/kg), benzo(a)anthracene (1,000 µg/kg), benzo(a)pyrene (1,000 µg/kg), benzo(b)fluoranthene (1,000 µg/kg), dibenzo(a,h)anthracene (84 µg/kg), and indeno(1,2,3-cd)pyrene (840 µg/kg). No other CTDEC were exceeded. Concentrations of the following contaminants from a few samples exceeded the CTPMC: benzo(a)anthracene (1,000 µg/kg), benzo(a)pyrene (1,000 µg/kg), benzo(b)fluoranthene (1,000 µg/kg), benzo(k)fluoranthene (1,000 µg/kg), carbazole (360 µg/kg), chrysene (1,000 µg/kg), dibenzo(a,h)anthracene (1,000 µg/kg), indeno(1,2,3-cd)pyrene (1,000 µg/kg), 4,4-DDD (29 µg/kg), 4,4-DDE (21 µg/kg), and alpha-BHC (1.1 µg/kg). Refer to Appendix B-3 for summary of statistics for each parameter.

5.0 CONTAMINANT FATE AND TRANSPORT

A variety of complex factors govern the fate and transport of contaminants within the OU9 study area. The physical and chemical properties of the contaminants and the medium (i.e., soil, groundwater, surface water, air) to which the contaminants are released are all factors that determine the eventual fate of these chemicals. The past operations and disposal history associated with disposal of wastes from the former Raymark Facility and other sources determine the chemical make-up of the contaminant and influence the migration of contaminants into the soil and groundwater. This section presents an assessment of the fate and transport of contaminants within OU9 study area soils. In the OU9 study area, the combination of on- and offsite-related contaminants, geologic and hydrogeologic conditions, and surface features influence how contaminants may have migrated into other environmental media (i.e., the underlying groundwater, surface water bodies, and sediments). For this RI, soil samples were collected and analyzed for the purpose of determining the presence or absence of Raymark waste.

The contaminant fate and transport described in this OU9 RI Report is a qualitative assessment. Given the lack of technical data and information, this assessment is based on assumed geologic and hydrogeologic conditions within the study area and the assumed movement of known contaminants within the study area soils. Fate and transport issues related to air, sediments, or groundwater are not addressed in this RI Report for the OU9 study area.

Section 5.0 presents fate and transport of contamination including:

- Section 5.1 - Contaminant Sources and Releases
- Section 5.2 - Mechanisms and Factors Governing Fate and Transport
- Section 5.3 – General Fate and Transport Processes of Soil Contaminants
- Section 5.4 – Contaminant Fate and Transport in Soils at the OU9 study area

The location of the OU9 study area is shown on Figure 1-1 and defined in Section 1.0.

5.1 Contaminant Sources and Releases

Contaminants were released into the environment within the OU9 study area by various historical disposal and operational practices associated with the former Raymark Facility, as well as other entities. A brief summary of past sources and releases of contamination at the former Raymark Facility is presented below. A detailed description of former Raymark Facility operations and manufacturing processes is presented in the Final OU1 RI (HNUS, 1995).

A series of four unlined lagoons at the former Raymark Facility were used by Raymark to retain and settle particulate matter from process waters generated as a by-product of the brake manufacturing activities. Sludges excavated or dredged from the lagoons, “off-specification” manufacturing materials that were discarded, and other waste products were disposed of at the OU9 study area from approximately 1952 to 1988. The Raymark waste used as fill contains VOCs, SVOCs, PCBs, pesticides, dioxins and furans, metals (primarily lead and copper), and asbestos. The nature and concentrations of the various contaminants in the fill materials changed over this time period because of alterations in manufacturing processes and product lines; however, these materials still contained the indicator contaminants of lead, asbestos, PCBs, and/or copper, as well as other contaminants. The disposed wastes were used as fill materials, as well as burned, within the dump area, further complicating the current identification of the wastes.

This fill and lagoon-dredged material was transported to the OU9 study area and disposed of within both the Short Beach Park portion of the study area and the Stratford Landfill portion of the study area. Waste disposal within Short Beach Park was partially documented. In 1993, the state performed an interim action to prevent contact with, and human health exposure to, the waste. This work involved the placement of a geotextile membrane over approximately 2.5 acres within the 64.1-acre Short Beach Park portion of the OU9 study area. The town also covered the waste with soil as it was discovered to prevent contact. No cleanup actions were conducted within the Stratford Landfill; however, waste from EPA removal actions on 4th and 5th Avenues was excavated by the Town of Stratford and placed on the western portion of the landfill in 1979, (see yellow area on Figure 3-1).

This waste on the western portion of the landfill is the only Raymark waste location within the Stratford Landfill that is less than 15 feet in depth. All other areas of Raymark waste at the

Stratford landfill have been covered by continuing landfill activity so that they now lie beneath 15 feet or more of soil and other wastes. Spillage, leakage, disposal of other wastes from other businesses, and the disposal of residential and commercial solid waste further complicate the contaminant release picture for both Short Beach Park and the Stratford Landfill. Today the Stratford Landfill is still used by the Town of Stratford as a dumping area for brush, leaves, and street sweepings while the Short Beach Park portion of the study area is an active town recreational area.

5.2 Mechanisms and Factors Governing Fate and Transport

Within the OU9 study area, there are five primary mechanisms by which contamination from the estimated areas of Raymark waste can enter into other environmental media:

- Contaminants in the fill can leach to subsurface soils;
- Erosion and surface runoff can carry contaminated soils into the surrounding wetland, river, and ocean areas;
- Wind erosion can carry contaminated soils across the site or into surrounding areas;
- Contaminants can leach into the groundwater, migrate through advection, and discharge into adjacent water bodies; and
- Human activity can disturb and redistribute contaminated soil.

The evaluations of contaminant fate and transport in this RI Report are based on existing OU9 study area conditions, identification of chemicals present in the environmental media, the physical state of soil and groundwater contaminants, and the general fate and transport mechanisms.

The fate and transport processes of concern are those that govern the migration of soil contaminants (once released or deposited) to the surrounding environment. Once these contaminants have entered another medium, other fate and transport mechanisms occur that may cause further chemical migration or transformations. The generalized discussion of fate and transport processes presented in Section 5.3 is provided so that the observed study area-specific contamination conditions can be better characterized and understood.

5.3 General Fate and Transport Processes of Soil Contaminants

A variety of processes occur that may cause organic and inorganic chemicals present in on-site soils to become immobilized, degraded, or to be mobilized to another environmental medium. Some of these processes include:

- Volatilization – Chemicals, in particular VOCs, having high vapor pressures will readily enter (volatilize) to the ambient air rather than remain adsorbed to the soil particles. Once in the atmosphere, the chemicals may undergo further transport through additional processes such as advection, diffusion, or dispersion. The chemicals may also be transformed through chemical processes such as hydrolysis or photolysis. SVOCs, metals, PCBs, pesticides, dioxins, and asbestos are generally less volatile than VOCs or are nonvolatile.

- Leaching – Chemicals may be transported downward through the soil by water from precipitation or by liquids that infiltrate through the soils. The leaching of chemicals from soils and the subsequent mobilization are controlled by soil properties (i.e., adsorptive capacity, organic carbon content, clay content, or specific surface area) and by chemical properties (i.e., solubility, ability to partition to other phases). Leaching may occur directly when the contaminated soil is in direct contact with the groundwater. Some of the Raymark waste is in direct contact with the groundwater.

- Runoff/Erosion – In situations where the chemicals remain adsorbed (bound) to soil particles because of the soil's chemical characteristics, chemicals may still be mobilized from contaminated areas to other uncontaminated environmental media. Contaminants can be conveyed over land by runoff that occurs during precipitation events (solubilized in rainwater or adsorbed to suspended particles), or through the erosion of contaminated soils that are present on unstable slopes or topographic features.

- Wind Erosion – When the force of the wind (which is a function of its velocity) exceeds the forces holding a particle to the ground, it moves the particle. In most places, wind speeds rarely exceed 50 km/hr and the largest particles that can be lifted off the ground and suspended in the air are grains of sand. At wind speeds approaching 50 km/hr, fine to medium sands can be lifted off the ground to a height of up to one meter. The sand

grains move a short distance in the air and then fall back to the ground where they may dislodge other particles and be lifted again. Coarse sand grains and pebbles are too large to be lifted off the ground by all but hurricane-force winds, so they are usually rolled or pushed across the ground. By contrast, clay and silt size particles can be lifted high into the air where they may be transported long distances. The potential for wind erosion increases with increasing wind velocity, and decreasing soil moisture, surface roughness, and vegetative cover. Consequently, wind erosion is significant where the wind is strong, the soil is dry, the ground surface is smooth, and the vegetation is sparse.

- Excavation/Human Activity – Soils can be mobilized during excavation by equipment, or digging by humans or animals. This may occur during on-site construction, renovation of the property, utility repairs, gardening, animal burrowing, etc. Contaminants may be conveyed into the air or into on-site piles allowing contact with humans.

These processes are directly influenced by the chemical properties and physical states of the contaminants, as summarized below.

5.3.1 Physical Chemical Properties that Influence Contaminant Fate and Transport

Several physical chemical properties strongly influence the fate and transport of contaminants in the environment. Each property, along with its relationship to the various fate and transport processes, is defined below.

5.3.1.1 Water Solubility

Water solubility is one of the primary physical chemical characteristics used to assess contaminants fate and transport in the environment. The water solubility of a chemical contaminant provides considerable insight into its mobility, stability, tendency to adsorb to soils or sediments, and propensity to accumulate in the environment or bioaccumulate in the food chain. Chemical contaminants with high water solubilities, greater than 1000 milligrams per liter (mg/L) or 0.1 percent (Ney, 1990), will have a tendency to remain dissolved in the water column and will not likely partition to soil particles, accumulate in the environment, or bioaccumulate in

aquatic organisms in the food chain. Highly soluble chemicals are less likely to volatilize from water and are generally more prone to biodegrade and metabolize. As these characteristics indicate, chemicals with higher water solubilities are more likely to be mobile, and therefore are less likely to persist in the environment.

Conversely, chemicals with low water solubilities, less than 10 mg/L or 0.001 percent (Ney, 1990), are generally less mobile and are more likely to adsorb to soil particles, accumulate and/or bioaccumulate, and persist in the environment. Low solubility chemicals tend to biodegrade or are metabolized less readily in plants and animals.

VOCs have moderate to high water solubilities; while SVOCs, pesticides, PCBs, and metals all have relatively low solubilities, are more likely to stay adsorbed to soil and sediment particles, and are less mobile. Asbestos is not soluble in water and is likely to stay adsorbed to soil and sediment particles, and is less mobile.

5.3.1.2 Octanol-Water Partition Coefficient

The octanol-water partition coefficient (K_{OW}) is a measure of the tendency of an organic compound to partition between organic (in this case, octanol) and aqueous phases. The chemical-specific K_{OW} is an indicator of its water solubility, mobility, sorption, and bioaccumulation. It has also been shown to correlate well with bioconcentration factors in aquatic organisms and the adsorption to soil and sediment (Howard, 1990).

The higher the K_{OW} value of a specific chemical, the greater the chemical's potential for sorption to soil particles, the lower its mobility, and the more likely it is to accumulate in the environment and bioaccumulate in the food chain. A high K_{OW}, greater than 1000 (Ney, 1990), is indicative of low water solubility and greater persistence in the environment.

Conversely, the lower the K_{OW} value, the greater the chemical's potential to biodegrade and be metabolized by plants and animals. A low K_{OW}, less than 500 (Ney, 1990), is indicative of high water solubility, high mobility, and little or no accumulation or bioaccumulation.

The VOCs identified in the OU9 study area have widely varied K_{OW} values. VOCs, as a group, have a lower K_{OW} values and a stronger tendency to enter into an aqueous solution and migrate in groundwater and surface water than the other organic compounds.

5.3.1.3 Adsorption Partition Coefficient

The adsorption partition coefficients (K_d and K_{OC}) are measures of the tendency of a contaminant to bind to soil or sediment particles. Adsorption coefficients are useful in evaluating the mobility of contaminants in the subsurface media. K_d is an experimentally derived coefficient that measures the tendency of a chemical to sorb to a particular soil/sediment medium. The K_d is both a chemical- and a sorption media-specific coefficient related to the organic carbon content of the medium. K_{OC}, the organic carbon partition coefficient, is a chemical-specific value derived by dividing K_d by the organic carbon content of the sorption medium in order to normalize the value to the organic carbon content of the medium. K_{OC} is defined as the ratio of the amount of chemical adsorbed per unit weight of organic carbon in the medium to the concentration of the chemical in solution at equilibrium. Chemicals with high adsorption coefficients have a tendency to bind to soil particles containing organic carbon and are, therefore, relatively immobile in groundwater.

Most of the VOCs identified within the OU9 study area have low to moderate K_{OC} values. These VOCs include ketones with the lowest K_{OC} values, and chlorinated hydrocarbon and aromatic hydrocarbon with low to moderate K_{OC} values. The VOCs, as a group, have a low tendency to adsorb to soil particles and are, therefore, more mobile in the environment than the other organic compounds. Most other organic compounds detected within the OU9 study area have high K_{OC} values, indicating a tendency to sorb to soil particles and be more persistent in the soils.

5.3.1.4 Vapor Pressure

Vapor pressure is a measure of the ability of a compound to volatilize from the pure liquid phase into the vapor phase. It provides an indication of the rate at which a chemical will volatilize from soil, sediment, or water. This property is of primary significance at environmental interfaces, such as surficial soil/air, surficial sediment/air, and surface water/air.

Chemicals with higher vapor pressures are expected to enter into the vapor phase more readily than those with lower vapor pressures. If chemicals with low vapor pressures (less than 10^{-6} mm Hg) are present in the atmosphere, they are most likely adhered to suspended particulate matter.

VOCs have relatively high vapor pressures and will, therefore, tend to enter the vapor phase. Vapor pressures for the major groups of VOCs identified in the OU9 study area (ketones, chlorinated hydrocarbons, and aromatic hydrocarbons) are generally many orders of magnitude higher than vapor pressures for SVOCs, pesticides, and PCBs. The VOCs identified in the OU9 study area are more likely to volatilize from the soil into the soil pore space in the vadose zone. Metals and asbestos, having very low or immeasurable vapor pressures, do not readily volatilize.

5.3.2 Physical State of Contaminants in Environmental Media

The physical state in which contaminants exist in various environmental media dictates the manner in which they may migrate or be transported. The organic and inorganic contaminants that may be present in the soil within the OU9 study area, as well as their potential to migrate, are discussed below. Issues related to groundwater contaminants are addressed in a non-specific qualitative fashion as they relate to the migration of contaminants to or from soil.

Organic and inorganic contaminants located in the wastes disposed of within the OU9 study area may contaminate the underlying soil, migrate to downgradient groundwater sources, and/or be discharged into the atmosphere. These contaminants may be present in soils in three principal physical phases: solid, liquid, or vapor.

Solid Phase - Inorganic contaminants (metals and asbestos) are often present in the solid phase, as bulk solids or as suspended particulates in an aqueous discharge, when disposed on the surface or into the subsurface. In the solid phase, inorganics are relatively immobile in a soil or sediment matrix unless the particle sizes are small enough that migration may occur as a suspended particle or colloid. Solid phase metal contaminants may also be broken down and/or leached by precipitation or subsequent liquid spills that solubilize the inorganic constituents, and may thereby become mobile.

Organic contaminants are rarely present in the environment in the solid phase.

Liquid Phase - Most of the organic contaminants related to industrial sites are present in the liquid phase (as a separate product or a mixture of liquid chemicals) or in the aqueous phase (dissolved in a water-based solution). Once these liquids enter unsaturated soil or sediment, several processes may occur. The organic contaminants may: (1) become adsorbed to the soil matrix because of low water solubilities, high soil organic carbon partition coefficients, and/or high soil organic content; (2) remain in a liquid phase in the soil pore water spaces as a result of pore size and interfacial tension; or (3) volatilize into soil pore spaces if the contaminants have high vapor pressures or high air-liquid partition coefficients. If present in sufficient quantity, a liquid contaminant (either dissolved or separate phase) may migrate downward under the influence of gravity and enter the underlying groundwater.

Metals may also be present in the liquid phase, as dissolved ions. In low pH conditions, more metals are apt to be present as dissolved ions and are, therefore, more readily available to mobilize. For instance, aqueous acid solutions used for cleaning metal surfaces contain numerous dissolved metals. If the solution is discharged into soil, some of the metals may remain in the aqueous phase and/or additional metals present in the soil may dissolve if the pH is sufficiently low. In addition, some metals may precipitate from solution in the presence of minerals in the soil matrix and become adsorbed onto soil particles.

Asbestos is not present in the environment in the liquid phase.

Vapor Phase - Organic contaminants, principally VOCs, present in an unsaturated soil or sediment matrix may volatilize into the pore spaces and migrate through the soil if the vapor pressure is sufficiently high. Once in the vapor phase, VOCs can migrate readily if no barriers impede their movement.

Other organic contaminants (with lower vapor pressures), as well as inorganic contaminants, are not typically present in the environment in the vapor phase.

5.4 Contaminant Fate and Transport in Soils at the OU9 Study Area

The following section describes the distribution and releases of contaminants within the OU9 study area, summarizes the physical states of contaminants in the soil, and discusses the primary pathways for contaminants in the OU9 study area to migrate into other environmental media in and around the OU9 study area.

The fate and transport discussions are focused on the major contaminants of potential concern (COPCs) identified from the human health risk assessment (see Section 6.0). These COPCs include: polynuclear aromatic hydrocarbons (PAHs), other SVOCs, PCBs, metals, dieldrin, dioxins, and asbestos.

Since the OU9 study area is a former dump site for wastes from Stratford businesses, contaminants are present in soil samples collected throughout the OU9 study area; however, only those contaminants located within the areas identified as the estimated areas containing Raymark waste will be part of any clean-up activity at the study area. A summary of the activities resulting in contaminant releases to the area, the physical state of the contaminants present in the soils within the OU9 study area, and the associated fate and transport mechanisms are presented below. Tables 4-4 through 4-7 summarize the analytical results and provide comparisons to relevant criteria.

The deposition of Raymark fill in the OU9 study area provides a source of contamination within the estimated areas of Raymark waste, and to an unknown extent, groundwater. Chemicals having high vapor pressures were detected infrequently and at low concentrations within the study area; therefore volatilization of contaminants to the ambient air is likely to be minimal. Soluble contaminants leaching from Raymark waste may contaminate underlying soils and groundwater. Some of the Raymark waste is in direct contact with the groundwater and the study area is primarily open without pavement or buildings, allowing the potential for leaching. Metals will be more soluble and mobile under low pH conditions; however, pH has not been evaluated at the study area. Acidic solutions were disposed of at OU1; but whether or not these materials were also disposed of at OU9 is unknown. Given the location of the OU9 study area and the existing topography of the area, erosion and surface runoff of dissolved contaminants from Raymark waste and adsorbed contaminants and asbestos most likely will not contaminate soils outside the OU9 study area. The slope of the landfill is such that it is likely erosion and

surface runoff is occurring within the study area. Contact and mixing of Raymark waste with proximate soils through human activities may lead to the transport of contamination throughout the OU9 study area in addition to the off-site locations. Soils can be mobilized during excavation by equipment, or digging by humans or animals. Excavation activities at the landfill and landscaping activities at the Short Beach Park portion of the study area may mobilize contaminants. Wind erosion is significant where the wind is strong, the soil is dry, the ground surface is smooth, and the vegetation is sparse. Areas of the Stratford landfill with Raymark waste identified within 0 to 15 feet bgs are covered by tall weeds and scrubby grasses, with the exception of a dirt access road, which passes through the landfill. Shrub and tree cover is sporadically found along the slopes and base of the landfill. Areas of Raymark waste at Short Beach Park are entirely covered by mowed grass. The presence of this vegetative cover reduces wind erosion.

5.4.1 VOCs in Soils

As a result of their high water solubilities, low soil partition coefficients, and low octanol-water partition coefficients, VOCs are readily leached from soil and transported into an aqueous medium. Furthermore, VOCs present in surface soils have more of a tendency to volatilize into the atmosphere. VOCs adsorbed to soil particles or present in soil pore spaces are more apt to volatilize into unsaturated soil pore spaces or voids than other organic compounds, and may potentially migrate to the surface or follow some other preferential flow paths (subsurface drains, utility conduits, etc.) because of their high vapor pressures. These chemical properties support the infrequent detection of elevated levels of VOCs in surface soil and the somewhat higher frequency, when analyzed, in subsurface soil throughout the OU9 study area. The higher concentrations of VOCs, primarily aromatic hydrocarbons (benzene, toluene, ethylbenzene, and/or xylenes (total)), were detected in subsurface soils located in the OU9 study area. Concentrations of VOCs at Short Beach Park were highest in samples collected from greater than 4 feet below ground surface. At the Stratford Landfill, highest VOC concentrations were found primarily at 2 to 4 feet below ground surface.

Based on current conditions within the OU9 study area, the migration of VOCs through volatilization appears to be unlikely or limited, because of low VOC concentrations and low frequencies of detection. However, since this OU9 study area abuts water bodies, erosion of fill could cause contaminated soils and fill materials to migrate and be deposited into these water

bodies. The actual concentrations of VOCs detected in soils within areas of Raymark waste at OU9 are so low that the likelihood of VOCs being transported to these water bodies is low for this OU9 study area.

5.4.2 SVOCs in Soils

As a result of their low water solubilities, high soil partition coefficients, and high octanol-water partition coefficients, SVOCs (primarily PAHs – benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene) are more readily adsorbed to soil particles than VOC contaminants. Furthermore, SVOCs present in surface soil have a tendency to volatilize into the atmosphere. SVOCs adsorbed to soil particles or present in soil pore spaces have a tendency to volatilize into unsaturated soil pore spaces or voids and may potentially migrate to the surface or follow some other preferential flow path. Their ability to volatilize, however, is less than that of VOCs (with higher vapor pressures) but greater than that of PCBs (with much lower vapor pressures).

These chemical properties support the frequent detection of elevated levels of SVOCs, primarily PAHs, in subsurface soil and the lower frequency of detection in surface soil throughout the OU9 study area. The high frequency of detections suggests that the PAHs were sorbed onto soil particles dumped in the OU9 study area when it was operating as a landfill.

While the leaching of SVOCs appears to be limited because of their low water solubilities, the OU9 study area, in particular the estimated areas of Raymark waste, are primarily open areas without much pavement and buildings. Also, because SVOCs are typically less soluble than VOCs and are less likely to leach into the groundwater, their impact on groundwater quality is assumed to be limited. Again, because this OU9 study area abuts water bodies, erosion of fill materials could cause contamination to migrate from the Stratford Landfill and be deposited in these water bodies. The slope of the landfill is such that it is likely runoff/erosion may be occurring.

5.4.3 PCBs, Pesticides, and Dioxins in Soils

Because of their low water solubilities, high soil partition coefficients, and high octanol-water partition coefficients, PCBs, pesticides, and dioxins are more readily adsorbed to soil particles than are either VOC or SVOC contaminants. Furthermore, in surface soil these contaminants have less of a tendency to volatilize into the atmosphere. Most of these contaminants are adsorbed to soil particles or present in soil pore spaces with little tendency to volatilize into unsaturated soil pore spaces or voids or to potentially migrate to the surface or follow some other preferential flow path. This is because of their low vapor pressures when compared to the highly volatile VOCs and somewhat volatile SVOCs. Because of the lack of mobility of PCBs, pesticides, and dioxins in the environment, these contaminants are likely to have remained where they were deposited.

Elevated levels of PCBs, particularly Aroclor 1262 and Aroclor 1268, were detected in both surface and subsurface soil throughout the OU9 study area. The high frequency of PCB detections in both surface and subsurface soils suggests that the PCBs were sorbed onto soil particles dumped in the area as fill material from the former Raymark Facility. The levels of PCBs were relatively consistent in soil samples throughout the OU9 study area and as Raymark waste indicators were sampled for more frequently than dioxins and pesticides. The highest PCB concentrations detected were in the 2- to 4-foot range at Short Beach Park and 1.9 to 2.6 feet at the Stratford Landfill.

Dioxins and pesticides were not sampled often, and were detected at low levels when analyzed. The pesticides and dioxins were primarily sampled from and detected within the Raymark waste areas.

Within Short Beach Park, most contamination is relatively shallow (less than 15 feet) and there have been some attempts to cover the surfaces at Short Beach Park with a layer of clean soil to mitigate immediate risks to human health. Review of soil analytical results, current site conditions within the OU9 study area (ground cover/pavement, topography), and the relatively insoluble nature of these contaminants indicate migration through leaching is unlikely or limited.

OU9 study area soils contaminated by PCBs, pesticides, and dioxins may be mobilizing into the adjoining water bodies through erosion under current conditions because most of the study

area, in particular the estimated areas of Raymark waste, are not paved, or covered with a membrane. However, since the OU9 study area does abut water bodies, it is possible that erosion of fill on these water banks may be causing some PCBs, pesticides, and dioxins to migrate into these adjacent water bodies. No sediment samples were obtained from these water bodies, but it is assumed that any erosion would be minimal.

5.4.4 Metals in Soils

Metals tend to be less mobile in the environment than organic contaminants. Under natural conditions, dissolution of metals may occur in the presence of water (because of rainwater runoff or groundwater infiltration) and some metal ions may migrate. However, these dissolved metals can readily precipitate out of solution and adsorb to soil particles. Metals will be more soluble and remain in an aqueous state if the pH is sufficiently low.

These metal properties (i.e. precipitation and adsorption) support the frequent detection of elevated levels of lead in both surface and subsurface soil throughout the OU9 study area. The higher concentrations in the subsurface soils may be because of the low metals' mobility in the environment, and the likelihood that they have remained where deposited in the Raymark waste. The leaching of metals to groundwater may not be of concern unless the groundwater quality is degraded to the extent that it poses potential threats to human health or the environment. No groundwater samples were obtained for comparison.

To evaluate the leaching potential, soil metals concentrations were compared with the CT pollutant mobility concentrations (PMC). The CTPMC are defined as the allowable metal concentrations in leachate resulting from designated leaching protocols. These protocols include the synthetic precipitation leaching procedure (SPLP), EPA SW-846, Method 1312, or the toxicity characteristic leaching procedure (TCLP), EPA SW-846, Method 1311. The SPLP and TCLP protocols are meant to simulate materials subjected to leaching by acid rain and are the accepted methods for evaluating the potential mobility of metals in soils and sediments. Several soil samples were tested under the SPLP protocol and the results are shown in Appendix B.

Erosion of metal-contaminated soils within the OU9 study area is caused by runoff, as most of the area is not covered by pavement and/or structures. The water banks abutting the OU9

study area were observed to contain fill materials that were not stabilized (i.e., by rip rap or cover materials). No sediment samples were obtained from these water bodies, but it is assumed that limited Raymark waste contaminants may have migrated into the adjacent water bodies, given the presence of vegetation on the banks.

5.4.5 Asbestos in Soils

Asbestos is a general term applied to a number of fibrous silicate minerals that are widely used for industrial purposes because they are incombustible, nonconducting, chemically resistant, and have a high tensile strength. The serpentine mineral chrysotile makes up the vast majority (90 - 95 %) of the world's asbestos production. The second and third most prevalent types of asbestos are the amphibole minerals amosite and crocidolite. Asbestos detected at the OU9 study area was identified as chrysotile.

Asbestos can pose a health hazard when the fibers are freed during the mining, processing, or erosion of ores, or the breakdown of asbestos-containing materials. Asbestos is relatively immobile in the environment, except through bulk advective movement or dispersion in aqueous or airborne environments. Asbestos is neither soluble nor volatile, but fibers may occur in suspension in both water and air. Asbestos fibers do not bind to soil particles, and they aren't degraded into other compounds, so they may persist in the environment for decades or longer. Fortunately, the shape and insolubility of asbestos fibers severely limits their mobility in soil and groundwater environments. Because of the low likelihood of asbestos mobility in the environment, the contaminant is likely to have remained where deposited in the Raymark waste. Erosion/surface runoff and wind erosion can be significant in the movement of surface soil contaminated with asbestos.

Elevated levels of asbestos were detected in both surface and subsurface soil throughout the OU9 study area, mostly in the same regions where elevated levels of copper and lead were found. The levels of asbestos were relatively consistent in soil samples throughout the OU9 study area. High asbestos levels were detected throughout all sample depth ranges. Within Short Beach Park, most contamination is relatively shallow (less than 15 feet) and there have been some attempts to cover the surfaces at Short Beach Park with a layer of clean soil to mitigate immediate risks to human health.

OU9 study area soils contaminated by asbestos may be mobilizing into the adjoining water bodies through erosion/runoff under current conditions because most of the study area, in particular the estimated areas of Raymark waste, are not paved, or covered by buildings. Since the OU9 study area abuts water bodies, erosion of fill on these water banks may be causing some asbestos to migrate into these adjacent water bodies. Sporadic shrub and tree cover are present along the water banks preventing some erosion; however, there is visual evidence of erosion of the banks into the adjoining water bodies. No sediment samples were collected.

OU9 study area soils contaminated by asbestos are unlikely to be significantly mobilized through wind erosion. Areas of the Stratford landfill with Raymark waste identified within 0 to 15 feet bgs are covered by tall weeds and scrubby grasses, with the exception of a dirt access road, which passes through the landfill. Shrub and tree cover is sporadically found along the slopes and base of the landfill. Areas of Raymark waste at Short Beach Park are entirely covered by mowed grass. The presence of this vegetative cover reduces wind erosion and the possibility of airborne asbestos mobility.

5.4.6 Fate and Transport Summary

Based on the data from other Raymark operable units and the presence of vegetation on the banks of water bodies adjacent to the study area, it is reasonable to conclude that limited soil contaminants present within the OU9 study area will migrate into surface water bodies through erosion of the stream banks and into groundwater through leaching.

Short Beach Park. The areas of Raymark waste are shown on Figure 3-1. These areas are not paved or covered by buildings. The area along Dorne Drive is reported to be covered with a geotextile membrane. Field observations during drilling confirmed the presence of the geotextile membrane, but could not establish whether or not it is continuous. Given the lack of as-built information on the membrane, this membrane may not be continuous; therefore, leaching may occur. Based on the collection of field data, there is a potential for leaching of metals to occur in this area; however, no groundwater data was collected and thus this potential for metals leaching cannot be verified.

None of the Raymark waste areas within Short Beach Park abut any water bodies and therefore erosion/runoff of Raymark waste is minimal. Wind erosion and human activity/excavation have

the potential to move contaminants in surface soil; however, vegetation within the Raymark waste areas reduces the potential impact of wind erosion.

No samples were routinely obtained in natural soils. Boreholes were advanced to locate the Raymark waste and once the bottom of waste was found and/or the water table encountered, drilling ceased. With the exception of SPLP conjuncture of contaminant movements, no discussion is presented on contaminant migration within natural materials.

Stratford Landfill. Raymark waste was identified at varying depths throughout the 29.8-acre property. For this reason, the entire area of the Stratford Landfill was considered to be the area of Raymark waste, as shown on Figure 3-1. The landfill is not covered by pavement or buildings; however, with the exception of the waste along the western area near the access road to the top of the landfill, the Raymark waste is buried beneath other fill to depths greater than 15 feet bgs and thus no wind erosion or erosion/runoff of Raymark waste will occur. The waste buried along the western area of the access road is located less than 15 feet bgs and erosion/runoff into the adjacent water body may occur. The presence of vegetative cover along the western area of the access road reduces potential wind erosion of Raymark waste. Human activity/excavation has the potential to move contaminants in surface and subsurface soil. Based on the collection of field data, there is a potential for leaching of metals to occur in this area; however, no groundwater data was collected and this cannot be verified.

All analytical samples collected in the landfill area were within the fill materials, therefore, no discussion is presented on the natural materials contaminants, or potential contaminant migration, from the landfill into the natural materials.

6.0 HUMAN HEALTH BASELINE RISK ASSESSMENT

This section presents the methodology for and the results of a baseline human health risk assessment (HHRA) conducted for estimated areas of Raymark waste within the Raymark Superfund Site, Short Beach Park and Stratford Landfill – Operable Unit 9 (OU9) study area described in Sections 1.0 through 5.0. Only the estimated areas with soil samples that meet the definition of Raymark waste, as described in Section 1.4, are included in this HHRA. The risk assessment addresses the risks associated with exposure to the portions of the study area estimated to contain Raymark waste as shown in Figure 6-1. The objective of the HHRA is to estimate potential current and future risks to the public from the contaminants detected (the four Raymark waste indicator chemicals and other contaminants) in the soil samples collected from within these estimated areas of Raymark waste. Data collected from the study area, but beyond the estimated areas of Raymark waste, while useful in the delineation of the extent of Raymark waste, are not included in this risk evaluation.

The HHRA evaluates non-cancer health hazards, cancer risks, and lead exposures through quantitative assessments and asbestos exposures through qualitative discussion. The potential for non-carcinogenic health effects is assessed by comparing an exposure estimate (dose) to a reference dose (RfD). Ratios of the intake to the RfD below unity indicate that adverse non-carcinogenic effects are unlikely. Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Risks below 1E-6 (or a risk less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable. Risks from lead exposure are not evaluated using the same methodology as other contaminants. Estimations of blood-lead concentrations are used to evaluate potential adverse health effects. Infants and young children are extremely susceptible to adverse effects from exposure to lead. Since children are a more sensitive subpopulation than adults, exposure to lead by adults in a residential or recreational scenario is not generally evaluated and the receptor of concern for these scenarios is the young child. Evaluation of the young child in a residential or recreation scenario is considered protective of adults, including pregnant women. Exposures to lead by commercial workers are evaluated by use of an approach that focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soil in non-residential scenarios. Therefore the receptor of concern in commercial worker scenarios is the fetus of the pregnant worker. Evaluation of the fetus of the pregnant

worker is considered protective of non-pregnant workers. Blood-lead levels greater than 10 µg/dL are considered to be a "concern." EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 µg/dL. Asbestos-containing material is defined as material containing more than 1 percent asbestos. The definition of asbestos-containing material was used for qualitative evaluations of asbestos exposures.

Section 6.1 provides an overview of the risk assessment process. Sections 6.2 through 6.5 outline the methodology and results of the HHRA. Appendix C presents supporting materials for the HHRA. Appendix C-1, Table 1 presents an overview of the various media, exposure points, potential receptors, and exposure pathways evaluated in this risk assessment. A detailed discussion of the potential receptors, exposure locations, and exposure pathways listed in Appendix C-1, Table 1 is presented in Section 6.3. An analysis of the uncertainties is presented in Section 6.6. Section 6.7 summarizes the HHRA for the OU9 study area. The risk assessment conducted for this RI follows the most recent guidance from the EPA (EPA, 1989b and 1991a), including regional EPA guidance (EPA, 1989a, 1994c, 1995, 1996c, and 1999b). Tables were prepared following the standard format in accordance with Risk Assessment Guidance for Superfund (RAGS HHEM) Part D (EPA, 1997c). These tables are presented in Appendix C-1.

Prior to this HHRA, the Connecticut Department of Public Health (CTDPH) evaluated surface soil data collected by EPA in 2003 and 2004 to determine if Short Beach Park surface soils present a public health hazard to adults and children using the park for recreational activities. These samples were collected at 12 locations from 0 to 6 inches bgs where screening analysis of samples collected from the 0- to 2- foot bgs interval indicated the presence of Raymark waste. CTDPH reported just two locations where these surface soils had a few contaminants present above comparison values. These exceedances were not large and did not appear to be widespread throughout Short Beach Park. CTDPH concluded that surface soils at Short Beach Park present "No Apparent Public Health Hazard." The CTDPH report is presented in Appendix D.

6.1 Overview of Risk Assessment Process

A risk assessment provides the framework for developing information necessary to determine the need for remediating and developing potential remedial alternatives for a site. A baseline HHRA consists of five major components, as follows:

- Data evaluation and identification of chemicals of potential concern (COPCs);
- Exposure assessment;
- Toxicity assessment;
- Risk characterization; and
- Characterization of uncertainty in the risk estimates.

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: contaminants with toxic characteristics must be found in environmental media; contaminants must be released by either natural processes or by human action; potential exposure points must exist; and human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure route is regarded as incomplete and no potential risks will be considered for human receptors.

The risk assessment for the OU9 study area estimates the potential for human health risk from exposures to soils within estimated areas of Raymark waste within the study area (Figure 6-1).

The data evaluation component of the HHRA is primarily concerned with selecting COPCs that are representative of the type and magnitude of potential human health effects. Both current and historical study area data are considered in developing a list of COPCs. In turn, these COPCs are used to evaluate potential human health risks. A discussion of the process and site-specific issues is contained in Section 6.2.

The exposure assessment identifies potential human exposure pathways at the study area under consideration. Exposure routes are identified based on information on study area chemical concentrations, chemical release mechanisms, human activity patterns, and other pertinent information to develop a conceptual site model. A generic discussion of the exposure assessment is contained in Section 6.3. Section 6.3.1 presents the conceptual site model.

Section 6.3.2 presents the potential routes of exposure. Section 6.3.3 presents potential human receptors and the relevant exposure assumptions. Section 6.3.4 presents exposure pathways and the equations for estimating chemical intake.

The toxicity assessment presents the available human health criteria for all the selected COPCs. This assessment is contained in Section 6.4. Quantitative toxicity indices are presented where they are available. A discussion of health effects and dose-response parameters such as Reference Doses (RfDs) and Cancer Slope Factors (CSFs) is presented.

The risk characterization section (Section 6.5) describes how the estimated intakes are combined with the toxicity information to estimate risks. Uncertainties associated with the risk assessment process are discussed qualitatively in Section 6.6. Section 6.7 summarizes the HHRA for the OU9 study area.

6.2 Data Evaluation

Data evaluation is a site-specific task that uses a variety of information to determine which of the detected chemicals at a study area are most likely to present a risk to potential receptors. The HHRA for this site evaluates the soils from within the estimated areas of Raymark waste, in which samples meet the definition of Raymark waste as described in Section 1.4 and shown in Figure 6-1. For the OU9 study area, the estimated areas of Raymark waste within the Short Beach Park portion of the study area were considered separately from the Stratford Landfill portion of the study area.

Within the Stratford Landfill portion of the study area the majority of the samples that met the definition of Raymark waste are located at depths greater than 15 feet bgs. As described in Section 1.4, the estimated areas of Raymark waste within the study area were defined by the presence of samples that met the definition of Raymark waste. Whenever a single sample from any depth met the definition, that location was included in the estimated area, regardless of whether or not samples from other depths met the definition. Because samples at depth met the definition of Raymark waste throughout the Stratford Landfill portion of the study area, the entire landfill area was considered a single estimated area of Raymark waste. Therefore, samples from throughout the Stratford Landfill portion of the study area were evaluated in this HHRA. For purposes of risk assessment, only samples collected from 0 to 15 feet bgs are

considered accessible; therefore, only samples collected from 0 to 15 feet bgs are included in risk calculations. Only three small areas of the landfill had samples within the 0- to 15-foot depth interval that met the definition of Raymark waste (see Figure 6-1). One of these areas (Area #1 of Raymark waste at 0 to 15 feet bgs) is an area on the western slope of the Stratford Landfill where the Town disposed of Raymark waste from 3rd and 4th Avenue. The second and third areas (Areas #2 and #3 of Raymark waste at 0 to 15 feet bgs) are along Dorne Drive where the landfill slopes down to the road level and borders an estimated area of Raymark waste at Short Beach Park. Data collected from these areas, as well as, data collected from throughout the Stratford Landfill, from depths of 0 to 15 feet bgs were evaluated in this HHRA. A separate evaluation of risks at each of these three small areas is discussed in Section 6.6.1.

Within the Short Beach Park portion of the study area, where the depth to the water table is less than 15 feet bgs, only two areas had samples from the soils above the water table that met the definition of Raymark waste. These two areas, comprising approximately 10 percent of the total area of Short Beach Park, are the only areas of Short Beach Park evaluated in this HHRA. See Figure 6-1. Data from the two areas, while not contiguous, are qualitatively very similar. For this reason (and also because land use is similar), data from the two estimated areas of Raymark waste within the Short Beach Park portion of the study area were combined into one dataset. Within this dataset, soils to a depth of 2 feet bgs and soils to the water table depth were evaluated separately.

Appendix C-2 provides lists of sample locations that lie within the estimated areas of Raymark waste at the study area. It should be noted that whenever a single sample from a particular location met the definition of Raymark waste, all samples from that location to the specified depth were included in the dataset regardless of whether or not each met the definition of Raymark waste. Once the estimated area of Raymark waste was defined, all sample locations within the area were included in the dataset for evaluation.

The end result of this qualitative selection process is a list of COPCs and representative exposure point concentrations. Exposure point concentrations (EPCs) are defined as the contaminant concentrations at the point of exposure. The methodology used to identify COPCs for the OU9 RI Report is provided in Section 6.2.1. The rationale for the selection and/or exclusion of each detected chemical is presented in Section 6.2.2. Section 6.2.3 presents a

qualitative comparison of study area data to groundwater protection benchmarks. The methodologies used to determine EPCs for the selected COPCs are presented in Section 6.2.4.

6.2.1 Selection of Chemicals of Potential Concern

COPCs for the baseline HHRA are limited to those chemicals that exceed a selection criterion. For this risk assessment, EPA Region IX risk-based criteria were used to reduce the number of chemicals and exposure routes considered in a risk assessment following EPA Region I guidance and direction. Region IX risk-based criteria are chemical concentrations based on a fixed level of risk from soil exposures through ingestion, dermal, and inhalation pathways. The premise of this screening step is that risk is typically dominated by a few chemicals and that, although dozens may actually be detected, many chemicals may contribute minimally to the total risk.

Maximum detected concentrations in the soils at the estimated areas of Raymark waste within the OU9 study area were compared to the risk-based screening criteria. If the maximum concentration exceeded the Region IX screening criteria, that chemical was retained as a COPC for that dataset for all exposure routes involving soils. For example, if barium was retained for surface soil at the Short Beach Park portion of the study area, this chemical was evaluated as a COPC within that dataset for both ingestion and dermal exposure routes.

In general, available validated data for all contaminants and unvalidated field-screening data for metals and polychlorinated biphenyls (PCBs) from the June 1993 and the 2003/2004 sampling investigations were used to identify COPCs for the study areas. Samples collected in 1989, April and May 1993, 1995, and 1996 were not included in the HHRA. Analytical results from these samples are presented in Appendix B-1 with a memorandum explaining why these samples were not used in either the nature and extent discussion or the HHRA. A list of samples included in the HHRA is presented in Appendix C-2. Analytical results for these samples are presented in Appendix B-2. Section 4.0 discusses sample collection, the field-screening methods, fixed laboratory analysis by EPA Contract Laboratory Program (CLP) methods, and the analytical results. Appendix B-4 presents a correlation study, comparing field-screening data to CLP data. The correlation study concluded that field-screening data for both metals and PCBs were comparable to CLP data. This differs from prior operable units in which the correlation studies indicated a poor correlation between field-screening data and CLP data

for PCBs because of variations in technique by a variety of samplers and analytical laboratories and variations in detection limits. In the datasets used for the OU9 study area, the data were restricted to samples collected from within the Raymark waste areas. Since PCBs were detected in the majority of the samples in these datasets and the majority of the samples were collected during a single sampling event in December 2003 and January 2004 and analyzed either in the field by a single team of samplers or in a single fixed laboratory, variations in samplers, laboratories, and detection limits did not negatively impact the correlations. Because of the results of the correlation study, field-screening data for metals and PCBs were included in this HHRA.

The COPC selection tables for the OU9 study area soils are discussed in Section 6.2.2. Analytical results qualified as rejected, “R”, during the data validation process, were not considered because of their potential unreliability. Soil data collected from depths greater than 15 feet or below the water table were not used in the COPC selection process. Fifteen feet represents the maximum assumed depth for potential human exposure during excavation/construction. Also, excavation and construction are not expected below the water table where the depth to the water table is less than 15 feet bgs. Location-specific COPC summary screening tables are provided in Appendix C-1.

Data evaluation and subsequent risk estimates for dioxins were evaluated through use of dioxin toxicity equivalents (TEQs). The Toxicity Equivalent Factors (TEFs), presented in Appendix C-3, were used to convert concentrations of individual dioxin and furan congeners to TEQs of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). These TEFs are taken from “Toxic Equivalency Factors for PCBs, PCDDs, PCDFs for Humans and Wildlife”; Environmental Health Perspectives, Volume 106, December 1998, Table 1, Page 776. Concentrations of individual dioxins and furans were multiplied by their TEFs to yield 2,3,7,8-TCDD equivalent concentrations. These values were then totaled to yield total dioxin TEQs for each sample. The TEQs could then be compared to the screening toxicity value for 2,3,7,8-TCDD in the COPC selection step. One-half of the detection limit was used for non-detected dioxin and furan results and was included along with positive results in the TEQ summation for each sample. Support documentation for the calculation of dioxin TEQ concentrations is presented in Appendix C-3.

Total Aroclor concentrations were determined on a sample-specific basis by summing individual Aroclor concentrations; one-half of the detection limit was used as a surrogate for non-detected

results. In situations in which only one or two Aroclors were detected, the total Aroclor value may be strongly influenced by the detection limit values of non-detected Aroclors.

COPCs were selected based on Region IX values for direct exposure. Direct exposure COPCs are those chemicals detected at maximum concentrations in excess of the risk-based EPA Region IX COPC screening levels for soil contact; these criteria were developed for the protection of direct human contact with soil. Only chemicals selected as COPCs based on comparisons to direct contact criteria were evaluated quantitatively in the HHRA. The criteria used to identify COPCs are presented in Appendix C-1, Tables 2.1 through 2.3. Chemicals with maximum concentrations greater than the COPC screening levels are discussed in Section 6.2.2.

As contaminants in soils may leach into groundwater, site-specific soil data were also compared to Connecticut Remediation Standard Regulations (CTRSRs) for groundwater protection. An evaluation of groundwater is not part of the scope of work for this human health risk assessment. However, a preliminary qualitative assessment of the potential for chemical migration from soils to groundwater was conducted based on a comparison of maximum chemical concentrations detected in soil within the estimated areas of Raymark waste at the OU9 study area to the CTRSR pollutant mobility criteria. These criteria, described below, are intended to prevent further degradation of groundwater by preventing any additional discharges, which would cause irreversible contamination. Appendix C-4, Tables 1 and 2 present the CTRSRs for pollutant mobility GB criteria.

Chemicals with maximum concentrations in estimated areas of Raymark waste greater than the CTRSRs for pollutant mobility criteria are discussed in Section 6.2.3. The comparison allows a preliminary evaluation of the chemicals' potential to migrate to groundwater and potentially impact the quality of groundwater. Chemicals in excess of CTRSRs, but not in excess of direct exposure criteria, are not carried through the quantitative risk assessment (numerical risk estimates are not developed) because they are not considered to be significant contributors to the direct exposure pathways identified for potential human receptors.

Discussions of the criteria used for COPC selection and identification of soil contaminants exceeding groundwater protection benchmarks are provided in the remainder of this section.

Criteria for the Selection of COPCs in Soil

COPCs for soils were selected for the OU9 study area. The soil samples that were included in the HHRA evaluation were collected from either depths of 0 to 15 feet bgs or 0 feet to the water table, whichever is shallower. This soil depth is used to account for soil to which commercial workers and potential future residents may be potentially exposed, particularly in the future when soils currently located at depth may be brought to the surface during excavation or construction activities. The soil samples that were included in the HHRA evaluation of recreational visitors at the Short Beach Park portion of the study area were collected from depths of 0 to 2 feet bgs.

The following screening criteria were used to identify COPCs for direct contact exposure to soils:

- **EPA Region IX Preliminary Remedial Goals (PRGs) for Soil Exposures.** EPA Region I recommends the use of EPA Region IX PRGs for COPC selection (EPA, 1994c). PRG concentrations for soil contact for industrial land use were used as COPC selection criteria for the Stratford Landfill portion of the study area. PRG concentrations for soil contact for residential land use were used conservatively as COPC selection criteria for the Short Beach Park portion of the study area. These values were developed using the current EPA Region IX Preliminary Remedial Goals Table (EPA, 2002), which identifies concentrations of potential concern for nearly 600 chemicals in various media (air, drinking water, and soil) using certain reasonably maximum exposure default assumptions.

  The EPA Region IX industrial and residential soil exposure values were calculated based on the methodology presented in Risk Assessment Guidance for Superfund, Human Health Risk Evaluation Manual, Part B (EPA 1991b) and consider the ingestion, dermal, and inhalation exposure pathways. For carcinogenic chemicals, the values used for COPC screening are based on a 1E-6 target incremental lifetime cancer risk. The criteria for non-carcinogenic chemicals are based on a target hazard quotient (HQ) of 1.0. These EPA Region IX industrial and residential soil exposure values for non-carcinogenic chemicals were adjusted to COPC screening levels based on a target hazard quotient (HQ) of 0.1, which is one-tenth of the suggested cumulative target non-

carcinogenic risk for a potential receptor. The estimation of cumulative target non-carcinogenic risks is described in greater detail in Section 6.5.

Since EPA Region I does not advocate quantitative risk assessment of the health effects of aluminum, iron, cobalt, and copper, these EPA Region IX PRGs have been eliminated. The EPA Region IX PRGs for copper and iron are based on provisional oral RfDs. EPA Region I does not endorse their use because these provisional oral RfDs were based on concentrations needed to protect against a deficiency of the metal, rather than on quantitative estimates related to the hazard posed by overexposure (EPA, 1999b). Total chromium present was screened using the EPA Region IX PRG value for hexavalent chromium. The EPA Region IX PRG for hexavalent chromium was selected to be conservative in the absence of chromium speciation data. For PCBs, individual Aroclors were compared to screening criteria for individual Aroclors. All Aroclors were accepted as COPCs if at least one Aroclor was detected at maximum concentrations exceeding COPC screening levels.

- **EPA Soil Lead Guidance.** EPA Region IX has developed industrial PRG concentrations for lead of 750 mg/kg, based on the EPA's Technical Review Workgroup for Lead model (EPA, 1996c and 1996d). The approach focuses on estimating fetal blood-lead concentrations in women exposed to lead contaminated soil in non-residential scenarios. The lead screening level based on industrial land use was applied for the Stratford Landfill portion of the study area. EPA Region IX has developed residential PRG concentrations for lead, based on the EPA's Office of Solid Waste and Emergency Response (OSWER) soil screening level of 400 mg/kg for residential land use (EPA, 1994b). The EPA's Integrated Exposure Uptake and Biokinetic (IEUBK) model, which estimates the risk to a child resident, is the basis for this soil screening level. The lead screening level based on residential land use was applied as a conservative approach for the Short Beach Park portion of the study area.

- **National Emission Standards for Hazardous Air Pollutants Benchmark for Asbestos.** EPA Region IX has not developed risk-based concentrations for asbestos. Asbestos was a primary component of friction materials, e.g., gaskets material, sheet packing and friction materials, including clutch facing, transmission plates, and brake linings, manufactured at the former Raymark Facility. Asbestos is considered a potential

inhalation hazard. The National Emission Standards for Hazardous Air Pollutants (NESHAP) - EPA Regulation 40 CFR Part 61, Subpart M, Appendix A (EPA, 1990a) defines asbestos as material containing more than 1 percent asbestos. Since asbestos was detected at the OU9 study area, the EPA's NESHAP benchmark of 1 percent for an asbestos screening value was used.

Frequency of detection was not used as a COPC selection criterion. Essential nutrients, including calcium, magnesium, potassium, and sodium, were not selected as COPCs.

Background Concentrations

As part of the investigation activities conducted by EPA, soil samples were collected from schools, day care centers, and recreational areas around the Town of Stratford. The samples were analyzed for pesticides, PCBs, and metals. No background soil samples were analyzed for VOCs, SVOCs, dioxins, or furans. Average and maximum background concentrations for pesticides, PCBs, and metals in soils are presented in Appendix C-5. The average background concentrations for pesticides, PCBs, and metals in soils are presented in Appendix C-1, Table 2.1 through 2.3.

Concentrations in the background soil samples were not used to select COPCs. A discussion of study area data in comparison to the established inorganic and organic background levels is provided in the uncertainty section. Background concentrations will be considered when developing clean-up levels where an action is recommended.

Groundwater Protection Benchmarks

In order to identify the potential for soil contaminant migration to groundwater, CTDEP criteria were used to evaluate soil; however, these criteria were not used to select COPCs for quantitative risk assessment.

CTDEP has developed pollutant mobility RSRs for GA/GAA (drinking water source) and GB (non-drinking water source) classified areas (CTDEP, 1996). Since the OU9 study area is classified as a GB area, CTRSRs for GB pollutant mobility were used to identify soil

contaminants exceeding groundwater protection benchmarks. GB classified waters are defined as non-drinking water sources. Such a classification stipulates elimination or reduction in the groundwater of pollutants that pose a threat to public safety, or an unacceptable risk to public health; meeting surface water protection and volatilization criteria; maintenance of quality consistent with designated use; and regulation of discharges to groundwater to prevent further degradation. The standards for carcinogenic chemicals are based on a 1E-6 target incremental lifetime cancer risk. The standards for non-carcinogenic chemicals are based on a target HQ of 1.

6.2.2 Identification of COPCs

Appendix C-1, Tables 2.1 through 2.3 present summaries of the COPCs for quantitative risk assessment for both the Short Beach Park and Stratford Landfill portions of the OU9 study area. COPCs were identified based on a comparison of study area data within estimated areas of Raymark waste to the COPC screening levels defined in Section 6.2.1. All validated CLP data and field screening data for metals collected during historical investigations, except soil data collected from depths greater than 15 feet bgs or below the water table, were used to identify COPCs. Data for soils at depths greater than 15 feet bgs while available for the Stratford Landfill portion of the study area, were not used because human exposure to deeper soils is considered unlikely. The maximum detections in soil were compared to COPC screening levels based on EPA Region IX PRGs. Those chemicals with concentrations exceeding the COPC screening criteria were selected as COPCs for the risk evaluation.

The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils collected from the Stratford Landfill portion of the study area to risk-based COPC screening levels for commercial land use, as shown in Appendix C-1, Table 2.1:

- Polynuclear aromatic hydrocarbons (PAHs) (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno[1,2,3-cd]pyrene)
- Semi-volatile organic compounds (SVOCs) (acetophenone, bis-2-chloroethyl ether, and N-nitroso-di-n-propylamine)
- Total Aroclors (1262 and 1268)
- Dioxins

- Metals (arsenic, chromium, and lead)
- Asbestos

The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils from depths of 0 to 2 feet bgs within the estimated areas of Raymark waste of the Short Beach Park portion of the study area to risk-based COPC screening levels for residential land use, as shown in Appendix C-1, Table 2.2:

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno[1,2,3-cd]pyrene)
- SVOCs (bis-2-chloroethyl ether)
- Total Aroclors (1262 and 1268)
- Dioxins
- Metals (arsenic, barium, chromium, lead, manganese, and thallium)
- Asbestos

The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils from depths of 0 feet bgs to the water table within the estimated areas of Raymark waste of the Short Beach Park portion of the study area to risk-based COPC screening levels for residential land use, as shown in Appendix C-1, Table 2.3:

- PAHs (acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno[1,2,3-cd]pyrene, 2-methyl-naphthalene, and naphthalene)
- SVOCs (acetophenone, bis-2-chloroethyl ether, and N-nitroso-di-n-propylamine)
- Total Aroclors (1242, 1248, 1254, 1260, 1262, and 1268)
- Pesticides (dieldrin)
- Dioxins
- Metals (antimony, arsenic, barium, cadmium, chromium, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc)
- Asbestos

6.2.3 Identification of Soil Contaminants Exceeding Groundwater Protection Benchmarks

Maximum detected concentrations in soils were also compared to CTRSRs for pollutant mobility in a GB-classified area in order to address the potential for leaching of soil contaminants into groundwater. Appendix C-4, Tables 1 and 2 present the comparisons of study area data within the estimated areas of Raymark waste to the groundwater protection benchmarks defined in Section 6.2.1.

Under the CTRSR guidance (CTDEP, 1996), concerns regarding the mobility of inorganics are addressed using Toxicity Characteristic Leaching Procedure (TCLP) and/or Synthetic Precipitation Leaching Procedure (SPLP) data. A comparison of site-specific SPLP and TCLP data to CTRSRs for pollutant mobility is included in Appendix C-4, Tables 1 and 2.

Maximum concentrations of the following chemicals in soils from depths of 0 to 15 feet bgs within the Stratford Landfill portion of the study area exceeded the CTRSRs pollutant mobility criteria, indicating a potential for these chemicals to migrate to groundwater and potentially impact the quality of groundwater; as shown in Appendix C-4, Table 1:

- SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoranthene, bis(2-ethylhexyl)phthalate, carbazole, chrysene, dibenzo(a,h) anthracene, and indeno[1,2,3-cd]pyrene)
- Pesticides (4,4'-DDT)
- Lead

Maximum concentrations in soils from depths of 0 feet bgs to the water table within the estimated areas of Raymark waste of the Short Beach Park portion of the study area of the following chemicals exceeded the CTRSRs pollutant mobility criteria, indicating a potential for these chemicals to migrate to groundwater and potentially impact the quality of groundwater; as shown in Appendix C-4, Table 2:

- SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoranthene, bis(2-ethylhexyl)phthalate, carbazole, chrysene, dibenzo(a,h)anthracene,

dibenzofuran, fluoranthene, indeno[1,2,3-cd]pyrene, 2-methylnaphthalene, N-nitroso-diphenylamine, phenanthrene, and pyrene)

- Pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, dieldrin, and gamma-chlordane)
- Lead

6.2.4 Exposure Point Concentrations

According to EPA regional guidance, risk assessments are conducted using an exposure point concentration for each COPC. The exposure point concentration is defined as the 95 percent upper confidence limit (UCL) on the mean and is calculated using the latest risk assessment guidance from EPA (EPA, 1992a, 1992b, and 1994c). A value of one-half of the detection limit is substituted for non-detected values in the calculation of the 95 percent UCL on the mean. Because of potential problems with sample heterogeneity, the maximum detected concentration reported for field duplicate pair samples was used to calculate the soil matrix EPCs, at the direction of EPA. Sample lists for each area evaluated are provided in Appendix C-2.

TtNUS calculated the 95 percent UCL on the mean (UCL) for the risk assessment using a TtNUS-modified version of EPA's ProUCL (Version 3.00.02, August 2004) software. The modifications enable ProUCL to calculate UCLs for several compounds at once, rather than one at a time.

ProUCL calculates UCLs using 15 different computation methods, five parametric and ten non-parametric. Parametric methods rely on the estimation of parameters (such as the mean or the standard deviation) describing the distribution of the variable of interest in the population; non-parametric methods do not.

The five parametric UCL computation methods include:

1. Student’s-t UCL,
2. approximate gamma UCL using chi-square approximation,
3. adjusted gamma UCL (adjusted for level significance),
4. Land’s H-UCL, and

5. Chebyshev inequality based UCL (using Minimum Variance Un-biased Estimators (MVUEs) of parameters of a lognormal distribution).

The ten non-parametric methods included in ProUCL are:

1. the central limit theorem (CLT) based UCL,
2. modified-t statistic (adjusted for skewness) bases UCL,
3. adjusted-CLT (adjusted for skewness) based UCL,
4. Chebyshev inequality based UCL (using sample mean and sample standard deviation),
5. Jackknife method based UCL,
6. UCL based upon standard bootstrap,
7. UCL based upon percentile bootstrap,
8. UCL based upon bias - corrected accelerated (BCA) bootstrap,
9. UCL based upon bootstrap-t, and
10. UCL based upon Hall's bootstrap.

ProUCL then suggests which UCL is most appropriate for the data set. Flow charts to map the logic used by ProUCL to select the most appropriate UCL are provided in Appendix C-6. After the 95 percent UCL on the mean was calculated, it was compared to the maximum detected concentration within the data set. In data sets in which the calculated 95 percent UCL on the mean exceeded the maximum detected concentration, the maximum detected concentration was used as the reasonable maximum exposure point concentration; the lesser of the mean or maximum concentration detected was used for the central tendency exposure point concentrations (see Section 6.3.3). This is a common problem in small data sets or data sets with high detection limits. Support documentation for the calculation of the 95 percent UCLs on the mean is presented in Appendix C-6. Exposure point concentrations used in the risk assessment are presented in Appendix C-1, Tables 3.1 through 3.3.

6.3 Exposure Assessment

The exposure assessment defines and evaluates the exposures that may be experienced by a receptor population. To have an exposure, several factors must be present: there must be a source of contamination, there must be a mechanism through which a receptor can come into

contact with the contaminants in that medium, and there must actually (or potentially) be a receptor present at the point of contact.

The exposure assessment presented consists of several sections that characterize the physical site setting and the receptors of concern, identifies the potential contaminant migration and exposure pathways, and presents the equations used to quantify exposure in terms of contaminant intake (dose). Appendix C-7 of this report contains sample calculations for the exposure assessment. Exposure assumptions are presented in Appendix C-1, Tables 4.1 through 4.4. Intakes are presented in Appendix C-1, Tables 7.1 through 7.4 and 8.1 through 8.4.

6.3.1 Conceptual Site Model

This section discusses the general conceptual site model for the OU9 study area. A conceptual site model facilitates a consistent and comprehensive evaluation of the risks to human health by creating a framework for identifying the paths by which human health may be impacted by contaminants predicted to exist at the source areas. A conceptual site model depicts the relationships between the following elements necessary to construct a complete exposure pathway:

- Sources of contamination and potential COPCs;
- Contaminant release mechanisms and transport pathways;
- Exposure mechanisms and exposure routes; and
- Receptors.

The conceptual site model was developed to provide the basis for identifying the potential risks to human health and the environment. The model considers the current and future conditions within the study area, and the actual or potential receptors that might come into contact with the COPCs.

The conceptual site model first considers the contaminant sources assumed to be available, either currently or in the future. For this model, the Raymark Facility waste disposed of within the study area is considered the source. Contaminants may be released from this source by mechanisms such as wind, water erosion, leaching to the subsurface, or excavation within

areas of contamination. Once released from the source, contaminants are transported in media such as air, surface water, or groundwater. Receptors may be exposed either directly or indirectly to contaminants in environmental media via a variety of mechanisms. The exposure mechanisms considered include recreation, working outdoors, etc. These exposure mechanisms generally act along one or more exposure routes such as ingestion, inhalation, or direct dermal contact.

The conceptual site model also indicates those exposure routes that are carried through the quantitative risk assessment for each receptor. An objective of developing the conceptual site model is to focus attention on those pathways that contribute the most to the potential impacts on human health and the environment, and to provide the rationale for screening out other exposure pathways that are minor components of the overall risk.

Sources of Contamination and Potential COPCs. As discussed in Section 1.3, the Raymark Industries, Inc. (Raymark) Facility manufactured friction materials containing asbestos and non-asbestos materials, metals, phenol-formaldehyde resins, and various adhesives. As a result of these activities, soils at the former Raymark Facility were contaminated primarily with asbestos, lead, and PCBs. Raymark operated from 1919 until 1989, when the plant was shut down and permanently closed. While the former Raymark Facility was active, it was common practice for the company to give away its excess manufacturing wastes for use as fill within the Town of Stratford. Both Short Beach Park and the Stratford Landfill received some of this soil/waste/fill; in addition, during early removal activities Raymark waste from residential properties was also placed at the Stratford Landfill.

Contaminant Release Mechanisms and Transport Pathways. Chemicals may be released from the study area by a variety of mechanisms. These mechanisms include stormwater runoff and subsequent surface soil erosion, soluble chemicals infiltration and subsequent migration through the subsurface soil to the water table where the chemicals may migrate downgradient, wind erosion of surface soil from unpaved areas, disturbance of contaminants in soil through human excavation or animal burrowing activities, and through cracks in asphalt pavement, if present. Contaminant fate and transport are discussed in Section 5.

Exposure Mechanisms and Exposure Routes. The potential for exposure to the contamination within the OU9 study area is based on several factors, including current and

future land uses, human activity patterns, site access controls, and chemical behavior in the environment. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under current and future site conditions. The future scenario accounts for possible changes in land use and site characteristics that may alter exposure and/or concentrations of COPCs in a given medium, in addition to the exposures that may result from current uses of the land.

The exposure assessment is based on the assumption that, in general, chemical compositions for environmental media are identical under current and future site conditions.

The exposure routes through which receptors may be exposed are incidental ingestion and dermal contact with contaminated soils and inhalation of dust.

A summary of the potentially significant exposures identified for quantitative evaluation is provided in Appendix C-1, Table 1.

The OU9 study area was described in Section 1.3 and is shown on Figure 1-1. The OU9 study area (approximately 94 acres) includes a town-owned recreational area and a minimally active landfill. Current use and zoning were considered in the determination of current and reasonably anticipated future uses. As a conservative approach, future on-site residents were included in the HHRA for the Short Beach Park portion of the study area. None of the property within the OU9 study area has been developed for residential purposes. Current land use and zoning suggests that future use of the area will remain unchanged.

Short Beach Park is used as a town-owned recreational area for recreational activities, such as soccer, baseball, and golf. The fields are used by town residents and residents of neighboring communities for organized soccer, baseball, and softball programs. The golf course is open to the public.

The Stratford Landfill is used as a minimally active landfill with commercial workers infrequently on-site to dump a load of brush materials. Fencing discourages public access; however, the fence is open in areas and not gated, allowing access to trespassers. The landfill is also open to town residents for leaf disposal during the fall season.

Exposed Populations. The OU9 study area is located in Stratford, Fairfield County, Connecticut. The principal industries within the community of Stratford include manufacturing aircraft, air conditioners, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. There were 49,389 people reported to live in the town in 2003.

Receptors. Several potential receptor populations were initially considered for inclusion in the exposure assessment. However, the majority of these receptors were eliminated from further evaluation based on the current land use, site access, COPCs, and the likelihood of exposure. Of the receptors initially considered (residents, recreational visitors, commercial workers, construction workers, and trespassers), the receptors retained for quantitative evaluation are commercial workers, recreational visitors, and future residents.

Possible current and future exposures of commercial workers to site-related contaminants would be through commercial/industrial activities at the Stratford Landfill portion of the study area or through grounds maintenance within the estimated areas of Raymark waste at the Short Beach Park portion of the study area. Currently workers are present infrequently at the Stratford Landfill portion of the study area. However, for purposes of evaluation of the commercial worker exposures, the commercial worker scenario was defined as an outdoor worker in direct contact with soils 250 days per year. This scenario is protective of commercial workers or trespassers who may be present less frequently and town residents disposing of leaves annually. The commercial worker scenario is also protective of construction workers who may be present frequently, but for a shorter duration. This scenario is not necessarily protective of future residential or recreational land use. At the Stratford Landfill portion of the study area commercial workers are assumed to be exposed to soils collected from depths of 0 to 15 feet bgs. At the Short Beach Park portion of the study area, commercial workers are assumed to be exposed to soils collected from depths of 0 feet bgs to the water table within estimated areas of Raymark waste while performing grounds maintenance.

Possible exposures of recreational visitors to site-related contaminants would be through recreational activities within the estimated areas of Raymark waste at the Short Beach Park portion of the study area. Conservative exposure assumptions (150 days per year) were selected for the evaluation of recreational exposures, since town residents may visit these properties frequently. At the Short Beach Park portion of the study area, recreational visitors

are assumed to be exposed to soils collected from depths of 0 to 2 feet bgs within estimated areas of Raymark waste.

While no changes in future land-use are expected, a future residential scenario is evaluated for the Short Beach portion of the study area because there are no restrictions established for future land-use. Current land use suggests that the area is valuable as recreational property. However, to address potential future use, hypothetical future on-site residents were also evaluated. Possible exposures of potential future residents to site-related contaminants would be through play or yard-work activities within the estimated areas of Raymark waste at the Short Beach Park portion of the study area. In the future, contaminated soils currently located at depth (to the water table) may be brought to the surface during land excavation or construction activities. For this reason, this risk assessment considers soils collected from 0 feet bgs to the water table for future exposures to hypothetical future residents within estimated areas of Raymark waste at the Short Beach Park portion of the study area.

Construction workers were not included in the HHRA. The HHRA was conducted assuming that the commercial worker or future resident may be in direct contact with soils as deep as 15 feet bgs on a frequent and long-term basis. Since these long-term scenarios are considered protective under a short-term construction worker scenario, the construction worker scenario was not evaluated separately.

6.3.2 Potential Routes of Exposure

A receptor can come into contact with contaminants in a variety of ways, which are generally the result of interactions between a receptor's behavior or lifestyle and an exposure medium. This HHRA defines an exposure route as a stylized description of the behavior that brings a receptor into contact with a contaminated medium. The exposure routes considered in this HHRA are soil and air. These are discussed in detail below. No groundwater, surface water, or sediment samples were collected.

<u>Direct Contact with Soil</u>

Receptors may come into direct contact with soil affected by the release of chemicals from the source areas. During the receptor's period of contact, the individual may be exposed via

inadvertent ingestion of a small amount of soil or via dermal absorption of certain contaminants from the soil.

Because of the limited guidance available to estimate soil exposure via dermal contact, dermal risks can only be evaluated quantitatively for contaminants with available soil absorption factors. Several of these chemicals were selected as COPCs for the estimated areas of Raymark waste within the OU9 study area. Therefore, dermal risks associated with soil were quantitatively addressed in the risk assessment. Dermal contact with other chemicals detected in the study area soils may or may not result in a significant exposure. It should be noted that organics such as PAHs, which were detected frequently in the soil samples and selected as COPCs, tend to strongly adhere to organic matter in soil. For these chemicals to be percutaneously absorbed, they must first desorb from soil and diffuse through the skin. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness, temperature, hydration, etc.), volatilization losses, and chemical-specific properties.

Air

This pathway is based on the scenario that a receptor is immersed in air that contains suspended particulates and volatile organic vapors originating from the source areas as part of daily living. Subsequent exposure of the receptor occurs upon inhalation of the ambient air.

A qualitative comparison of maximum detected soil concentrations and EPA Generic Soil Screening Levels (SSLs) for inhalation, based on intermedia transfer from soil to air (EPA, 1996a), was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. Generic SSLs for inhalation are modeled soil concentrations based on a back calculation of dust concentrations associated with a one-in-a-million (10^{-6}) cancer risk for carcinogens or a hazard quotient (HQ) of one for non-carcinogens. These concentrations are derived from equations combining default exposure information assumptions chosen to be protective of human health for most site conditions with EPA toxicity data. Generally, at sites where contaminant concentrations fall below SSLs, no further action or study is warranted under CERCLA. The inhalation SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential commercial receptors at the Stratford Landfill or Short Beach Park or potential recreational receptors at Short Beach

Park. Appendix C-1, Tables 2.1 through 2.3 present the inhalation SSLs for residential land-use.

All reported soil concentrations within the estimated areas of Raymark waste at both the Stratford Landfill and Short Beach Park portions of the study area are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a).

Qualitative evaluations of potential inhalation risks from exposures to asbestos were performed. OU9 study area soils contaminated by asbestos are unlikely to be significantly mobilized through wind erosion. Areas of Stratford landfill with Raymark waste identified within 0 to 15 feet bgs are covered by tall weeds and scrubby grasses, with the exception of a dirt access road, which passes through the landfill. Shrub and tree cover is sporadically found along the slopes and base of the landfill. Areas of Raymark waste at Short Beach Park are entirely covered by mowed grass. The presence of this vegetative cover reduces wind erosion and the possibility of airborne asbestos mobility. Based on field conditions within the OU9 study area, it is likely that asbestos does not currently present a significant inhalation risk from the estimated areas of Raymark waste. Disturbances of asbestos-containing soil through excavation will increase the potential for airborne asbestos exposures and associated inhalation risks.

Based on the qualitative screening, no further quantitative evaluation of exposures to fugitive dust and VOCs released from soil is warranted. Results of the asbestos evaluations are discussed in Section 6.5.2.

6.3.3 Potential Receptors

Potential receptors have been identified under current and future land use conditions. These receptors were identified by analyzing the interaction of current and anticipated future land use practices with the identified sources of contamination.

The following four receptor groups have been defined for this risk assessment:

- Commercial Workers - Adults working 40 hours per week on a full-time permanent basis at the Stratford Landfill portion of the study area. This scenario is protective of current and future commercial workers who may be present less frequently as well as

trespassers who may frequent the property. This long-term scenario is also considered to be protective of a short-term construction worker scenario.

- Recreational visitors - Recreational visitors (adults and children) who may visit the Short Beach Park portion of the study area on a frequent basis for play or leisure activities.

- Commercial Workers/Groundskeepers - Adults working 40 hours per week on a full-time permanent basis at the Short Beach Park portion of the study area. This scenario is protective of current and future workers who may be present less frequently. This long-term scenario is also considered to be protective of a short-term construction worker scenario.

- Residents – Hypothetical future residents (adults and children) who may reside at the Short Beach Park portion of the study area. This scenario is extremely unlikely, but is being considered because there is currently no permanent land-use restriction in place preventing future development of the study area for residential use. This scenario is protective of recreational visitors and trespassers.

Table 1 of Appendix C-1 presents receptors and exposure pathways identified for the OU9 study area, and provides the rationale for the quantitative evaluation of selected exposure pathways.

Potential receptors are evaluated for exposures to estimated areas of Raymark waste only. Samples meeting the definition of Raymark waste were collected from throughout the area of Stratford Landfill. At Short Beach Park, samples meeting the definition of Raymark waste were collected from two limited areas. These two areas comprise approximately 10 percent of the total area of Short Beach Park. This evaluation assumes receptors at Short Beach Park (recreational visitors, commercial workers/groundskeepers, and hypothetical future residents) spend all of their time on-site within these estimated areas of Raymark waste.

Two bounding estimates of each exposure scenario were considered according to or consistent with EPA Region I guidance. The first is identified as a central tendency exposure (CTE) receptor, which was developed using both regional guidance (EPA, 1994c) and professional judgment regarding site-specific conditions. The second class of receptor is called the

reasonable maximum exposure (RME) and was developed according to EPA guidance (EPA, 1989b and 1994c). The CTE scenario uses average values for exposure parameters and represents an "average case" exposure scenario. The RME scenario uses maximum values for exposure parameters. The RME scenario is intended to provide an upper bound of the possible risk. The RME is conceptually the "high end" exposure, above the 90TH percentile of the population distribution, but not higher than the individual in the population with the highest exposure. Therefore, the RME scenario represents a "reasonable worst case" exposure scenario.

Exposure scenarios for each of the four receptor groups defined above are discussed below.

Commercial Workers

The adult commercial worker was evaluated for exposures to soils at the Stratford Landfill portion of the study area to a depth of 15 feet bgs, for the current and/or future land use scenario. In the future, contaminated soils currently located at depth may be brought to the surface through excavation and land development.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact. Commercial workers were assumed to be exposed to site media 250 days/year. These receptors were assumed to ingest an average of 50 mg/day for 9 years for the CTE evaluation and 100 mg of soil per day for 25 years for the RME evaluation. Face, hands, and forearms were expected to be available for dermal contact with soils. The calculated available skin surface area for these body parts was 2,500 cm^2. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.2 mg/ cm^2 and 0.02 mg/cm^2 were used as soil-to-skin adherence factors for adult commercial workers for the RME and CTE evaluations, respectively. The RME value corresponds to 50th percentile weighted adherence values for heavy equipment operators and utility workers. The CTE value corresponds to 50th percentile weighted adherence values for commercial groundskeepers (EPA 2004b).

Recreational Users

Adult and child recreational visitors were evaluated for current and future exposures to the soils to a depth of 2 feet bgs at the estimated areas of Raymark waste at the Short Beach Park portion of the study area. Recreational visitors were assumed to be adults and small children. Exposures and associated risks from contaminants outside the estimated areas of Raymark waste were not evaluated in this risk assessment.

Site-specific considerations were used to determine exposure frequencies for recreational visitors. This receptor was assumed to have a high frequency of exposure; the exposure assumptions for recreational visitors were 150 days/year because of the high frequency of use by organized teams. Adult receptors were assumed to ingest an average of 50 mg of soil per day for 7 years for the CTE evaluation and 100 mg of soil per day for 24 years for the RME evaluation. Child receptors were assumed to ingest an average of 100 mg of soil per day for 2 years for the CTE evaluation and 200 mg of soil per day for 6 years for the RME evaluation. The fraction of soil intake derived from the contaminated source was set at one. The proposed exposure duration values were based on EPA guidance for RME and CTE evaluation (EPA, 1997b). Values for small children for the RME evaluation reflect the entire age span for the receptor evaluated. The associated CTE values reflect a short period of time (basically one third of the RME value).

Hands, forearms, lower legs, feet, and head were assumed to be available for dermal contact with soil for young children. Hands, forearms, lower legs, and head were assumed to be available for dermal contact with soil for adults. The calculated available skin surface areas for dermal contact with soil for adults and small children (ages 0-6 years) were 5,700 cm^2 and 2,800 cm^2, respectively. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.07 mg/cm^2 and 0.01 mg/cm^2 were used as soil-to-skin adherence factors for adult exposures for the RME and CTE evaluations, respectively. The adult recreational RME soil-to-skin adherence factor of 0.07 mg/cm^2 corresponds to the 50th percentile weighted adherence values for gardeners. The adult recreational CTE soil-to-skin adherence factor of 0.01 mg/cm^2 corresponds to the 50th percentile weighted adherence values for groundskeepers. Values of 0.2 mg/cm^2 and 0.06 mg/cm^2 were used as soil-to-skin adherence factors for child exposures for the RME and CTE evaluations, respectively. The child recreational RME soil-to-skin adherence factor of 0.2 mg/cm^2 corresponds to the 50th

percentile weighted adherence values for children playing in wet soil. The child recreational CTE soil-to-skin adherence factor of 0.06 mg/cm^2 corresponds to the 95th percentile weighted adherence values for children in indoor activities. The adherence factors have been recommended in EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) (EPA, 2004b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

Commercial Workers/Groundskeepers

The adult commercial worker/groundskeeper was evaluated for exposures to soils at the estimated areas of Raymark waste at the Short Beach Park portion of the study area to the depth of the water table, for the current and/or future land use scenario. In the future or during maintenance work, contaminated soils currently located at depth may be brought to the surface through excavation and land development. Exposures and associated risks from contaminants outside the estimated areas of Raymark waste were not evaluated in this risk assessment.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact. The same exposure assumptions as those selected for commercial workers at the Stratford Landfill portion of the study area described above were selected for commercial workers/groundskeepers at the Short Beach Park portion of the study area.

Hypothetical Future Residents

Hypothetical future adult and child residents were evaluated for future exposures to the soils to the depth of the water table at the estimated areas of Raymark waste at the Short Beach Park portion of the study area. Soils to the depth of the water table were used to account for the depth of soils that could be brought to the surface during site development. Residents were assumed to be adults and small children. Exposures and associated risks from contaminants outside the estimated areas of Raymark waste were not evaluated in this risk assessment.

Site-specific considerations were used to determine exposure frequencies for residents. Residents were assumed to be exposed 350 days/year. This exposure frequency is the CTDEP and EPA default exposure frequency for residents (EPA, 1991a). Adult receptors were assumed

to ingest an average of 50 mg of soil per day for 7 years for the CTE evaluation and 100 mg of soil per day for 24 years for the RME evaluation. Child receptors were assumed to ingest an average of 100 mg of soil per day for 2 years for the CTE evaluation and 200 mg of soil per day for 6 years for the RME evaluation. The fraction of soil intake derived from the contaminated source was set at one. The proposed exposure duration values are based on EPA guidance for RME and CTE evaluation (EPA, 1997b). Values for small children for the RME evaluation reflect the entire age span for the receptor evaluated. The associated CTE values reflect a short period of time (basically one third of the RME value).

Hands, forearms, lower legs, feet, and head were expected to be available for dermal contact with soil for young children. Hands, forearms, lower legs, and head were expected to be available for dermal contact with soil for adults. The calculated available skin surface areas for dermal contact with soil for adults and small children (ages 0-6 years) were 5,700 cm^2 and 2,800 cm^2, respectively. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.07 mg/ cm^2 and 0.01 mg/cm^2 were used as soil-to-skin adherence factors for adult exposures for the RME and CTE evaluations, respectively.

The adult recreational RME soil-to-skin adherence factor of 0.07 mg/cm^2 corresponds to the 50th percentile weighted adherence values for gardeners. The adult recreational CTE soil-to-skin adherence factor of 0.01 mg/cm^2 corresponds to the 50th percentile weighted adherence values for groundskeepers. Values of 0.2 mg/cm^2 and 0.06 mg/cm^2 were used as soil-to-skin adherence factors for child exposures for the RME and CTE evaluations, respectively. The child recreational RME soil-to-skin adherence factor of 0.2 mg/cm^2 corresponds to the 50th percentile weighted adherence values for children playing in wet soil. The child recreational CTE soil-to-skin adherence factor of 0.06 mg/cm^2 corresponds to the 95th percentile weighted adherence values for children in indoor activities. The adherence factors have been recommended in EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment (EPA, 2004b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

6.3.4 Exposure Pathways

An exposure pathway consists of four elements: a source and mechanism of release; a route of contaminant transport through an environmental medium; a contact point for a human receptor; and an exposure route at the point of contact. All four components must be present for the exposure pathway to be considered complete. This section summarizes the potentially complete exposure pathways that were quantitatively evaluated in the risk assessment and provides the rationale for those pathways that were not evaluated. Appendix C-1, Table 1 presents a summary of the potentially complete and incomplete exposure pathways and receptors.

The primary routes of exposure for potential human receptors within the OU9 study area are incidental ingestion of and dermal contact with soil. Other potential exposure routes such as those associated with using groundwater or inhaling fugitive dust and volatile emissions were not considered for the following reasons:

- The shallow aquifer at the OU9 study area is not used as a potable water supply. Thus, domestic groundwater exposures by nearby residents are eliminated. In addition, groundwater at OU9 is not used or expected to be used in the future as a potable water supply because of the assumed brackish conditions in most areas, as well as productivity constraints. No groundwater investigations are planned for the OU9 study area.

- Potential exposures to volatile emissions and fugitive dust from soils within the OU9 study area are considered to be minimal, based on the qualitative comparison of OU9 data to the EPA Generic SSLs for transfers from soil to air, discussed in Section 6.3.2, and the field conditions within the OU9 study area; thereby eliminating the need for quantitative evaluation of this exposure pathway. Qualitative evaluations of potential inhalation risks from exposures to asbestos are provided in Section 6.5.2.

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of EPA guidance documents that are cited in the specific intake estimation sections that follow.

Exposures depend on the predicted concentrations of chemicals in environmental media and local land use practices, and both are subject to change over time. This results in a large number of possible combinations of receptors, media, exposure pathways, and concentrations. As mentioned previously, Appendix C-1, Table 1 presents a summary of the exposure pathways evaluated in the quantitative risk assessment. The commercial and recreational scenarios are applicable under both current and future land use conditions. The residential scenario is applicable under future land use conditions only.

Exposure model parameters are presented in Appendix C-1, Tables 4.1, 4.2A, 4.2B, 4.3, 4.4A, and 4.4B. Table 4.1 presents exposure parameters for the industrial/commercial scenario at the Stratford Landfill portion of the study area. Tables 4.2A and 4.2B present exposure parameters for the recreational scenario for adults and children. Table 4.3 presents exposure parameters for the commercial worker/groundskeeper scenario at the Short Beach Park portion of the study area. Tables 4.4A and 4.4B present exposure parameters for the residential scenario for adults and children. The values reflect current EPA guidance and comments received from EPA Region I. All parameters are referenced in footnotes on each table. These parameters are used in the equations presented in this section, along with the exposure point concentrations presented in Appendix C-1, Tables 3.1 through 3.3, to calculate intakes, which are used to determine risks. Individual chemical intakes for each receptor/exposure route combination are presented in Appendix C-1, Tables 7.1 through 7.4 and 8.1 through 8.4. The equations used to quantify intakes are presented below.

<u>Incidental Ingestion of Soil</u>. The estimation of intake of contaminants in soils was determined using the predicted concentration of a contaminant in the OU9 study area. This pathway is evaluated for adult commercial workers and both child and adult recreational visitors and residents. In general, intakes associated with soil ingestion were calculated using the following equation:

$$Intake = \frac{(C)(IR)(FI)(OABS)(EF)(ED)(CF)}{(BW)(AT)}$$

where: Intake	=	intake of contaminant from soil (mg/kg/day)
C	=	exposure concentration for soil (mg/kg)
IR	=	ingestion rate (mg/day)

FI	=	fraction ingested from contaminated source (decimal fraction)
OABS	=	oral relative absorption factor (decimal fraction)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT=ED*365 days/yr;
		for carcinogens, AT=70 yr*365 days/yr

Appendix C-1, Tables 4.1 through 4.4 contain summaries of the input parameters for incidental ingestion of soil. The oral relative absorption factor was set equal to one for all contaminants, assuming that absorption from soil is equal to absorption from the media used to develop toxicity values.

<u>Dermal Contact with Soil.</u> Dermal contact exposures to soil were also evaluated for adult commercial workers and both child and adult recreational visitors and residents.

The following equation was used to estimate the dermal exposure dose for soil:

$$Dose\ (mg/kg/day) = \frac{(C)\ (DABS)\ (AF)\ (SA)\ (EF)\ (ED)\ (CF)}{(BW)\ (AT)}$$

where:	Dose	=	dose of contaminant from soil (mg/kg/day)
	C	=	exposure concentration for soil (mg/kg)
	DABS	=	dermal absorption factor (unitless)
	AF	=	soil-to-skin adherence factor (mg/cm^2)
	SA	=	skin area available for contact (cm^2/day)
	EF	=	exposure frequency (days/yr)
	ED	=	exposure duration (yr)
	CF	=	conversion factor (10^{-6} kg/mg)
	BW	=	body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT=ED*365 days/yr;
for carcinogens, AT=70 yr*365 days/yr

Chemical-specific dermal absorption factors (DABS), presented in EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment (EPA, 2004b), were used to estimate exposure doses. Unfortunately, limited information regarding dermal absorption is available. The DABS values, where available, for the COPCs are presented in Appendix C-1, Table 5.1. Because of the absence of dermal absorption data, TtNUS qualitatively evaluated dermal exposures to all other COPCs.

The input parameters for dermal contact with soil are summarized in Appendix C-1, Tables 4.1, 4.2A, 4.2B, 4.3, 4.4A, and 4.4B.

6.4 Toxicity Assessment

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. The goal of the toxicity assessment is to provide, for each COPC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects (Sections 6.5).

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the chemicals of potential concern.

The entire toxicological database is used to guide the derivation of cancer slope factors (CSFs) for carcinogenic effects and reference doses (RfDs) for non-carcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and

evaluations of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of the toxicity data used to derive CSFs and RfDs comes from animal studies.

For non-carcinogenic effects, the most appropriate animal model (the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such data, however, an RfD for one route of exposure may be extrapolated from data from a study that evaluated a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicological similarity.

CSFs for weight-of-evidence Group A or B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C chemicals for which the data are sufficient; CSFs are not derived for Group D or E chemicals. (An explanation/definition of these weight-of-evidence classes is provided in Section 6.4.2). Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Brief summaries of the toxicity profiles for the major COPCs are presented in Appendix C-8. These profiles present a summary of the available literature on carcinogenic and

non-carcinogenic effects associated with human exposure to the chemical. For more in-depth information see www.epa.gov/iris or www.atsdr.cdc.gov.

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6.4.1 Non-carcinogenic Effects

For non-carcinogens, it is assumed that there exists a dose below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. Therefore, for non-carcinogens, a range of exposures exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for non-carcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to an RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs.

To derive an RfD, EPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for extrapolation of data from laboratory animals to humans (interspecies extrapolation), variation in human sensitivity to the toxic effects of a compound (intraspecies differences), derivation of a chronic RfD based on a subchronic rather than a chronic study, or derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed by multiplying an oral RfD (based on an administered dose) by the gastrointestinal tract absorption factor. The resulting dermal RfD, based on an absorbed dose, is used to evaluate the dermal (absorbed) dose calculated by the dermal exposure algorithms.

EPA's database (IRIS - the Integrated Risk Information System) (EPA, 2004a) was consulted as the primary source for RfD values, as well as for CSFs. EPA intends that IRIS supersedes all other sources of toxicity information for risk assessment. If values are not available in IRIS, the Health Effects Assessment Summary Tables (HEAST) (EPA, 1997a) are consulted, as well as, the current EPA Region IX Preliminary Remediation Goals (PRGs) Table (EPA, 2002). If no RfD is available from any of these sources, non-carcinogenic risks are not quantified and potential exposures are addressed in the uncertainty section (Section 6.6).

Reference doses for the COPCs for the OU9 study area are presented in Appendix C-1, Table 5.1. This table also includes the primary target organs affected by a particular chemical. This information may be used in the risk characterization (Section 6.5) to segregate risks by target organ effects when the total Hazard Index is greater than unity.

PCB risk characterization is generally addressed by evaluating total Aroclor concentrations. The PCB non-cancer risk estimates presented in this assessment were based on total Aroclor concentrations. Section 6.2.1 discusses the calculation of total Aroclor concentrations. For non-carcinogenic risk, oral RfDs are available for only two PCB commercial Aroclor formulations, Aroclor 1016 and Aroclor 1254. The oral RfD for Aroclor 1016 is 7.00E-05 mg/kg/day and the oral RfD for Aroclor 1254 is 2.00E-05 mg/kg/day. PCB non-cancer risk can be evaluated using the total Aroclor concentration and the RfD for the more toxic Aroclor (Aroclor 1254). This approach is conservative and tends to overestimate risks associated with the lighter Aroclors. Within the estimated areas of Raymark waste within the OU9 study area, the heavier Aroclors, Aroclor 1262 and Aroclor 1268, generally comprise the majority of the total Aroclor concentration. As a result of the high proportion of heavy Aroclors, the use of total Aroclors, in combination with the RfD for Aroclor 1254, for evaluating non-cancer risks, is not likely to significantly overestimate risks.

6.4.2 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes a slope factor and a weight-of-evidence classification consistent with EPA's 1986 Guidelines for Carcinogenic Risk Assessment (EPA, 1986). A revised weight-of-evidence classification system has been developed and presented in the Draft Revised Guidelines for Carcinogenic Risk Assessment (EPA, 1999a); however, none of the COPCs for the OU9 study area are impacted at this time. The 1986 weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of the following five groups in EPA's 1986 classification system to denote its potential for carcinogenic effects:

- Group A - known human carcinogen
- Group B1 or B2 - probable human carcinogen
- Group C - possible human carcinogen
- Group D – cannot be classified as a human carcinogen because of a lack of data
- Group E - evidence of non-carcinogenicity in humans

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined in the IRIS glossary as: "An upper-bound, approximately a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure to an agent. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than 1 in 100" (EPA, 2004a). Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens, such as lead, have none. Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$ for oral routes. CSFs for COPCs at the OU9 study area are presented in Appendix C-1, Table 6.1. The primary source of information for these values is the EPA IRIS database, followed by the other EPA sources in Section 6.4.1 described for non-carcinogens.

CSFs exist for several (but not all) Group C compounds, which are identified as "possible" human carcinogens. These compounds typically exhibit inadequate evidence of carcinogenicity

in humans and limited evidence in animals. No Group C compounds were identified as COPCs in this HHRA.

Dermal CSFs are derived from the corresponding oral values. To derive the dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Appendix C-1, Table 6.1. The absorption efficiencies were obtained from Table 4.1, "Summary of Gastrointestinal Absorption Efficiencies and Recommendations for Adjustment of Oral Slope Factors for Specific Compounds" of the EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (EPA, 2004b). Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. While benzo(a)pyrene was well studied, other Class B2 PAHs had insufficient data with which to calculate a CSF. EPA has published provisional guidance to assess PAHs (EPA, 1993). Estimated orders of potential potency (rather than a toxicity equivalence factor or TEF) were developed based on skin painting tests and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin). The quality of the data does not support any greater precision. The orders of potential potency used in this HHRA are presented in Appendix C-9 and are those proposed for use by EPA Region I (EPA, 1994c). EPA has determined that the oral CSF for benzo(a)pyrene is 7.3 $(mg/kg/day)^{-1}$. Oral CSFs for other carcinogenic PAHs were determined by multiplying the oral CSF for benzo(a)pyrene by the estimated order of potential potency for the PAH. These oral CSFs for PAHs became the basis for deriving the dermal CSFs used to evaluate dermal risk from PAHs.

The toxicity and cancer risk characterization for PCBs was conducted according to guidance presented in the EPA technical guidance document PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures (EPA, 1996b). The guidance document suggests a methodology for the risk evaluation of the total Aroclor concentration in an environmental medium.

Risk estimates for dioxins were evaluated through the use of dioxin TEQs as described in Section 6.2.1. Dioxin TEQs were used in conjunction with the toxicity value for 2,3,7,8-TCDD of

1.5E+5 (mg/kg/day)$^{-1}$ from IRIS (EPA, 2004a) in determining cancer risk. Use of this cancer slope factor for dioxins may underestimate risks from exposure to dioxins. This CSF is being reviewed by EPA. EPA has prepared a Draft Dioxin Reassessment (EPA, 2000), which recommends a CSF for dioxins of 1.0E+6 (mg/kg/day)$^{-1}$. Appendix C-10 presents the cancer risks from exposures to dioxins using the CSF of 1.0E+6 (mg/kg/day)$^{-1}$. Cancer risks estimated using this approach are approximately an order of magnitude greater than risks calculated using the CSF of 1.5E+5 (mg/kg/day)$^{-1}$.

6.5 Risk Characterization

This section provides a characterization of the potential human health risks associated with the potential exposure to COPCs in soils at estimated areas of Raymark waste within the OU9 study area. Section 6.5.1 outlines the methods used to estimate the type and magnitude of health risks, and Section 6.5.2 presents the results for the current and potential future land use conditions within the OU9 study area.

6.5.1 Risk Characterization Methodology

Potential human health risks resulting from exposure to COPCs were estimated using algorithms established by EPA. The methods described by EPA are protective of human health and are likely to overestimate (rather than underestimate) risk. The methodology uses specific algorithms to calculate risk as a function of chemical concentration, human exposure parameters, and toxicity.

Risks from hazardous chemicals are calculated for either carcinogenic or non-carcinogenic effects. Some carcinogenic chemicals may also exhibit non-carcinogenic effects. Potential impacts are then characterized for both types of health effects.

Non-carcinogens. The hazards associated with the effects of non-carcinogenic chemicals are evaluated by comparing an exposure level or intake to an RfD. The ratio of the intake to the RfD is called the hazard quotient (HQ) and is defined as follows (EPA, 1989b):

$$HQ = \frac{Intake}{RfD}$$

where: HQ = Hazard Quotient (unitless)

Intake = Intake (mg/kg/day), a function of exposure and chemical concentration

RfD = Reference dose (mg/kg/day)

If the ratio of the intake to the RfD exceeds unity, there exists a potential for non-carcinogenic (toxic) effects to occur. A Hazard Index (HI) is generated by summing the individual HQs for all COPCs. If the value of the HI exceeds unity, there is a potential for non-carcinogenic health effects associated with that particular chemical mixture, and therefore it is necessary to segregate the HQs by target organ effects. The HQ should not be construed as a probability, but rather as a numerical indicator of the extent to which a predicted intake exceeds or is less than an RfD.

Chemical Carcinogens. Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. At low doses, the incremental lifetime cancer risk (ILCR) is determined as follows (EPA, 1989b):

$$ILCR = (Intake)(CSF)$$

where: ILCR = Incremental lifetime cancer risk, expressed as a unitless probability

Intake = Intake (mg/kg/day)

CSF = Cancer slope factor $(mg/kg/day)^{-1}$

Risks below 1E-6 (or a risk less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable. The CTDEP regulations use 1E-5 (1 in 100,000) as a break point between acceptable and unacceptable risks for cumulative cancer risk from multiple contaminants and a break point of 1E-6 (one-in-a-million) cancer risk for individual contaminants (CTDEP, 1996).

Risks are estimated for all carcinogenic compounds regardless of the class designation described in Section 6.4.2.

Lead. Risks from lead exposure are not evaluated using the same methodology as other contaminants. Exposures to lead by non-residential adults (commercial workers) are evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, 1996c and 1996d). The slope factor approach focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soil in non-residential scenarios. Evaluation of risks from the ingestion of soil by adults was performed based on receptor exposure scenarios for adult commercial workers. The fetus of the pregnant worker is the most sensitive receptor in a commercial worker scenario. Evaluation of this receptor is protective of all adult workers. Residential and recreational child exposures to lead were evaluated using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (EPA, 1994a). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Since children are a more sensitive subpopulation than adults, evaluation of the child is protective of adults. Therefore, exposure to lead by adults in a residential or recreational scenario is not generally evaluated.

Blood-lead concentration is the most widely used index of internal lead body burdens associated with potential adverse health effects. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The threshold for toxic effects to children from this chemical is believed to be in the range of 10 micrograms/deciliter (µg/dL) to 15 µg/dL. Blood-lead levels greater than 10 µg/dL are considered to be a "concern."

The IEUBK Model and Technical Review Work Group Model for Lead are used to address exposures to lead. Exposure concentrations, as well as default parameters for some input parameters, were used in the evaluation. Because the output of these models is a range of predicted blood-lead concentrations, it is appropriate to input average soil lead concentrations rather than 95 percent UCL on the mean values. Entering a 95 percent UCL on the mean tends to bias the model outputs toward the high end, thus potentially overestimating risk. The exposure point concentrations selected for use in this evaluation are the arithmetic average soil

lead concentrations for the exposure areas. Exposures outside the estimated areas of Raymark waste were not evaluated.

Exposure to lead in soils by adults at the Stratford Landfill portion of the study area was evaluated using the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The model estimates the 95th percentile blood-lead concentration among fetuses born to women having site exposures. These concentrations are then compared to the established level of concern of 10 μg/dL. An additional step in the process estimates the probability that fetal blood-lead levels will exceed 10 μg/dL. EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 μg/dL.

Exposure to lead in soils by children at the Short Beach Park portion of the study area was evaluated using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (EPA, 1994a). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. These estimated blood levels of lead are then compared to the established level of concern of 10 μg/dL. An additional step in the process estimates the probability that blood-lead levels will exceed 10 μg/dL. EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 μg/dL.

The results of the lead exposure evaluations are discussed in Section 6.5.3. The input parameters used and the results of lead models, estimated blood-lead levels, and probability density histograms are presented in Appendix C-11.

Asbestos. Quantitative risk estimates (inhalation risk estimates) have not been developed for asbestos in this HHRA. EPA considers asbestos to be a carcinogen for exposures through the inhalation pathway. EPA has published a carcinogenic inhalation unit risk toxicity factor for quantitative cancer risk estimates for asbestos; however, this factor is in units of fibers/ml in ambient air. Use of the EPA unit risk factor requires either measurements of asbestos in air or measurements of the expected amount of asbestos released to the air in respirable dust from asbestos-contaminated soil. At this study area, no data are available for asbestos concentrations in air or dust. Recently, a method for measurements of the expected amount of asbestos released to the air in respirable dust from asbestos-contaminated soil has been developed. The accuracy of this method has not been verified and, therefore, EPA has not yet

accepted the method for risk assessment and risk management purposes. Asbestos in soil at this site has been reported as a percentage in soil and was measured by a visual microscopic evaluation of the percentage of a soil sample that is comprised of asbestos fibers. This data is insufficient for quantitative risk assessment because it is highly subjective and cannot be used to predict air or dust concentrations.

Asbestos-containing material is defined as material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR Part 61) (EPA, 1990a). Asbestos is considered a potential inhalation hazard if it is "friable" (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air. For this reason, the definition of asbestos-containing material was used for qualitative evaluations of asbestos exposures.

6.5.2 Risk Characterization Results

A summary of the quantitative risk assessment for the study area is provided in this section. Sample calculations are provided in Appendix C-7. Appendix C-1, Tables 7.1 through 7.4, and Tables 8.1 through 8.4 present non-cancer and cancer risk estimates, respectively, for each receptor and medium. Appendix C-1, Tables 9.1 through 9.4 present summaries of cancer risks and health hazard indices from all applicable media and pathways for each exposure scenario. Appendix C-1, Tables 10.1 through 10.4 reduce the information developed in Appendix C-1, Tables 9.1 through 9.4 to the major risk drivers only for scenarios with cancer risks greater than 1E-04 or hazard indices greater than 1.0. Results of the evaluations of lead exposures are presented in Appendix C-11. Table 6-1 summarizes the RME non-cancer and cancer results and provides primary contributors to unacceptable risks, lead evaluation results for all scenarios, and asbestos results.

<u>Non-carcinogenic Risks</u>

Hazard indices (HI) developed for commercial workers, recreational visitors, groundskeepers, and future residents at estimated areas of Raymark waste are shown in the table below:

Summary of Hazard Indices

Exposure Scenario		RME Case	CTE Case
Stratford Landfill			
Commercial Workers	(Adult)	3.46	0.94
Short Beach Park(1)			
Recreational Visitors	(Adult) (Child)	0.11 0.94	0.044 0.41
Commercial Workers/ Groundskeepers	(Adult)	1.0	0.3
Future Residents	(Adult) (Child)	1.2 10.1	0.47 4.4

(1) Approximately 10 percent of the total area of Short Beach Park is estimated to contain Raymark waste. This evaluation assumes the receptors spend all of their on-site time within the estimated areas of Raymark waste.

RME and CTE HIs are less than or equal to unity for recreational visitors and commercial workers/groundskeepers at the Short Beach Park portion of the study area. This indicates that adverse non-carcinogenic health effects are unlikely for recreational visitors and commercial workers/groundskeepers at the Short Beach Park portion of the study area even under the maximum exposure conditions. RME HIs are greater than unity for hypothetical future residents (adults and children) and full-time commercial workers at the Stratford Landfill portion of the study area. CTE HIs are less than unity for all receptors except hypothetical future residents (children). Further examination of these results reveals that individual hazard quotients for total Aroclors for hypothetical future residents (adult and children) at the Short Beach Park portion of the study area and commercial workers at the Stratford Landfill portion of the study area exceed unity, resulting in organ-specific HIs for skin, eye, and immune systems exceeding unity. This indicates that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for these receptors.

Carcinogenic Risks

Incremental cancer risk estimates developed for commercial workers, recreational visitors, groundskeepers, and future residents at estimated areas of Raymark waste are shown in the table below:

Summary of Cancer Risks

Exposure Scenario		RME Case	CTE Case
Stratford Landfill			
Commercial Workers	(Adult)	1.3E-04	1.2E-05
Short Beach Park[(1)]			
Recreational Visitors	(Adult) (Child) (Lifetime)	4.0E-06 8.3E-06 1.2E-05	4.6E-07 1.2E-06 1.7E-06
Commercial Workers/Groundskeepers	(Adult)	4.7E-05	5.0E-06
Future Residents	(Adult) (Child) (Lifetime)	5.3E-05 1.1E-04 1.7E-04	6.1E-06 1.6E-05 2.2E-05

(1) Approximately 10 percent of the total area of Short Beach Park is estimated to contain Raymark waste. This evaluation assumes the receptors spend all of their on-site time within the estimated areas of Raymark waste.

The EPA cancer risk range is 10^{-4} to 10^{-6}. The CTDEP target cancer risk level is 10^{-6} for single contaminants and 10^{-5} for total risk from multiple contaminants. Cancer risks for the adult and child resident are added together for a lifetime exposure. Cancer risks for the adult and child recreational visitor are also added together for a lifetime exposure.

The RME cancer risk estimates for the recreational visitors and groundskeepers exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area do not exceed the EPA cancer risk range (10^{-4} to 10^{-6}); however, they exceed the CTDEP target total risk level of 10^{-5} for multiple contaminants. The RME cancer risk estimates for hypothetical future residents exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area and full-time commercial workers exposed to soils at the Stratford Landfill portion of the study area slightly exceed the EPA cancer risk range (10^{-4} to 10^{-6}) and exceed the CTDEP target total risk level of 10^{-5} for multiple contaminants.

None of the CTE cancer risk estimates exceed the EPA cancer risk range (10^{-4} to 10^{-6}); however, CTE cancer risk estimates for hypothetical future residents exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area and full-time commercial workers exposed to soils at the Stratford Landfill portion of the study area slightly exceed the CTDEP target total risk level of 10^{-5} for multiple contaminants.

See Tables 8.1 through 8.4 in Appendix C-1 for details on cancer risk calculations. The major contributors to risk at the study area are benzo(a)pyrene and PCBs, each with individual RME cancer risk estimates greater than 1E-5 for child residents. As detailed in Appendix C-1, Tables 9.1 through 9.4, dioxins, Aroclors, arsenic, and several PAHs have estimated cancer risks greater than the CTDEP target risk level for single contaminants of 10^{-6}.

Cancer risk estimates for dioxins, shown on the tables cited above and included in the discussion above, were calculated using the CSF for 2,3,7,8-TCDD of 1.5E+5 $(mg/kg/d)^{-1}$ from IRIS (EPA, 2004a). As discussed in Section 6.4.2, this CSF is undergoing EPA review. Cancer risk estimates for dioxins calculated using the CSF for dioxins of 1E+6 $(mg/kg/d)^{-1}$ from the Draft Dioxin Reassessment (EPA, 2000) are presented in Appendix C-10. Total RME cancer risks estimated using the Draft Dioxin Reassessment CSF for dioxin for commercial workers exposed to soils at the Stratford Landfill portion of the study area are 3.8E-04. Total RME cancer risks estimated using the Draft Dioxin Reassessment CSF for dioxin for recreational visitors (adult and child) exposed to soils (0 to 2 feet bgs) within the estimated areas of Raymark waste at the Short Beach Park portion of the study area are 2.1E-05. Total RME cancer risks estimated using the Draft Dioxin Reassessment CSF for dioxin for commercial workers/groundskeepers exposed to soils (0 feet bgs to water table) within the estimated areas of Raymark waste at the Short Beach Park portion of the study area are 6.6E-05. Total RME cancer risks estimated using the Draft Dioxin Reassessment CSF for dioxin for future residents (adult and child) exposed to soils (0 feet bgs to water table) within the estimated areas of Raymark waste at the Short Beach Park portion of the study area are 2.4E-04.

Exposure to Lead

Lead was identified as a COPC in soils within the estimated areas of Raymark waste of the OU9 study area. Lead was detected in samples collected from 0 to 15 feet bgs within the Stratford Landfill portion of the study area at a maximum concentration of 28,700 mg/kg. The average lead concentration in this dataset was 625 mg/kg. Lead was detected in samples collected from 0 to 2 feet bgs within the estimated areas of Raymark waste at the Short Beach Park portion of the study area at a maximum concentration of 3,520 mg/kg. The average lead concentration in this dataset was 220 mg/kg. Lead was detected in samples collected from 0 feet bgs to the water table within the estimated areas of Raymark waste at the Short Beach Park portion of the study area at a maximum concentration of 20,500 mg/kg. The average lead concentration in this

dataset was 1,170 mg/kg. As stated in Section 6.5.1, average lead concentrations are used as exposure point concentrations in the lead models.

Summary of Lead Evaluations

Exposure Scenario		Probability[(2)]
Stratford Landfill		
Commercial Workers	(fetus of pregnant worker)	1.4 – 2.7%
Short Beach Park[(1)]		
Recreational Visitors	(Child)	1.5%
Commercial Workers/ Groundskeepers	(fetus of pregnant worker)	4.1 – 6.2%
Future Residents	(Child)	54.5%

(1) Approximately 10 percent of the total area of Short Beach Park is estimated to contain Raymark waste. This evaluation assumes the receptors spend all of their on-site time within the estimated areas of Raymark waste.
(2) Probability that blood-lead concentration exceeds 10 µg/dL.

Exposure to lead in soils by the adult commercial workers at the Stratford Landfill portion of the study area was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, 1996d). The exposure point concentration of 625 mg/kg for soil collected from 0 to 15 feet bgs at the Stratford Landfill portion of the study area, as well as, several default parameters, were used to estimate blood-lead levels for adult commercial workers contacting soil at the Stratford Landfill portion of the study area. The model estimated that the 95th percentile blood-lead concentration among fetuses born to women exposed to soil at the Stratford Landfill portion of the study area would be 6.8 to 8.2 µg/dL. This is less than EPA's established level of concern of 10 µg/dL. The probability that the fetal blood-lead concentration exceeds 10 µg/dL is 1.4 to 2.7 percent. EPA's target is 5 percent. The results of the slope-factor approach indicate that adverse effects are not anticipated for fetuses of pregnant workers exposed to lead in soil at the Stratford Landfill portion of the study area.

Exposure to lead in surface soils (0 to 2 feet bgs) by the child recreational visitor was evaluated using the EPA IEUBK Model, as discussed in Section 6.5.1. The IEUBK model was developed to evaluate exposures to lead by children in a residential setting. Using the model for a recreational scenario is a conservative approach. The arithmetic average lead concentration of 220 mg/kg for soil, as well as several default parameters, were used to estimate blood-lead

levels for children in a residential setting. IEUBK Model outputs are included in Appendix C-11. The IEUBK model estimates that 1.5 percent of children exposed as residents to the average surface soil lead concentration within the estimated areas of Raymark waste at the Short Beach Park portion of the study area would be expected to have blood-lead levels greater than 10 µg/dL; this is less than EPA's target of 5 percent. The results of the EPA IEUBK Model indicate that adverse effects are not anticipated for children exposed to lead in surface soil at the estimated areas of Raymark waste at the Short Beach Park portion of the study area.

Exposure to lead in soils by the adult commercial workers/groundskeepers at the Short Beach Park portion of the study area was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, 1996d). The exposure point concentration of 1,170 mg/kg for soil collected from 0 feet bgs to the water table within the estimated areas of Raymark waste at the Short Beach Park portion of the study area, as well as several default parameters, were used to estimate blood-lead levels for adult commercial workers contacting soil within the estimated areas of Raymark waste at the Short Beach Park portion of the study area. This evaluation assumes that workers spend all of their working time within the estimated areas of Raymark waste at Short Beach Park, despite the estimated areas of Raymark waste comprising only 10 percent of the total area of Short Beach Park. The model estimated that the 95th percentile blood-lead concentration among fetuses born to women exposed to soil within the estimated areas of Raymark waste at the Short Beach Park portion of the study area would be 9.4 to 10.8 µg/dL. This range approximates EPA's established level of concern of 10 µg/dL. The probability that the fetal blood-lead concentration exceeds 10 µg/dL is 4.1 to 6.2 percent. EPA's target is 5 percent. 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 estimated areas of Raymark waste at the Short Beach Park portion of the study area.

Exposure to lead in soils (0 feet bgs to the water table) by the future child resident was evaluated using the EPA IEUBK Model, as discussed in Section 6.5.1. The IEUBK model was developed to evaluate exposures to lead by children in a residential setting. The arithmetic average lead concentration of 1,170 mg/kg for soil, as well as several default parameters, were used to estimate blood-lead levels for children in a residential setting. IEUBK Model outputs are included in Appendix C-11. The IEUBK model estimates that 54.5 percent of children exposed as residents to the average soil lead concentration within the estimated areas of Raymark waste at the Short Beach Park portion of the study area would be expected to have blood-lead levels

greater than 10 µg/dL; this exceeds EPA's target of 5 percent. The results of the EPA IEUBK Model indicate that adverse effects are anticipated for future residential children exposed to lead in soil at the estimated areas of Raymark waste at the Short Beach Park portion of the study area.

In conclusion, exposures to lead in soils at the Short Beach Park portion of the study area exceed EPA's target level of concern when the case is considered for hypothetical future residents (children) exposed to average study area concentrations of lead in soils. Adverse effects are also possible for commercial worker/groundskeepers exposure to lead in soils at estimated areas of Raymark waste within the Short Beach Park portion of the study area.

Exposure to Asbestos

Asbestos was detected in 36 of the 39 soil samples collected from the Stratford Landfill portion of the study area at a concentration range of trace to 48 percent. These samples were collected from 0 to 15 feet bgs. The average concentration was 12 percent. Asbestos was detected in 37 of the 50 surface soil samples collected from the estimated areas of Raymark waste at the Short Beach Park portion of the study area at a concentration range of trace to 32 percent. These samples were collected from the 0 to 2 feet bgs. The average concentration was 6 percent. Asbestos was detected in 137 of the 157 soil samples collected from the estimated areas of Raymark waste at the Short Beach Park portion of the study area at a concentration range of trace to 48 percent. These samples were collected from 0 feet bgs to the water table. The average concentration was 10 percent. Section 4.4.1.1 provides detailed information regarding detections of asbestos in soils collected from estimated areas of Raymark waste at various depths. While the highest concentrations of asbestos were detected in samples collected from 2 to 4 feet bgs, numerous samples collected from 0 to 2 feet bgs contain asbestos at levels that may present an inhalation hazard if exposed and disturbed.

OU9 study area soils contaminated by asbestos are unlikely to present a significant inhalation exposure. Areas of Stratford landfill with Raymark waste identified within 0 to 15 feet bgs are covered by tall weeds and scrubby grasses, with the exception of a dirt access road, which passes through the landfill. Shrub and tree cover is sporadically found along the slopes and base of the landfill. Areas of Raymark waste at Short Beach Park are entirely covered by

mowed grass. The presence of this vegetative cover reduces wind erosion and the possibility of airborne asbestos mobility. Asbestos located at depth is not a current inhalation hazard.

The asbestos contained in soils may become friable under dry conditions and may become a health concern through inhalation exposures to fibers in dust from the study area. Disturbances of asbestos-containing soils through excavation or other human activities will increase the potential for airborne asbestos exposures and associated inhalation risks.

6.6 Uncertainties Analysis

There are uncertainties associated with all HHRAs. This section summarizes these uncertainties, and discusses how they may affect the final risk numbers discussed in Section 6.5.

There is uncertainty associated with all steps of the risk assessment process. Uncertainty in the data evaluation is associated with sampling adequacy, the current status of the predictive databases for development of screening values, the procedures used to include or exclude constituents as chemicals of potential concern, and the methods used and the assumptions made to determine exposure point concentrations. The selection of chemicals of potential concern is based on exposure assumptions and toxicity information, which in turn have associated uncertainties. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing data to support dose-response relationships and the weight-of-evidence used for determining the carcinogenicity of chemicals of concern. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

While there are various sources of uncertainty (as described above) throughout the risk assessments, assumptions were made so that the final calculated risks would be conservative estimates that are protective of public health. Thus, the resultant uncertainty in the numerical risk assessments is in how much lower the actual risks are.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the variance that can be attributed to sampling techniques and laboratory analysis of contaminants. For example, this type of uncertainty is associated with analytical data collected for each location. The risk assessment reflects the accumulated variances of the individual values used. Informational uncertainty refers to estimates of toxicity and exposure. Often this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without considering uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over-predicting both carcinogenic and non-carcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point-of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are below an "acceptable" risk level (1E-6), the interpretation of no significant risk is straightforward. However, when risks calculated using a high degree of uncertainty are above an "acceptable" risk level (1E-4), a conclusion can be difficult unless uncertainty is considered. The risk estimates alone may indicate unacceptable risk; however, if uncertainty is biased toward over-predicting risk, actual risks could fall within acceptable range.

Recent EPA guidance on risk assessment (EPA, 1992a and 1994c) requires risk assessors to use exposure and toxicity assumptions from the "high end" and the "central tendency" of their distributions. These values correspond to the RME and CTE scenarios. The RME is conceptually the “high end” exposure above the 90th percentile of the population distribution but

not higher than the individual in the population with the highest exposure. The CTE reflects the central (average) estimates of exposure.

Uncertainties within the components of the HHRA for the OU9 study area are discussed below.

6.6.1 Uncertainty in Data Evaluation

Uncertainty is associated with analytical data collected and analyzed for the study area. This risk assessment evaluates exposures to individuals limited to estimated areas of Raymark waste within the OU9 study area where samples met the definition of Raymark waste, described in Section 1.4 and shown in Figure 6-1. Areas of the study area not meeting the definition of Raymark waste were not included in this evaluation. Individual samples that do not meet the definition of Raymark waste, but that were collected from locations where one or more samples met the definition of Raymark waste, are included in the evaluations. The inclusion of these samples may cause an under estimate of risks from Raymark waste. This is particularly true at the Stratford Landfill, where the majority of samples collected from 0 to 15 feet bgs do not meet the definition of Raymark waste.

Risks from each of the three areas of the Stratford Landfill, where Raymark waste was detected in samples collected from 0 to 15 feet bgs (the area on the western slope of the landfill and the two areas along Dorne Drive) were evaluated separately (see Figure 6-1). Appendix C-12 presents sample lists, summaries of the data, risk calculations, and lead evaluations for commercial workers for each of these three areas. These evaluations assumed workers are exposed only within these small areas. Risks from Area #1 of Raymark waste at 0 to 15 feet bgs on the western slope of the Stratford Landfill are greater than risks averaged across the entire landfill portion of the study area. Risks from Areas #2 and #3 of Raymark waste at 0 to 15 feet bgs along Dorne Drive are slightly less than risks averaged across the entire landfill portion of the study area. RME cancer risks for commercial workers at the western slope of the landfill (Area #1 of Raymark waste at 0 to 15 feet bgs) are 1.4E-4 and the RME hazard index is 9.5. RME cancer risks for Area #2 of Raymark waste at 0 to 15 feet bgs along Dorne Drive are 1.5E-5 and the RME HI is 1.0. RME cancer risks for Area #3 of Raymark waste at 0 to 15 feet bgs along Dorne Drive are 1.0E-4 and the RME HI is 1.5. The results of the slope factor approach to evaluation of lead exposures to commercial workers at the western slope of the landfill indicate that adverse effects are likely for fetuses of pregnant workers exposed to lead in

soils at this area. Lead levels do not reach EPA's level of concern at the areas of Raymark waste at 0 to 15 feet bgs along Dorne Drive. Based on the cancer risk, non-cancer health hazard, and lead elevations presented in Appendix C-12, the area on the western slope of the Stratford Landfill where samples collected from 0 to 15 feet bgs met the definition of Raymark waste is of greater concern than other portions of the Stratford Landfill. The results of these evaluations are summarized in Table 6-1.

There is uncertainly associated with identification of samples that meet the definition of Raymark waste. The source of this uncertainty is the limited analyses performed on some samples and the margin of error in reporting laboratory results. Any uncertainty associated with the estimated extent of Raymark waste affects the risk assessment by affecting which samples are included in datasets for each portion of the study area.

As discussed in Section 4 and Section 6.2.1, some of the data were generated from field-screening methods, rather than EPA-approved analytical methods. A correlation study, comparing field-screening data to CLP data was performed and is presented in Appendix B-4. The correlation study concluded that field-screening data for both metals and PCBs were comparable to CLP data. For this reason, field-screening data for both metals and PCBs were included in this HHRA. Typically, environmental samples analyzed in the field in "real time" may result in slight differences from those analyzed in a fixed-base laboratory. Because one half of the detection limit was used as a proxy for non-detected results in determining mean concentrations and 95 percent UCLs, and detection limits for metals and PCBs in the field-screening analyses were higher than in CLP analysis, metals data (copper and lead) and PCBs including samples analyzed in the field may result in slightly higher exposure point concentrations. Because of the high degree of correlation between field-screening data and CLP data for both metals and PCBs shown in Appendix B-4, it is unlikely that use of the field-screening data contributes significantly to the overall uncertainty of the risk assessment. At most, it may result in risks that are slightly higher than actual conditions.

There is a minor amount of uncertainty associated with the selection of COPCs in the quantitative risk assessment. Conservative screening values were used to select COPCs; thus, it is unlikely that any contaminant that may pose a risk was eliminated from the risk assessment. There were chemicals detected for which EPA has little or no information regarding the chemical's toxicity. Without any measure of toxicity, there is often very little that can be done to

quantitatively address the potential hazard that the chemical may pose. Furthermore, there are many compounds that are not part of EPA's routine list of analytes. If a compound is not on EPA's routine analyte list, it most likely will not be reported even if present in the environment. This too can have an impact on the selection of chemicals of potential concern.

COPCs were selected if the maximum detected concentration in soils exceeded its respective risk-based screening criterion. Even if the compound was detected at a very low frequency, i.e., less than 5 percent, if the maximum detected concentration exceeded the screening criterion, the compound was still retained for evaluation in the risk assessment. Based on a review of the data, the absence of using frequency of detection as a COPC selection criterion did not result in a significant increase in the number of COPCs evaluated in this risk assessment. Therefore, this does not significantly contribute to the uncertainty of the risk assessment.

Background concentrations were not used to eliminate COPCs. Maximum detected concentrations were compared to average background concentrations. Among the selected COPCs, none of the contaminants had a maximum detected concentration below the average background concentration. Therefore, the use of background concentrations to eliminate COPCs would not have changed the selection of COPCs at the OU9 study area.

Uncertainty arises from calculation of exposure point concentrations. The dataset from the Stratford Landfill portion of the study area consisted of a small number of samples for most analytes. SVOCs, VOCs, pesticides, and most metals were evaluated in only seven samples and dioxins were evaluated in only two samples within the Stratford Landfill portion of the OU9 study area. PCBs were evaluated using CLP methods in only 11 samples. Within the estimated areas of Raymark waste at the Short Beach Park portion of the study area only nine surface soil samples were analyzed for dioxins. These small datasets make the estimation of the upper 95 percent confidence limit on the mean somewhat uncertain.

The inclusion of soils currently located at depths of as much as 15 feet bgs in the calculation of exposure point concentrations may overestimate current risk to current commercial workers who do not contact soils at depth. These samples were included to address concerns for future exposures when excavation or construction may bring these soils to the surface or for exposures during excavation activities.

6.6.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises from the selection of receptors and selection of exposure parameters. Each is discussed below.

Exposure Routes and Receptor Identification. The selection of exposure routes and receptor groups was based on discussions with the EPA. This may either under- or over-estimates the risks, with the final result dependent on how well the receptors were defined.

Selection of Exposure Parameters. Each exposure factor selected for use in this risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, EPA guidelines on the RME receptor were used that generally consist of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Many of the exposure parameters were determined from statistical analyses of human population characteristics. Often the database used to summarize a particular exposure parameter (body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (dermal absorption of organic chemicals from soil), there is greater uncertainty.

Many of the quantities used to calculate exposures and risks in this report were selected from a distribution of possible values. For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. In order to estimate a central tendency estimate of exposure, EPA has suggested the use of the CTE receptor, whose intake variables are set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Many of the parameters were estimated using professional judgment, although EPA Region I default parameters were used where available (EPA, 1994c).

Receptors at Short Beach Park are evaluated for exposures to estimated areas of Raymark waste. These areas comprise approximately 10 percent of the total area of Short Beach Park. The evaluations assumed receptors spend all of their on-site time within the estimated areas of Raymark waste and therefore may over estimate risks for receptors who spend time both within those areas and outside those areas.

Recreational visitors to Short Beach Park were evaluated assuming frequent use similar to assumptions typically used for on-site residents. These assumptions were selected because of the heavy use of the park by local residents and sports teams. Children may participate on multiple teams and/or be attending the games and practices of siblings, as well as their own team activities. These exposure assumptions are likely to overestimate risk for most visitors to the park.

6.6.3 Uncertainty in the Toxicological Evaluation

A toxicity evaluation is a chemical's hazard identification and dose-response assessment. The hazard identification deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard identification of carcinogenicity is an evaluation of the weight-of-evidence that a chemical causes cancer. Positive animal cancer test data suggest that humans contain tissue(s) that may also manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects, however, positive animal data suggest the nature of the effects (the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose-related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized. Uncertainty in the dose-response evaluation includes determining a slope factor for the carcinogenic assessment and deriving an RfD for the non-carcinogenic assessment. The slope factor is an upper bound estimate of the human cancer risk per milligram of contaminant per

milligram of body weight per day. The RfD is an estimate with uncertainty (spanning perhaps an order of magnitude of daily exposure to humans) below which a person is likely to be without appreciable risk of adverse effect over a lifetime. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are similar in age and genotype so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed.

Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and from the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a non-threshold assumption of carcinogenesis. There is evidence to suggest, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic (William and Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

Use of the cancer slope factor for dioxins of 1.5E+5 $(mg/kg/day)^{-1}$ from IRIS (EPA, 2004a) may underestimate risks from exposure to dioxins. EPA has prepared a Draft Dioxin Reassessment (EPA, 2000), which recommends a CSF for dioxins of 1.0E+6 $(mg/kg/day)^{-1}$. Appendix C-10 presents the cancer risks for study area exposures to dioxins using the dioxin CSF of 1.0E+6 $(mg/kg/day)^{-1}$. Cancer risks estimated using this approach are approximately an order of magnitude greater than risks calculated using the CSF for dioxins of 1.5E+5 $(mg/kg/day)^{-1}$.

For non-cancer effects, additional uncertainty factors may be applied in deriving the RfD to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for non-

cancer effects arises from the use of an effect level in estimating an RfD, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimating an RfD for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study. Uncertainty in deriving RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

Uncertainty also arises in the dose-response assessment for values derived for several principal chemicals of concern by using studies with limitations. For example, Group B2 PAHs for which no toxicity data are available are evaluated using benzo(a)pyrene toxicity data with estimated orders of potential potency. This may either underestimate or overestimate the carcinogenic risks associated with PAHs.

Uncertainty is associated with the exclusion of copper from the quantitative risk assessment. EPA Region I does not generally quantitatively evaluate non-carcinogenic hazards posed by copper because of the lack of an approved toxicity value (RfD). EPA Region IX PRGs for copper are based on a provisional oral RfD, which was based on concentrations needed to protect against a deficiency of the compound, rather than on quantitative estimates related to the hazard posed by overexposure (EPA, 1999b). Copper is a major contaminant in Raymark waste. Exclusion of copper from this risk assessment may result in an underestimate of non-carcinogenic risks. Copper concentrations exceeded the EPA Region IX residential soil PRG of 3,100 mg/kg in soils at the Short Beach Park portion of the study area; however, because of the lack of a verifiable toxicity value, no quantitative estimate of risks can be performed. Copper is reported in soils from within the estimated areas of Raymark waste at the Short Beach Park portion of the study area (0 feet bgs to the water table) at concentrations ranging from 13.6 mg/kg to 32,500 mg/kg. The absence of a quantitative risk evaluation of copper may result in an underestimate of total non-cancer risks.

Some uncertainty is associated with the evaluation of chromium, which was assumed to be present in its hexavalent state. Since hexavalent chromium is considered to be more toxic than the trivalent state, which is more common, risks for this chemical are probably overestimated to some degree.

Uncertainty is associated with evaluating exposures to lead. Two methods have been used in this risk characterization to evaluate lead exposures. Exposures of commercial workers to lead are evaluated by use of the EPA Technical Review Workgroup Model for lead. This approach focuses on estimating fetal blood-lead concentrations in women exposed to lead contaminated soils in non-residential scenarios. Uncertainty is associated with estimating maternal blood-lead concentrations and with the relationship between maternal blood-lead concentrations and fetal blood-lead concentrations. Exposures of child recreational visitors and future residents to lead were evaluated using EPA's IEUBK model. Uncertainty is associated with the use of default values for exposures to lead via pathways other than soil ingestion. The IEUBK model was developed based on children exposed in a residential scenario.

Uncertainty is associated with the lack of a quantitative evaluation of inhalation exposures to asbestos. Risks from exposures to asbestos are not quantified because of a lack of toxicity values and reliable models for predicting air concentrations of asbestos from soil concentrations. A qualitative evaluation of asbestos is included in Section 6.5.

Uncertainty in the final calculations of risk results from assumptions made regarding additivity of effects from exposure to multiple compounds from various exposure routes. High uncertainty exists when cancer risks for several substances are summed across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity was made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, this uncertainty cannot be evaluated for its impact on the risk assessment, since it may either underestimate or overestimate potential human health risk.

6.7 Summary of Human Health Risk Assessment

This section and Table 6-1 present a summary of the major risk assessment findings for the OU9 study area. Four potential receptor groups were evaluated: commercial workers (adult), recreational visitors (adult and child), commercial workers/groundskeepers (adult), and hypothetical future residents (adult and child). Evaluations were limited to estimated areas of Raymark waste, assuming receptors spend all of their on-site time within these areas. Approximately 10 percent of the total area of Short Beach Park is estimated to contain Raymark waste. Raymark waste has been identified throughout the Stratford Landfill; however, it is present in soils collected from 0 to 15 feet bgs in only three small areas of the landfill.

6.7.1 Non-carcinogenic Risks

HIs are less than or equal to unity for recreational visitors and commercial workers/ groundskeepers at the Short Beach portion of the study area. For this reason, adverse non-carcinogenic health effects are not anticipated for recreational visitors and commercial workers/groundskeepers at the Short Beach Park portion of the study area.

RME HIs are greater than unity for hypothetical future residents (adults and children) at the Short Beach Park portion of the study area and full-time commercial workers at the Stratford Landfill portion of the study area. The western slope of the landfill is of particular concern. Further examination of these results, reveals that individual hazard quotients for total Aroclors for hypothetical future residents and commercial workers at the Stratford Landfill portion of the study area exceed unity, resulting in organ-specific HIs for skin, eye, and immune systems exceeding unity. This indicates that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for these receptors.

6.7.2 Carcinogenic Risks

Cancer risk estimates for recreational visitors and groundskeepers exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area do not exceed the EPA cancer risk range (10^{-4} to 10^{-6}).

The RME cancer risk estimates for hypothetical future residents exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area and full-time commercial workers exposed to soils at the Stratford Landfill portion of the study area slightly exceed the EPA cancer risk range (10^{-4} to 10^{-6}). The RME cancer risk estimate for commercial workers exposed to soils along the western slope of the landfill exceeds risk estimates averaged over the entire landfill. The major contributors to risk at the study area are benzo(a)pyrene and PCBs, each with individual RME cancer risk estimates greater than 1E-5 for child residents at the Short Beach Park portion of the study area. Individual RME cancer risk estimates for dioxins, PCBs, arsenic, and several PAHs are great than 1E-6 for receptors at both the Stratford Landfill and Short Beach Park portions of the study area.

6.7.3 Exposure to Lead

Exposures to lead were evaluated using two models. Exposures to lead in soil at the both portions of the study area for a pregnant adult worker were evaluated by using a slope-factor developed by the EPA Technical Review Workgroup for Lead (EPA, 1996d). The 95th percentile blood-lead level for women having study area exposures, the 95th percentile blood-lead concentration among fetuses born to women having study area exposures, and the probability that the fetal blood-lead concentration exceeds 10 µg/dL were estimated with this model. The probability that the fetal blood-lead concentration exceeds 10 µg/dL was less than the acceptable level established by EPA of 5 percent at the Stratford Landfill portion of the study area. However; the probability that the fetal blood-lead concentration exceeds 10 µg/dL was greater than 5 percent at Area #1 of Raymark waste at 0 to 15 feet bgs along the western slope of the landfill. The probability that the fetal blood-lead concentration exceeds 10 µg/dL was approximately equal to the acceptable level established by EPA of 5 percent at the Short Beach Park portion of the study area. These results indicate that adverse effects are not likely for fetuses of pregnant commercial workers exposed to lead in soil at the Stratford Landfill portion of the study area except in the area along the western slope. Adverse effects are possible for pregnant groundskeepers exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area.

The effects on children to exposure to lead in soil at the Short Beach Park portion of the study area in a recreational or residential setting were evaluated by using the EPA IEUBK Model. The IEUBK Model presents a geometric mean blood-lead level for children and estimates the

percentage of children expected to have blood-lead levels greater than 10 µg/dL. The percentage of child recreational visitors expected to have blood-lead levels greater than 10 µg/dL was less than the acceptable level established by EPA of 5 percent. These results indicate that adverse effects are unlikely for child recreational visitors exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area. The percentage of hypothetical future child residents expected to have blood-lead levels greater than 10 µg/dL was greater than the acceptable level established by EPA of 5 percent. These results indicate that adverse effects may occur for hypothetical future child residents exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area.

6.7.4 Exposure to Asbestos

Asbestos is considered a potential inhalation hazard. Although quantitative risk estimates (inhalation risk estimates) cannot be developed for asbestos, a qualitative comparison of study area data to the definition of asbestos-containing material (material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR Part 61)) is provided. The presence of asbestos at average concentrations greater than 1 percent indicates the potential for inhalation risks from asbestos exposure. However, based on field conditions (presence of vegetative cover) in the estimated areas of Raymark waste, it is likely that asbestos does not currently present a significant inhalation risk from the estimated areas of Raymark waste within the OU9 study area. Disturbances of asbestos-containing soils through excavation or other human activities will increase the potential for airborne asbestos exposures and associated inhalation risks.

7.0 ECOLOGICAL EVALUATION

The objective of the OU9 study area ecological evaluation is to identify and describe natural resources, environmental conditions, and potential ecological receptors in their present state, before impacts occur from further site investigation or remedial action activities. Remedial activities may result in the unavoidable loss of on-site resources. If significant ecological resources such as wetlands, streams, or threatened or endangered species are present, mitigation or restoration goals would need to be established. An evaluation of the current site conditions and site flora and fauna is necessary to help establish potential goals in the event on-site resources are unavoidably degraded or lost during response actions.

The information collected for this ecological evaluation is based on a site visit conducted on June 28 and 29, 2004, and other information collected from literature research and other field activities at the site. The evaluation includes a description of study area ecological habitats and a survey of vegetation and wildlife present in the study area. This ecological evaluation does not include an assessment of site contamination or potential risk to ecological receptors. No samples were collected to provide an analytical assessment of the study area conditions.

7.1 Characteristics of the Study Area

This section presents the characteristics of the OU9 study area that are relevant to establishing current on-site habitats. The study area consists of two areas, Short Beach Park (a town recreation area) and the Stratford Landfill. The study area encompasses a total area of approximately 93.9 acres with Short Beach Park encompassing 64.1 acres and the landfill encompassing approximately 29.8 acres. Presently, the Short Beach Park area consists of the following activities: a par 3 golf course, baseball and soccer fields, picnic areas, tennis and basketball courts, wildlife viewing, swimming and passive recreation, fishing, skateboard park, miniature golf, playscape, concessions, showers, restrooms, and parking lots. Portions of the Short Beach Park, including the beach parking lots, tennis and basketball courts, sandy beaches with associated pavilions, concession stand, skateboard facility, and playscape are not included in the OU9 study area.

The Stratford Landfill is no longer receiving residential or industrial wastes, however the town is still dumping compost materials (residential leaves, mulch, and sand) at the landfill. Access to

the landfill is restricted by a locked chainlink fence that surrounds the property but access to Short Beach Park is unrestricted.

The OU9 study area is bordered to the north by an inlet known as the “Marine Basin” and an undeveloped Bridgeport (Sikorsky) Airport “clear zone” property, to the east by parking lots, sandy beaches, pavilions, and certain other recreational areas of Short Beach Park including the mouth of the Housatonic River and Long Island Sound, and to the south and west by residences on Short Beach Road (see Figure 7-1).

A majority of the OU9 study area has been extensively modified by filling and draining for the development of the park recreational areas and landfill. A review of historical documents and aerial photographs indicate that the major portion of the filling began in the early 1950s along the western edge of the Short Beach Park area that is currently used as a golf course. The filling continued to the midpoint of the property, just south of the current baseball diamonds. In the 1960s, 1970s, and early 1980s, the entire property from the Marine Basin to the southern end of Shore Beach Road was used as a landfill. Historical information indicates that Raymark waste was disposed of intermittently throughout the property during this time (EPA, 2003). By the 1990s, dumping stopped and part of the area was covered with clean fill and a geomembrane. This geomembrane was installed by CTDEP between 1993 and 1994.

The Short Beach Park topography is relatively flat with some small, low mounds on the golf course. The landfill is a relatively large mound of fill with an elevation of approximately 30 to 35 feet above sea level.

7.2 Ecological Setting

The habitat types associated with the OU9 study area are characteristic of disturbed areas in New England. Much of the land area surrounding the study area consists of residential, commercial and industrial properties with minimal habitat values (Figure 7-1). However, important coastal marsh and open water habitats associated with the Housatonic River and Long Island Sound, such as the Marine Basin, Nell’s Island, and the Great Meadows Marsh area, are adjacent or in close proximity to the study area.

Over the years the filling, draining, and development activities have significantly impacted the original site habitats that were present at the site. Historical evidence, based on a review of aerial photographs and maps, indicates that most of study area was formerly coastal marsh that was hydrologically connected by creeks to the Housatonic River/Long Island Sound to the east and also through to the Great Meadows Marsh/Stewart P. McKinney Wildlife Refuge area west/southwest of the study area. Based on this evidence, the area most likely similar to the coastal marsh habitat that currently exists at OU9 is the wildlife refuge and at Nell's Island.

Tables 7-1a through 7-1d provide a list of plants and wildlife observed at or in the vicinity of the study area. Tables 7-1b through 7-1d also include species that may be expected to utilize the study area habitats. These lists are useful indicators of species present but do not represent a comprehensive inventory of species in the area.

Landfill. The landfill habitat contains early successional upland species indicative of recently disturbed places and is characterized by common reed (*Phragmites australis*), Japanese knotweed (*Polygonum cuspidatum*), common ragweed (*Ambrosia artemisiifolia*), white sweet clover (*Melilotus alba*), upland grasses, and beach clotbur (*Xanthium echinatum*). Shrub and tree cover is dominated by Tree-of-Heaven (Ailanthus altissima) that is sporadically found along the slopes and base of the landfill. Approximately 15 percent of the top area of the landfill is covered with piles of unvegetated composted leaf and mulch material which was actively being dumped onsite at the time of the field survey in June 2004. Also present on the landfill were a few piles of sand and shell debris which was assumed to be waste material from beach cleaning activities. A surface drainage channel/swale is located along the eastern side of the landfill base that drains the beach parking lots and fields towards the Marine Basin.

Short Beach Park. The OU9 study area portion of Short Beach Park, which includes the golf course, baseball fields, soccer fields, and miniature golf course, occupy approximately 60 percent of the total park area. The area habitat primarily consists of mowed and maintained lawn. As expected, the playing fields are mostly devoid of tree and shrub plantings. Trees and shrubs are sporadically located throughout the golf course and provide sparse cover. The trees and shrubs are typically used to indicate fairway and golf course boundaries. Tree and shrub species in this area are characterized by willows (*Salix spp.*), red mulberry (*Morus rubra*), black cherry (*Prunus serotina*), silver maple (*Acer saccharunum*), crabapple (*Pyrus sp.*), Scotch pine (*Pinus sylvestrus*), and eastern red cedar (*Juniperus virginiana*). Herbaceous cover other than

lawn area is present on-site as isolated islands or as understory of tree and shrub fairway boundaries. Representative herbaceous species include the mowed lawn areas and patches of common reed, common ragweed, yarrow (*Archillia millefolium*), wild carrot (*Daucus carota*), beach clotbur, Asiatic bittersweet (*Celastrus orbiculatus*), and rough-stemmed goldenrod. The soil in some areas of the golf course was noted to be relatively thin, with small pieces of probable landfill waste material (glass and metal) exposed at the surface.

There are three small shallow freshwater wetland ponds (water hazards) present at the golf course. It is assumed, based on field observations, that these ponds were constructed and are not natural inland wetlands. Each shallow pond has a narrow dense band of common reed surrounding the pond's edge that provides some visual screening from the mowed areas of the golf course. The total pond area represents approximately 2 acres. Very few emergent species were observed in the ponds and the two eastern-most ponds were observed to be severely overgrown by algae resulting in eutrophic conditions. A great egret was observed foraging in the western-most pond and a pair of mallards were also identified in another of the ponds.

Marine Basin. The Marine Basin lies directly north of and abuts the Stratford Landfill. Although the basin is not within the boundary of the study area, it is in close proximity and is an important habitat that provides for a variety of water birds and other wildlife. The basin is connected to drainage creeks to the west that drain the airport property and is flushed by incoming and outgoing tides on a daily basis. The basin habitat supports a dense belt of smooth cordgrass (Spartina alterniflora) interspersed with common glasswort (Salicornia europaea) and seaside goldenrod (Solidago sempervirens). The water channel connecting the basin through the beach is a hard bottom channel of sand and oyster shell. Dozens of horseshoe crabs were demonstrating mating behavior and a few green crabs (Carcinus maenas) were observed moving through the basin channel during the June 2004 site visit. Fiddler crab (Uca sp.) burrows and ribbed mussel were also observed in the low marsh. Avian species observed at the basin included cattle and snowy egrets, great blue heron, killdeer, white throated swift, and semipalmated plover (Charadrius semipalmatus).

7.2.1 Wildlife

An inventory of the study area wildlife was conducted during the site investigation activities and during the field survey in June 2004. Table 7-1b through 7-1d lists the wildlife species identified

within the OU9 study area, based on actual sightings and/or on the observation of signs and droppings during the field activities. Table 7-1b also includes species that are expected to use the on-site habitats. These lists are useful indicators of the wildlife present in the area, but do not represent a comprehensive species inventory.

The dense herbaceous vegetation at the landfill, adjacent undeveloped property, Marine Basin, and to a somewhat lesser extent, the golf course area habitats, provide suitable conditions for a variety of mammals, birds, reptiles, and insects, and other invertebrates commonly found in disturbed terrestrial and coastal habitats. The landfill and golf course fences and the dense development surrounding the study area preclude its use by mammals requiring a large habitat range. Those species with smaller habitat ranges and more general habitat requirements probably use the study area more frequently. It should also be noted that the quantity and quality of the upland habitat might not be of sufficient size or complexity to support all species listed in Table 7-1b, but the table is an indicator of what could be on the properties at any one time.

7.2.2 Mammals

Mammals observed within the OU9 study area include grey squirrels (*Sciurus carolinensis*), chipmunks (*Tamias striatus*), eastern cottontail (*Sylvilagus floridanus*), muskrat (*ondatra zibethicus*), white-footed mice (*Peromyscus leucopus*), and short-tailed shrew (*Blarina brevicauda*). An inactive woodchuck (*Marmota monax*) burrow was also identified along the perimeter fenceline at the landfill and whitetailed deer (*Odocorleus viginianus)* tracks were observed in a drainage ditch along the beach parking lot. Other small mammals that may use the study area habitat include opossum (*Didelphis virginiana*) and striped skunk (*Mephistis mephitis*). These mammals are shown on table 7-1b for wildlife.

7.2.3 Birds

Most bird species are expected to use the OU9 study area on a largely transient basis for feeding and roosting. There is, however, sufficient habitat within and beyond the OU9 study area for nesting and breeding for species that do not require interior, isolated habitats. No breeding habitats were observed within the OU9 study area.

Bird species observed within the OU9 study area include wild turkeys (*Melealgris gallopavo*), red-winged blackbird (*Agelaius phoeniceus)*, Canadian geese, killdeer, great egret, cattle egret, black-crowned night heron, green heron, northern harrier hawk, monk parakeets (*Myiopsitta monachus*), red-tailed hawk (*Buteo jamaicensis*), mute swan, goldthread, black-capped chickadee (*Parus atricapillus*), common grackle (*Quisculus quiscula*), common crow (*Corvus brachyrhynchos*), and blue jay (*Cyanocitta cristata*). In conjunction with the adjacent tree perches, the areas of open space at the site make for ideal hunting conditions for raptors. Other openfield and edge species that may use the habitats are listed in Table 7-1.

7.2.4 Reptiles and Amphibians

Several green frogs (*Rana clamitans melanota)* were observed in the golf course ponds. The only reptile observed on site during the June 2004 field survey (in a drainage swale) included the eastern garter snake (*Thamnophis s. sirtalis*). Other reptiles that are expected to be present in the area for all or part of their life cycles include the eastern milk snake (*Lampropeltis t. triangulum*), eastern smooth green snake (*Opheodrys v. vernalis*), and northern brown snake (*Storeria d. dekayi*) (see Table 7-1d).

7.3 Conclusions

The OU9 study area has been significantly modified and disturbed in the past as a result of filling and draining activities at both the Short Beach Park recreation area and the landfill. Most of the habitat present at the landfill area represents an early successional habitat that has been recently established. The habitat within the Short Beach Park primarily consists of maintained areas that are mowed on a regular basis. Although the terrestrial habitat of the study area is not unique and is a stressed and disturbed habitat, it is still an important habitat for a variety of terrestrial wildlife and marsh and water birds. The only wetlands identified in the study area include the shallow ponds at the golf course. The surrounding developed areas and contaminated subsurface soils also limit the quality of the available habitat. In addition, the potential exists for wildlife to be impacted by contaminated food sources or from direct contact, e.g., burrows, subsurface foraging, or contaminant migration, to the adjacent Marine Basin and shoreline food chain.

Based on information currently available, no state or federally listed threatened or endangered flora or fauna were identified in the OU9 study area.

If further remedial actions are undertaken within the OU9 study area Raymark waste areas, and if feasible, consideration could be made to restore or re-create the habitat in adjacent areas that was previously provided by the coastal marshes that existed in the past. This would enhance the ecological health of the area. Construction of marsh wetlands may be feasible in the adjacent undeveloped properties near the study area, such as portions of the airport clear zone. If properly created, grassland habitat on the landfill could provide important habitat for declining species of plants and wildlife. Reducing the nitrogen loading and increasing the buffer zone of the golf course ponds could also significantly enhance the area habitat and aesthetic values.

8.0 SUMMARY AND CONCLUSIONS

The OU9 study area was a former dump site from the 1940s to the 1970s. It consists of 93.9 acres, with approximately ten percent of the 64.1-acre Short Beach Park study area and one hundred percent of the 29.8-acre Stratford Landfill impacted by wastes from the former Raymark Facility. This study area is located within the tidally influenced 100-year floodplain of the Housatonic River Basin.

This OU9 RI Report summarizes the soil samples taken within the study area as described in Section 4.0. No air, sediment, surface water, or groundwater samples were collected and therefore, are not evaluated within this RI Report.

The objectives of this OU9 RI Report are to:

- Serve as the mechanism for compiling and evaluating the available data needed to characterize the Raymark waste located in the OU9 study area;
- Characterize the nature and extent of contamination from the former Raymark Facility located within the OU9 study area;
- Assess the risks to human health and the environment within the OU9 study area; and
- Serve as the data resource for developing, screening, and evaluating a potential range of alternatives that addresses the soil contamination within the OU9 study area.

As detailed in Section 1.0, the OU9 study area is located along the Housatonic River downgradient of the former Raymark Facility. This study area was targeted for investigation because disposal of waste from the former Raymark Facility has been documented within the study area. This study area was impacted by the Raymark waste through direct disposal of waste.

8.1 Nature and Extent of Contamination Summary

This RI Report presents the results of the known soil sampling that has been conducted within the study area. Most of the information within this RI Report was obtained from the field investigations conducted in 2003/2004. This information provides the primary basis of the nature and extent of soil contamination presented in Section 4. These investigations were performed to determine the presence or absence of Raymark waste in the soils within the study area. Soil boring logs from this effort are presented in Appendix A, and the locations of soil borings are shown on Figure 2-1. Also included in the nature and extent of soil contamination discussion are samples collected during June 1993. However, samples collected in 1989, April and May 1993, 1995, and 1996 were not included in the nature and extent of soil contamination discussion.

All analytical results, including historical sampling, are described in Section 2.0 and the analytical results are presented in Appendix B. Appendix B-1 presents analytical results from samples collected in 1989, April and May 1993, 1995, and 1996 that were not used in the nature and extent discussion. In September 1989, EPA collected surface soil and sediment samples from the Stratford Landfill. Soil samples were also collected in 1993 by the CTDEP as part of their evaluation for an interim cap in an area of Short Beach Park known to contain Raymark waste (refer to Section 2.2). In March 1995, soil samples were collected in the area of the cap (Section 2.4). Soil samples were collected by EPA in 1996 to evaluate an area of the baseball fields for placement of dugouts (refer to Section 2.5). Appendix B-1 includes a memorandum explaining why these samples were not used for the nature and extent discussion**.** Appendix B-2 presents analytical results from samples collected in June 1993 and the 2003/2004 sampling effort that were used to determine estimated areas of Raymark waste. See Sections 1.4 and 1.5.2 for an explanation of Raymark waste and the approach to determining estimated areas of Raymark waste. Samples identified as containing Raymark waste are listed on Table 4-1. The nature and extent discussion focuses on samples collected from estimated areas of Raymark waste only (see Figure 3-1). Within Appendix B-2, samples that fall within the estimated areas of Raymark waste are separated from samples that do not.

A qualitative discussion of contamination outside estimated areas of Raymark waste is presented in Section 4.5. Supporting tables are provided in Appendix B-3. Portions of the OU9 study area that are outside of the defined Raymark waste areas are not considered part of the

Superfund site. For that reason, only the areas within the estimated areas of Raymark waste are evaluated in Section 4.4, Nature and Extent of Contamination in Soils.

This section summarizes the known nature and extent of soil contamination, detailed in Section 4.0. The contamination sources in the OU9 study area are locations where Raymark waste materials were disposed of (dumped). These materials were mixed with other dumped materials and the analysis shows a random pattern of disposal.

8.1.1 Nature of the Contamination

The Raymark waste contains volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), dioxins and furans, metals (lead, copper, and barium), and asbestos. This waste was disposed of as fill material on properties located both within and outside the OU9 study area.

The sample results were compared to the definition of Raymark waste, specifically lead, copper, asbestos, and PCBs (see Section 1.4). Asbestos results were compared to the definition of asbestos-containing material as defined in 40 CFR 61 Subpart M, as a material containing more than 1 percent asbestos. Tables 4-4 through 4-7 present the asbestos results. However, CTDEP does not have a criterion for asbestos in soils.

To evaluate the soil analytical results for other contaminants, the CTDEC was used as a screening value to identify contaminants that may pose threats to human health through direct contact with soils. The mobility of metals and PCBs, from the Synthetic Precipitation Leaching Procedure (SPLP) results were compared to the CTPMC criteria. CTDECs are regulatory criteria for soil based predominantly on risk from exposures via the ingestion pathway with consideration given to state-determine background concentrations, detection limits, and state determined ceiling limits. It is difficult to sort out Raymark waste impacts from a known landfill, given the lack of homogeneity within the dump area.

8.1.1.1 Polychlorinated Biphenyls (PCBs)

PCBs are an identified contaminant in the OU9 study area within the estimated areas of Raymark waste.

Nature of PCB Contamination. PCBs identified within the OU9 study area consisted primarily of Aroclor 1262 and Aroclor 1268. PCBs are typically used as plasticizers in the manufacture of brake linings, rubber gaskets, and synthetic resins (which were products used or produced at Raymark).

8.1.1.2 Metals

Metals are identified contaminants in the OU9 study area within the estimated areas of Raymark waste.

Nature of Metals Contamination. Copper and lead were the most prevalent Raymark-related metals found at concentrations greater than CTDEC. Other metals that were found at concentrations exceeding CTDEC were antimony, arsenic, barium, beryllium, chromium, thallium, and vanadium. These metals are used in fabricating brake and friction products (such as were used at Raymark). All of these metals within the study area can originate from Raymark waste, but other sources of metals exist.

8.1.1.3 Asbestos

Asbestos is an identified contaminant within the OU9 study area within the estimated areas of Raymark waste.

Nature of Asbestos Contamination. Asbestos-containing materials were a primary component of products manufactured at the former Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads, linings, clutches, transmission plates, and gaskets.

8.1.2 Extent of Soil Contamination

The field activities were performed to identify the presence or absence of Raymark waste within the OU9 study area. These investigations have revealed that contaminants of Raymark waste are present in the soil within the OU9 study area within the estimated areas of Raymark waste.

Summary of Contamination at Depths of 0 to 2 Feet bgs at Short Beach Park

Organic and inorganic contaminants were detected in samples collected within the areas found to contain Raymark waste at Short Beach Park from 0 to 2 feet bgs. More than trace amounts of asbestos were found throughout the estimated areas of Raymark waste. Many PAHs were detected frequently, but only benzo(b)fluoranthene, dibenzo(a,h)anthracene, and chrysene concentrations exceeded either the CTDEC or the CTPMC. VOCs were also detected in samples from 0 to 2 feet bgs, however the CTDEC and CTPMC were not exceeded for any compounds. Pesticides including 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were found at a limited number of locations at concentrations greater than the CTPMC. PCBs were also detected, and only a few samples contained Aroclors at concentrations greater than the CTDEC. Aroclors 1262 and 1268 were the only PCBs to exceed the CTDEC. No Aroclors were detected in the SPLP leachate, consequently the CTPMC was not exceeded. Dioxins were detected in every sample analyzed for dioxins.

Metals were detected in every sample. Arsenic, beryllium, copper and lead concentrations exceeded the CTDEC for residential soils. Metals were analyzed in the SPLP leachate for one sample, and the CTPMC was not exceeded for any metal.

Summary of Contamination at Depths Greater than 2 Feet bgs at Short Beach Park

Organic and inorganic contaminants were detected frequently in samples collected from 2 to 12 feet bgs in the areas found to contain Raymark waste at Short Beach Park. More than 1 percent asbestos was detected in 75 of 107 samples collected; the median amount of asbestos found in samples was 7.7 percent. The highest amount of asbestos was found at SB-745 in the middle of the interim cap and at SB-480 in the southern area of Raymark waste. Organics were detected frequently throughout the areas of Raymark waste at Short Beach Park. Dioxins were detected in every sample. SVOCs, predominantly PAHs, were frequently detected at concentrations above the CTDEC and the CTPMC. VOCs were also detected throughout the estimated areas of Raymark waste, however, concentrations were relatively low and did not exceed the CTDEC or CTPMC. Pesticides including 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected most frequently, and concentrations in some samples exceeded the CTPMC. Concentrations of aldrin, alpha-BHC, beta-BHC, dieldrin, and gamma-chlordane exceeded either the CTDEC or the CTPMC. PCBs were also detected. Aroclors 1262 and

1268 were detected most frequently. Concentrations of Aroclors 1242, 1248, 1254, 1260 in addition to 1262 and 1268, were above the CTDEC in at least one sample. The highest PCB concentration was of Aroclor 1268 found at SB-697 **within the interim cap area**. PCBs were not detected in the SPLP leachate.

Metals were also detected frequently throughout the estimated areas of Raymark waste in the Short Beach Park area. Antimony, arsenic, barium, beryllium, chromium, copper, lead, thallium, and vanadium were all detected at concentration higher than the CTDEC. Only lead was detected at concentrations above the CTPMC in samples analyzed for SPLP metals.

Summary of Contamination at Depths of 0 to 2 Feet bgs at the Stratford Landfill

Asbestos was detected in six of seven samples analyzed, and four samples had more than 1 percent. The median was 5 percent. Only two samples from 0 to 2 feet bgs were analyzed for VOCs, SVOCs, and pesticides. None of these compounds exceeded the CTDEC or the CTPMC. PCBs were analyzed for, and concentrations of Aroclors 1262 exceeded the CTDEC at one location SB-774. No PCBs were detected in the SPLP leachate. Total metals were analyzed in two samples and metals were frequently detected at low concentrations. Lead was the only metal detected at concentrations greater than the CTDEC for industrial soils. No samples were analyzed for SPLP metals.

Summary of Contamination at Depths Greater than 2 Feet bgs at the Stratford Landfill

Asbestos was detected at greater than 1 percent in 39 of 55 samples. The median amount was 4 percent. Five samples from greater than 2 feet bgs were analyzed for VOCs, SVOCs, and pesticides. Several SVOCs were detected in the five samples. PAHs were the primary contaminants detected at concentrations above the CTDEC or CTPMC. No VOCs were detected at concentrations greater than the CTDEC or the CTPMC. Few pesticides were detected. No pesticides exceeded the CTDEC, and the CTPMC was exceeded only by 4,4'-DDT. PCBs were detected at high concentrations. Aroclors 1262 and 1268 were the only PCBs detected at concentrations exceeding the CTDEC for industrial soils. The CTPMC were not exceeded in samples analyzed by SPLP PCBs. Total metals were analyzed in five

samples. Metals were frequently detected at relatively low concentrations. Concentrations of arsenic, chromium, and lead exceeded the CTDEC for industrial soils.

Summary of Results Outside Estimated Areas of Raymark Waste

Some of the contamination outside the defined Raymark waste areas at Short Beach Park exceed safe levels established by the state or federal governments. However, because these areas do not meet the definition of Raymark waste, they were not evaluated for risk effects within this document. This discussion is presented in Section 4.5 and Appendix B-2.

8.2 Contaminant Fate and Transport Summary

A variety of complex factors govern the fate and transport of contaminants within the OU9 study area. The physical and chemical properties of the contaminants and the medium (i.e., soil, groundwater, surface water, air) to which the contaminants are released are all factors that determine the eventual fate of these chemicals. The past operations and disposal history associated with disposal of wastes from the former Raymark Facility and other sources determine the chemical make-up of the contaminant and influence the migration of contaminants into the soil and groundwater. Within the OU9 study area, the combination of on- and offsite-related contaminants, geologic, and hydrogeologic conditions, and surface features influence how contaminants may have migrated into other environmental media (i.e., the underlying groundwater, surface water bodies, and sediments). For this RI Report, soil samples were collected and analyzed for the purpose of determining the presence or absence of Raymark waste. No further analysis of the contaminants or other media was performed. However, based on the data from other Raymark operable units, it is reasonable to conclude that soil contaminants present within the OU9 study area will migrate into surface water bodies through erosion of the stream banks and into groundwater through leaching.

8.3 Risk Assessment Summary

The risk assessment for this RI Report focused on both human health and ecological risks.

8.3.1 Human Health Risk Assessment

A baseline human health risk assessment (HHRA) was conducted for estimated areas of Raymark waste within the study area. The HHRA evaluated risks to commercial workers at the Stratford Landfill portion of the study area and recreational visitors, commercial workers/groundskeepers, and future residents at the Short Beach Park portion of the study area. Recreational visitors were evaluated for exposures to soils collected from 0 to 2 feet below ground surface (bgs). All other receptors were evaluated for exposures to soils collected from 0 to 15 feet bgs or to the water table. Risks for deeper intervals containing Raymark waste were determined not to be readily accessible and were not evaluated.

Potential receptors were evaluated for exposures to estimated areas of Raymark waste only, to a maximum depth of 15 feet (0 to 15 feet bgs) at the Stratford Landfill or to the water table at Short Beach Park.

At the Stratford Landfill, risks were calculated for exposures throughout the landfill because samples meeting the definition of Raymark waste were collected from throughout the area at various depths. In addition, since Raymark waste was identified in samples collected from 0 to 15 feet bgs in only three small areas of the landfill as shown on Figure 6-1, a separate evaluation of each of these areas was performed.

At Short Beach Park, the HHRA assumed receptors at Short Beach Park spend all of their time within the 10 percent area of the park found to contain Raymark waste and do not spend any time in the other portions of the property. This conservative approach results in maximizing the potential exposures and estimated risks from Raymark waste. See Figure 6-1.

The HHRA evaluates non-cancer health hazards, cancer risks, and lead exposures through quantitative assessments and asbestos exposures through qualitative discussion. The potential for non-carcinogenic health effects is assessed by comparing an exposure estimate (dose) to a reference dose (RfD). Ratios of the intake to the RfD (hazard indices or HIs) below unity indicate that adverse non-carcinogenic effects are unlikely. Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Risks below 1E-6 (or a risk less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in

10,000) are generally considered to be unacceptable. Risks from lead exposure are not evaluated using the same methodology as other contaminants. Estimations of blood-lead concentrations are used to evaluate potential adverse health effects. Infants and young children are extremely susceptible to adverse effects from exposure to lead. Since children are a more sensitive subpopulation than adults, exposure to lead by adults in a residential or recreational scenario is not generally evaluated and the receptor of concern for these scenarios is the young child. Evaluation of the young child in a residential or recreation scenario is considered protective of adults, including pregnant women. Exposures to lead by commercial workers are evaluated by use of an approach that focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soil in non-residential scenarios. Therefore the receptor of concern in commercial worker scenarios is the fetus of the pregnant worker. Evaluation of the fetus of the pregnant worker is considered protective of non-pregnant workers. Blood-lead levels greater than 10 µg/dL are considered to be a "concern." EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 µg/dL. Asbestos-containing material is defined as material containing more than one percent asbestos. The definition of asbestos-containing material was used for qualitative evaluations of asbestos exposures.

This section and Table 6-1 present a summary of the major risk assessment findings for the OU9 study area.

8.3.1.1 Non-carcinogenic Risks

HIs are less than or equal to unity for recreational visitors and commercial workers/ groundskeepers at the Short Beach Park portion of the study area. Therefore, adverse non-carcinogenic health effects are not anticipated for recreational visitors and commercial workers/groundskeepers at the Short Beach Park portion of the study area.

RME HIs are greater than unity for hypothetical future residents (adults and children) at the Short Beach Park portion of the study area and full-time commercial workers at the Stratford Landfill portion of the study area. The western slope of the landfill is of particular concern. Further examination of these results, reveals that individual hazard quotients for total Aroclors for hypothetical future residents and commercial workers at the Stratford Landfill portion of the study area exceed unity, resulting in organ-specific HIs for skin, eye, and immune systems

exceeding unity. This indicates that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for hypothetical future residents at the Short Beach Park portion of the study area and full-time commercial workers at the Stratford Landfill portion of the study area.

8.3.1.2 Carcinogenic Risks

Cancer risk estimates for recreational visitors and groundskeepers exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area do not exceed the EPA cancer risk range (10^{-4} to 10^{-6}).

The RME cancer risk estimates for hypothetical future residents exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area and full-time commercial workers exposed to soils at the Stratford Landfill portion of the study area slightly exceed the EPA cancer risk range (10^{-4} to 10^{-6}). The RME cancer risk estimate for commercial workers exposed to soils along the western slope of the landfill exceeds risk estimates averaged over the entire landfill. The major contributors to risk at the study area are benzo(a)pyrene and PCBs, each with individual RME cancer risk estimates greater than 1E-5 for child residents at the Short Beach Park portion of the study area. Individual RME cancer risk estimates for dioxins, PCBs, arsenic, and several PAHs are greater than 1E-6 for receptors at both the Stratford Landfill and Short Beach Park portions of the study area.

8.3.1.3 Exposure to Lead

Exposures to lead were evaluated using two models. Exposures to lead in soil at both Short Beach Park and the Stratford Landfill for a pregnant adult worker were evaluated by using a slope-factor developed by the EPA Technical Review Workgroup for Lead (EPA, 1996d). The 95th percentile blood-lead level for women having study area exposures, the 95th percentile blood-lead concentration among fetuses born to women having study area exposures, and the probability that the fetal blood-lead concentration exceeds 10 µg/dL were estimated with this model. The probability that the fetal blood-lead concentration exceeds 10 µg/dL was less than the acceptable level established by EPA of 5 percent at the Stratford Landfill portion of the study area. However; the probability that the fetal blood-lead concentration exceeds 10 µg/dL was greater than 5 percent at Area #1 of Raymark waste at 0 to 15 feet bgs along the western

slope of the landfill (see Figure 6-1). The probability that the fetal blood-lead concentration exceeds 10 µg/dL was approximately equal to the acceptable level established by EPA of 5 percent at the Short Beach Park portion of the study area. These results indicate that adverse effects are not likely for fetuses of pregnant commercial workers exposed to lead in soil at the Stratford Landfill portion of the study area except in the area along the western slope. Adverse effects are possible for pregnant groundskeepers exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area.

The effects on children to exposure to lead in soil at the Short Beach Park portion of the study area in a recreational or residential setting were evaluated by using the EPA IEUBK Model. The IEUBK Model presents a geometric mean blood-lead level for children and estimates the percentage of children expected to have blood-lead levels greater than 10 µg/dL. The percentage of child recreational visitors expected to have blood-lead levels greater than 10 µg/dL was less than the acceptable level established by EPA of 5 percent. These results indicate that adverse effects are unlikely for child recreational visitors exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area. The percentage of hypothetical future child residents expected to have blood-lead levels greater than 10 µg/dL was greater than the acceptable level established by EPA of 5 percent. These results indicate that adverse effects may occur for hypothetical future child residents exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area.

8.3.1.4 Exposure to Asbestos

Asbestos is considered a potential inhalation hazard. Although quantitative risk estimates (inhalation risk estimates) cannot be developed for asbestos, a qualitative comparison of study area data to the definition of asbestos-containing material (material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR Part 61)) is provided. The presence of asbestos at average concentrations greater than 1 percent indicates the potential for inhalation risks from asbestos exposure. However, based on field conditions (presence of vegetative cover) in the estimated areas of Raymark waste, it is likely that asbestos does not currently present a significant inhalation risk from the estimated areas of Raymark waste within the OU9 study area. Disturbances of asbestos-containing soils through excavation or other human

activities will increase the potential for airborne asbestos exposures and associated inhalation risks.

8.3.1.5 Uncertainty in the Human Health Risk Assessment

While there are various sources of uncertainty throughout the risk assessment, assumptions were made so that the final calculated risks would be conservative estimates that are protective of public health. Thus, the resultant uncertainty in the numerical risk assessment is in how much lower the actual risks are.

8.3.2 Ecological Risk Assessment

The OU9 study area has been significantly modified and disturbed in the past as a result of filling and draining activities at both the Short Beach Park recreation area and the Stratford Landfill. Most of the habitat present at the landfill area represents an early successional habitat that has been recently established. The habitat within the Short Beach Park primarily consists of maintained areas that are mowed on a regular basis. Although the terrestrial habitat of the study area is not unique and is a stressed and disturbed habitat, it is still an important habitat for a variety of terrestrial wildlife and marsh and water birds. The only wetlands identified in the study area include the shallow ponds at the golf course. The surrounding developed areas and contaminated subsurface soils also limit the quality of the available habitat. In addition, the potential exists for wildlife to be impacted by contaminated food sources or from direct contact, e.g., burrows, subsurface foraging, or contaminant migration to the adjacent Marine Basin and shoreline food chain.

Based on information currently available, no state or federally listed threatened or endangered flora or fauna were identified in the OU9 study area.

If further remedial actions are undertaken within the OU9 study area, and if feasible, consideration could be made to restore or re-create the habitat that was previously provided by the coastal marshes that existed at the site in the past. Construction of marsh wetlands may be feasible in the adjacent undeveloped properties near the study area, such as portions of the airport clear zone. If properly created, grassland habitat on the landfill could provide important habitat for declining species of plants and wildlife. Grassland habitat has been declining at an

alarming rate and is now considered one of the most endangered habitats. Reducing the nitrogen loading and increasing the buffer zone of the golf course ponds could also significantly enhance the area habitat and aesthetic values.

8.4 Conclusions

The interpretation of the data and information compiled for this RI Report indicates that:

- Raymark waste was disposed of on the OU9 study area.

- Adverse non-carcinogenic health effects are unlikely for recreational visitors at Short Beach Park.

- Adverse non-carcinogenic health effects are possible for hypothetical future residents (adults and children) and commercial workers/groundskeepers at the Short Beach Park portion of the study area and full-time commercial workers at the Stratford Landfill portion of the study area.

- Cancer risk estimates for recreational visitors and groundskeepers exposed to soils within estimated areas of Raymark waste at the Short Beach Park portion of the study area do not exceed the EPA cancer risk range (10^{-4} to 10^{-6}).

- Cancer risk estimates for hypothetical future residents exposed to soils within the estimated areas of Raymark waste at the Short Beach Park portion of the study area and full-time commercial workers exposed to soils at the Stratford Landfill portion of the study area slightly exceed the EPA cancer risk range (10^{-4} to 10^{-6}).

- Adverse effects are unlikely for child recreational visitors exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area or pregnant adult workers at the Stratford Landfill.

- Adverse effects are possible for pregnant groundskeepers and hypothetical future child residents exposed to lead in soil at estimated areas of Raymark waste within the Short Beach Park portion of the study area.

- The presence of asbestos at average concentrations greater than 1 percent indicates the potential for inhalation risks from asbestos exposure.

TABLES

TABLE 4-1
SOIL SAMPLES AT SHORT BEACH PARK AND THE STRATFORD LANDFILL
CONTAINING RAYMARK WASTE
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

BORING	NSAMPLE	Asbestos (%)	Lead (mg/kg)	Copper (mg/kg)	Aroclor-1268 (µg/kg)
Short Beach Park - 0 - 2 feet bgs					
SB-504	SBP-SS-504A-000.5	3	417	371	36 U
SB-701	SBP-SS-701A-000.5	24	1200	3740	43 U
SB-333	SBP-SO-333-0002	5.7	551	1820	320
SB-337	SBP-SO-337-0002	21.2	1810	7440	680
SB-407	SBP-SO-407-0002	3.7	710	540	2000
SB-451	SBP-SO-451-0002	3	736	1080	160
SB-482	SBP-SO-482-0002	32	1970	4760	650
SB-482	SBP-SO-482A-0002	2	1780	3510	350
SB-492	SBP-SO-492-0002	28	3520	10300	500 U
SB-492	SBP-SO-492A-0002	20	499	1510	140
SB-501	SBP-SO-501-0002	15.8	927	2360	500 U
SB-503	SBP-SO-503-0002	10	651	601	1300
SB-504	SBP-SO-504-0002	2	786	781	2500
SB-622	SBP-SO-622A-0002	18	1710	5800	150
SB-701	SBP-SO-701-0002	32	2570	6780	570
SB-707	SBP-SO-707-0002	4.8	527	1500	140
SB-720	SBP-SO-720-0002	16	738	2080	160
SB-723	SBP-SO-723-0002	30	1390	2990	850
Short Beach Park - greater than 2 feet bgs					
SB-326	SBP-SO-326-0204	14.3	1490	3115	500 U
SB-327	SBP-SO-327-0204	9	1530	3440	640
SB-330	SBP-SO-330-0204	6	1110	2020	100
SB-334	SBP-SO-334-0204	2.2	872	2375	260
SB-336	SBP-SO-336-0204	12	6100	27900	500 U
SB-337	SBP-SO-337A-0204	26	4750	14200	4600
SB-353	SBP-SO-353-0204	20	14100	14900	6700
SB-353	SBP-SO-353A-0204	26	1400	1630	230
SB-355	SBP-SO-355-0204	14.1	3100	4120	500 U
SB-355	SBP-SO-355A-0204	24	19700	22000	1100
SB-357	SBP-SO-357-0204	12	4210	5950	740
SB-407	SBP-SO-407-0204	7.7	956	1200	1100
SB-407	SBP-SO-407A-0204	10.5	1750	1920	3200
SB-411	SBP-SO-411-0204-MAX	11.8	768	1990	150
SB-431	SBP-SO-431A-0204	20	7170	31000	270
SB-453	SBP-SO-453-0204	14	1480	1850	300
SB-480	SBP-SO-480-0204	48	13800	26300	10000
SB-480	SBP-SO-480A-0204	16	7600	19300	6500
SB-482	SBP-SO-482-0204	42	7100	18400	500 U
SB-482	SBP-SO-482A-0204-MAX	20	12500	27800	180
SB-484	SBP-SO-484-0204	28	2670	15600	500 U
SB-486	SBP-SO-486-0204	35	11800	25000	3600
SB-486	SBP-SO-486A-0204	20	7380	13500	1400
SB-492	SBP-SO-492-0204-MAX	35	4150	15300	500 U

TABLE 4-1 (cont.)
SOIL SAMPLES AT SHORT BEACH PARK AND THE STRATFORD LANDFILL
CONTAINING RAYMARK WASTE
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

BORING	NSAMPLE	Asbestos (%)	Lead (mg/kg)	Copper (mg/kg)	Aroclor-1268 (µg/kg)
Short Beach Park - greater than 2 feet bgs (cont.)					
SB-492	SBP-SO-492A-0204	15	2650	8680	120
SB-486	SBP-SO-486A-0204	20	7380	13500	1400
SB-492	SBP-SO-492-0204-MAX	35	4150	15300	500 U
SB-492	SBP-SO-492A-0204	15	2650	8680	120
SB-501	SBP-SO-501-0204	19	5990	23000	500 U
SB-502	SBP-SO-502-0204	2.8	761	3170	250
SB-503	SBP-SO-503-0204	4.7	1070	1310	2700
SB-505	SBP-SO-505-0204-MAX	20	4970	14500	3700
SB-506	SBP-SO-506-0204	16.4	1480	3410	230
SB-506	SBP-SO-506A-0204	21.5	6270	15600	2800
SB-519	SBP-SO-519-0204	10.8	4940	23700	340
SB-521	SBP-SO-521-0204	5.3	478	1230	490
SB-561	SBP-SO-561-0204	1.2	508	694	360
SB-563	SBP-SO-563-0204	3	487	725	500 U
SB-569	SBP-SO-569-0204	42	2190	9940	500 U
SB-615	SBP-SO-615-0204	1.5	416	578	2200
SB-622	SBP-SO-622-0204	14	4070	15700	160
SB-622	SBP-SO-622A-0204	18	5040	16200	6200
SB-697	SBP-SO-697-0204	9	3630	3320	44000
SB-699	SBP-SO-699-0204	24	4390	24700	450
SB-701	SBP-SO-701-0204	12.5	870	2150	500 U
SB-703	SBP-SO-703-0204	27	3430	8660	2700
SB-718	SBP-SO-718-0204	6	508	1710	500 U
SB-719	SBP-SO-719-0204	9	1620	4050	500 U
SB-720	SBP-SO-720-0204	10.5	2160	5580	1000 U
SB-722	SBP-SO-722-0204	18	4090	8840	2200
SB-725	SBP-SO-725-0204	28	5010	27600	700
SB-733	SBP-SO-733-0204	32	1790	6190	500 U
SB-739	SBP-SO-739-0204	17.5	1740	1620	1400
SB-740	SBP-SO-740-0204	32	950	150 U	6600
SB-741	SBP-SO-741-0204	1.6	455	984	500 U
SB-762	SBP-SO-762-0204	5.6	5135	16350	500 U
SB-353	SBP-SO-353A-0406	5	1520	2200	530
SB-353	SBP-SO-353A-0810	7	777	1390	61
SB-355	SBP-SO-355A-0406	20	13500	17300	580
SB-357	SBP-SO-357A-0406	24	3180	3330	180
SB-357	SBP-SO-357A-1012	2.1	1770	1830	42 U
SB-416	SBP-SO-416A-0406	28	3220	2380	2200
SB-482	SBP-SO-482A-0406	19.5	3310	7690	410
SB-482	SBP-SO-482A-0608	1.2	1710	3480	41 U
SB-486	SBP-SO-486A-0406	24	12100	21900	640
SB-501	SBP-SO-501A-0406	26	7240	17400	1200
SB-569	SBP-SO-569A-0406	35	2250	7220	39 U

TABLE 4-1 (cont.)
SOIL SAMPLES AT SHORT BEACH PARK AND THE STRATFORD LANDFILL
CONTAINING RAYMARK WASTE
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

BORING	NSAMPLE	Asbestos (%)	Lead (mg/kg)	Copper (mg/kg)	Aroclor-1268 (µg/kg)
Short Beach Park - greater than 2 feet bgs (cont.)					
SB-622	SBP-SO-622A-0406	15	2710	8050	44 U
SB-622	SBP-SO-622A-0608	4	2550	3700	89 U
SB-707	SBP-SO-707A-0406	30	2570	9210	250
SB-745	SBP-SO-745A-0406	48	20500	32500	630
SB-745	SBP-SO-745A-0608-MAX	3	742	867	400 U
Stratford Landfill - 0 to 2 feet bgs					
SBB2 FF-250	SBB2 FF-250	5	500	NA	4000
SB-753	SBP-SO-753-0002	10	1580	1860	2200
SB-772	SBP-SO-772-0002	10	456	558	1000 U
SB-774	SBP-SO-774-0002	21	2420	4650	7900
Stratford Landfill - greater than 4 feet bgs					
SB-516	SBP-SO-516-0204	10.8	472	352	630
SB-526	SBP-SO-526-0204	16	1310	688	1200
SB-528	SBP-SO-528-0204	43.6	3670	5640	3300
SB-528	SBP-SO-528A-0204	48	7690	13200	5400
SB-532	SBP-SO-532-0204	14.4	772	1090	4300
SB-532	SBP-SO-532A-0204	39	721	787	790
SB-735	SBP-SO-735-0204-MAX	9	871	848	1800
SB-746	SBP-SO-746-0204	24	694	1250	290
SB-773	SBP-SO-773-0204	1.8	770	477	1300
SL-SB302	SL-SO-302A-0305	14	4740	3570	410
SL-SO-TP01	SL-SO-TP01-0204	25	2840	4250	8200
SL-SO-TP02	SL-SO-TP02-1.92.6	30	15800	25700	41000
SL-SO-TP04	SL-SO-TP04-0203	18	28700	2570	4300
SB-528	SBP-SO-528A-0608	32	2120	2700	1000
SL-SB300	SL-SO-300-3638	2.4	867	932	1000 U
SL-SB301	SL-SO-301-1012	26	2020	2640	1000 U
SL-SB301	SL-SO-301-2628	32	2340	2690	NA
SL-SB301	SL-SO-301-3032	24	534	778	1000 U
SL-SB302	SL-SO-302A-0507	12.5	575	454	500 U
SL-SB303	SL-SO-303-2830	2.1	658	362	1000 U
SL-SB303	SL-SO-303-3234-MAX	3.5	541	1180	1000 U
SL-SB303	SL-SO-303-3436	1.6	1130	1970	1600
SL-SB303	SL-SO-303-3638	1.6	703	698	1000 U
SL-SB304	SL-SO-304-2224	1.5	407	408	1000 U
SL-SB307	SL-SO-307-3032	4.8	1120	835	1000 U
SL-SB313	SL-SO-313-2022	26	1170	650	1000 U
SL-SB313	SL-SO-313-2224	24	9980	5640	1000 U
SL-SB314	SL-SO-314-1618	1.8	1220	1230	1000 U
SL-SO-TP07	SL-SO-TP07-0506	6	2980	3640	3000

U - Analyte was not detected above the laboratory detction limit.

NA - Not analyzed

TABLE 4-2
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		No. 1	No. 2	No. 3	No. 4
Acetone	2-Propanone	X		X	
Adhesive CR04					X
Alcohol			X		X
Aluminum	Alumina		X		X
Ammonia Aqua		X			X
Arco 4545					X
Asbestos			X	X	X
Boiler Feed Water		X			
1-Butanol	N-Butyl Alcohol			X	
2-Butanone	MEK			X	
N-Butyl Alcohol				X	
Carbon Tetrachloride	Perchloromethane			X	
Caustic	Sodium Hydroxide	X			X
Caustic Liquid/Sludge	Sodium Hydroxide				X
China Oil					X
Chinawood Oil	Meta Para Cresol; Phenolic Mixture	X			
Ching Oil					X
Chlorinated Fluorocarbons				X	
Coal	Natural Solid		X		
Coal Tar Resin	Petroleum-Like Fuel				X
Copper			X		
Cotton			X		
Cresolic Acid	Cresol; Methylphenol			X	
Cresylic Acid	Cresol; Methylphenol	X		X	X
Denatured Alcohol		X			
Denatured Ethanol					X
Dust (Dry)					X
Dust (Wet)					X
Fiberglass Fibers			X		
Fire Water		X			
Formaldehyde Resin					X
Formaldehyde (37%)		X		X	
#2 Fuel Oil	Diesel Oil	X			
#6 Fuel Oil		X	X		
Gilsonite	Asphaltic Material				X
Graphite	Black Lead		X		
Hexamethylene Tetramine	Methanamine				X
Hycar Rubber			X		
Hydraulic Oil			X		
Iron Hydroxide Sludge			X		
Latex	Hydrocarbon Polymer	X	X		X
Lead			X	X	X

TABLE 4-2 (cont.)
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		No. 1	No. 2	No. 3	No. 4
Linseed Oil	Flaxseed Oil	X			
Liquid Phenolic Resin	Condensation of Phenol with Aldehydes		X		
Meta Para Cresol	Phenolic Mixture	X			
Methanol	Methyl Alcohol				X
Methylbenzene	Toluene			X	
Methyl Chloride	Dichloromethane			X	
Methyl Chloroform	1,1,1-Trichloroethane		X	X	
Methylethyl Ketone	2-Butanone	X		X	X
Methylphenol	Cresol			X	
Mineral Spirits					X
Monochlorobenzene	Phenyl Chloride	X			X
Muriatic Acid	Hydrochloric Acid		X		
Naptha	Petroleum Product	X	X		
Nitric Acid		X	X		
Nylon					X
Phenol	Tung Oil	X	X	X	X
Phenol Formaldehyde Copolymer	Synthetic Thermosetting Polymer				X
Phenolic Resin	Condensation of Phenol with Aldehydes				X
Phenolic Resin 424					X
Phenolic Resin 439					X
Phenolic Resin 478					X
Pickle Liquor	Waste Acid Containing Dissolved Metals			X	
Polybutadiene Resin	Synthetic Thermoplastic Polymer				X
Powdered Metals					X
2-Propanone	Acetone	X		X	
Process CNSL		X			X
Raw Cashew Nut Oil		X			X
RC 439	477 Saturant	X			
RC 845					X
Reclaimed City Water		X			
Red Oxide	Iron Oxide		X		
Resin Solution CR04					X
Rinsate Water					X
Rubber	Polyisoprene		X		
Rubber Cement			X		
Sartomer 845					X
Saturant 295E	90% Anacardic Acid; Sulfur Blistering Compound	X			
Saturant 439		X			

TABLE 4-2 (cont.)
CHEMICAL COMPOUNDS USED OR HANDLED AT THE RAYMARK FACILITY
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

CHEMICAL COMPOUND/MATERIAL	DESCRIPTION	INFORMATION SOURCES			
		No. 1	No. 2	No. 3	No. 4
Saturant 451		X			X
Saturant 500-3					X
Saturant 500-F					X
Saturant 8240		X			
Saturant 850F					X
Saturant 851					X
Saturant RC 581					X
Scrap Resin	Petroleum and Mineral Spirits	X			
Scrap Saturant					X
#3 Sludge					X
Soap Saturant 850F					X
Solvent 204		X			
Steel			X		X
Steel Wool			X		
Sulfuric Acid	Battery Acid		X		
Tetrachloroethylene	Perchloroethylene (PCE)			X	
Textile Spirits					X
Toluene				X	X
Toluol	Cresol	X	X		
1,1,1-Trichloroethane (TCA)		X	X	X	
Trichloroethylene (TCE)	Trichloroethene			X	
Tung Oil		X			X
Unleaded Gasoline		X			
Varsol	Petroleum Aliphatic Solvents				X
Varsol #18		X			X
Vegetable Oil					X
VMP Naptha	Varnish; Petroleum Spirits	X			
Waste Oil		X			
White Water		X	X		X

Information Sources:
No. 1 - Overall Site Plan, Sheet No. S1 (ELI, 1995).
No. 2 - RCRA Facility Investigation Report, Section 2.0 (ELI, 1995).
No. 3 - RCRA Application, Part A, 8/15/80.
No. 4 - RCRA Application, Part B, 8/15/80.

TABLE 4-3
CRITERIA FOR COMPARISON TO CHEMICALS DETECTED IN SOILS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Parameter	CT DEP Direct Exposure Criteria - Industrial Soils	CT DEP Direct Exposure Criteria - Residential Soils	CT DEP Pollutant Mobility Criteria - GB Aquifers
Asbestos (%)*	1	1	
Metals (MG/KG)			
Antimony	8200	27	
Arsenic	10	10	
Barium	140000	4700	
Beryllium	2	2	
Cadmium	1000	34	
Chromium	100	100	
Cobalt	2500	1000	
Copper	76000	2500	
Lead	1000	400	
Manganese	47000	1600	
Mercury	610	20	
Nickel	7500	1400	
Selenium	10000	340	
Silver	10000	340	
Thallium	160	5.4	
Vanadium	14000	470	
Zinc	610000	20000	
Metals by SPLP (UG/L)			
Antimony			60
Arsenic			500
Barium			10000
Beryllium			40
Cadmium			50
Chromium			500
Copper			13000
Lead			150
Mercury			20
Nickel			1000
Selenium			500
Silver			360
Thallium			50
Vanadium			500
Zinc			50000
SEMIVOLATILE ORGANIC COMPOUNDS (UG/KG)			
2,4-Dimethylphenol	2500000	1000000	28000
2-Methylnaphthalene	2500000	474000	9800
2-Methylphenol	2500000	1000000	70000
3,3'-Dichlorobenzidine	13000	1400	330
4-Bromophenyl-phenylether	1000000	500000	82000
4-Chloroaniline	2500000	270000	5600
4-Methylphenol	2500000	340000	7000
4-Nitroaniline	2500000	200000	4200
4-Nitrophenol	2500000	540000	11000
Acenaphthene	2500000	1000000	84000
Acenaphthylene	2500000	1000000	84000
Anthracene	2500000	1000000	400000
Benzo(a)anthracene	7800	1000	1000
Benzo(a)pyrene	1000	1000	1000

TABLE 4-3 (cont.)
CRITERIA FOR COMPARISON TO CHEMICALS DETECTED IN SOILS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Parameter	CT DEP Direct Exposure Criteria - Industrial Soils	CT DEP Direct Exposure Criteria - Residential Soils	CT DEP Pollutant Mobility Criteria - GB Aquifers
Benzo(b)fluoranthene	7800	1000	1000
Benzo(g,h,i)perylene	2500000	1000000	42000
Benzo(k)fluoranthene	78000	8400	1000
bis(2-Ethylhexyl)phthalate	410000	44000	11000
Butylbenzylphthalate	2500000	1000000	200000
Carbazole	290000	31000	360
Chrysene	780000	84000	1000
Dibenzo(a,h)anthracene	780	84	1000
Dibenzofuran	2500000	270000	5600
Diethylphthalate	2500000	1000000	1100000
Dimethylphthalate	2500000	1000000	1100000
Di-n-Butylphthalate	2500000	1000000	140000
Di-n-octylphthalate	2500000	1000000	20000
Fluoranthene	2500000	1000000	56000
Fluorene	2500000	1000000	56000
Hexachlorobenzene	3600	1000	1000
Indeno(1,2,3-cd)pyrene	7800	840	1000
Naphthalene	2500000	1000000	56000
N-Nitroso-di-n-propylamine	820	88	1000
N-Nitroso-diphenylamine	1200000	130000	1400
Pentachlorophenol	48000	5100	1000
Phenanthrene	2500000	1000000	40000
Phenol	2500000	1000000	800000
Pyrene	2500000	1000000	40000
VOLATILE ORGANIC COMPOUNDS (UG/KG)			
1,1,1-Trichloroethane	1000000	500000	40000
1,1,2,2-Tetrachloroethane	29000	3100	100
1,1,2-Trichloroethane	100000	11000	1000
1,1-Dichloroethane	1000000	500000	14000
1,1-Dichloroethene	9500	1000	1400
1,2,4-Trichlorobenzene	2500000	680000	14000
1,2-Dichlorobenzene	1000000	500000	3100
1,2-Dichloroethane	63000	6700	200
1,4-Dichlorobenzene	240000	26000	15000
2-Butanone	1000000	500000	80000
2-Hexanone	1000000	500000	56000
4-Methyl-2-Pentanone	1000000	500000	14000
Acenaphthene	2500000	1000000	84000
Acetone	1000000	500000	140000
Benzene	200000	21000	200
Bromodichloromethane	92000	9900	110
Bromoform	720000	78000	800
Carbon Disulfide	1000000	500000	140000
Chlorobenzene	1000000	500000	20000
Chloroethane	1000000	210000	2400
Chloroform	940000	100000	1200
Chloromethane	440000	47000	540
Ethylbenzene	1000000	500000	10100
Methylene Chloride	760000	82000	1000
Naphthalene	2500000	1000000	56000

TABLE 4-3 (cont.)
CRITERIA FOR COMPARISON TO CHEMICALS DETECTED IN SOILS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Parameter	CT DEP Direct Exposure Criteria - Industrial Soils	CT DEP Direct Exposure Criteria - Residential Soils	CT DEP Pollutant Mobility Criteria - GB Aquifers
Styrene	1000000	500000	20000
Tetrachloroethene	110000	12000	1000
Toluene	1000000	500000	67000
Total Xylenes	1000000	500000	19500
Trichloroethene	520000	56000	1000
Vinyl Chloride	3000	320	400
PCBs (UG/KG)			
Aroclor, Total	10000	1000	
Aroclor, Total (Conservative)	10000	1000	
Aroclor-1016	10000	1000	
Aroclor-1221	10000	1000	
Aroclor-1232	10000	1000	
Aroclor-1242	10000	1000	
Aroclor-1248	10000	1000	
Aroclor-1254	10000	1000	
Aroclor-1260	10000	1000	
Aroclor-1262	10000	1000	
Aroclor-1268	10000	1000	
PESTICIDES (UG/KG)			
4,4'-DDD	24000	2600	29
4,4'-DDE	17000	1800	21
4,4'-DDT	17000	1800	21
Aldrin	340	36	0.41
alpha-BHC	910	97	1.1
alpha-Chlordane	2200	490	66
beta-BHC	3200	340	3.9
delta-BHC	910	97	1.1
Dieldrin	360	38	7
Endosulfan I	1200000	410000	8400
Endosulfan II	1200000	410000	8400
Endosulfan Sulfate	1200000	410000	8400
Endrin	610000	20000	
Endrin Aldehyde	610000	20000	
Endrin Ketone	610000	20000	
gamma-BHC	610000	20000	40
gamma-Chlordane	2200	490	66
Heptachlor	1300	140	13
Heptachlor Epoxide	630	67	20
Methoxychlor	10000000	340000	8000
Toxaphene	5200	560	600
PCBs by SPLP (UG/L)			
Aroclor, Total			5
Aroclor, Total (Conservative)			5

Note:

* - Asbestos is included with a criterion of 1% in the Direct Exposure Criteria columns for comparison purposes. It's criterion is not a promulgated CT Remediation Standard Regulation.

TABLE 4-4
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Asbestos (%) (1)												
Asbestos	37	50	6	0.9	0.9 *	32 *	1	22			9.933645209	SBP-SO-482-0002, SBP-SO-701-0002
Dioxins (UG/KG)												
1,2,3,4,6,7,8-HpCDD	9	9	0.11	0.0703	0.0307	0.307					0.10314885	SBP-SS-501A-000.5
1,2,3,4,6,7,8-HpCDF	9	9	0.044	0.0272	0.0119	0.145					0.042341115	SBP-SS-503A-000.5
1,2,3,4,7,8,9-HpCDF	8	9	0.0015	0.001	0.00067 J	0.0031 J					0.000971847	SBP-SS-503A-000.5
1,2,3,4,7,8-HxCDD	8	9	0.0015	0.00068	0.00044 J	0.0058 J					0.001733821	SBP-SS-337A-000.5-MAX
1,2,3,4,7,8-HxCDF	9	9	0.011	0.0038	0.0018 J	0.0652					0.020436249	SBP-SS-503A-000.5
1,2,3,6,7,8-HxCDD	9	9	0.012	0.006	0.0019 J	0.0333					0.012182034	SBP-SS-501A-000.5
1,2,3,6,7,8-HxCDF	9	9	0.0037	0.0018	0.0011 J	0.0156					0.004586696	SBP-SS-503A-000.5
1,2,3,7,8,9-HxCDD	9	9	0.0041	0.003	0.0014 J	0.0099					0.003256319	SBP-SS-501A-000.5
1,2,3,7,8,9-HxCDF	6	9	0.00057	0.00053	0.00051 J	0.0012 J					0.000406912	SBP-SS-503A-000.5
1,2,3,7,8-PeCDD	6	9	0.0014	0.00074	0.00055 J	0.0049 J					0.001657919	SBP-SS-501A-000.5
1,2,3,7,8-PeCDF	6	9	0.0021	0.00081	0.00039 J	0.0128					0.004045585	SBP-SS-503A-000.5
2,3,4,6,7,8-HxCDF	9	9	0.0077	0.0039	0.0018 J	0.0331					0.009839645	SBP-SS-503A-000.5
2,3,4,7,8-PeCDF	9	9	0.0083	0.0026	0.00077 J	0.0512					0.016297182	SBP-SS-503A-000.5
2,3,7,8-TCDD	7	9	0.00055	0.00033	0.00024 J	0.0018					0.00057353	SBP-SS-501A-000.5
2,3,7,8-TCDF	9	9	0.0072	0.0026	0.001	0.043					0.013520365	SBP-SS-503A-000.5
OCDD	9	9	1.5	1.23	0.222	3.79					1.128342811	SBP-SS-482A-000.5
OCDF	9	9	0.072	0.0558	0.0221	0.21					0.057258908	SBP-SS-482A-000.5
Total HpCDD	9	9	0.23	0.16	0.0542 J	0.625 J					0.214972334	SBP-SS-501A-000.5
Total HpCDF	2	9	0.048	0.0335	0.0335 J	0.0554 J					0.030740796	SBP-SO-492A-0002
Total HxCDD	3	9	0.061	0.0307	0.0371 J	0.198 J					0.076569502	SBP-SS-482A-000.5
Total HxCDF	0	9	0.056	0	0	0					0	None
Total PeCDD	0	9	0.0036	0	0	0					0	None
Total PeCDF	0	9	0.039	0	0	0					0	None
Total TCDD	0	9	0.0016	0	0	0					0	None
Total TCDF	0	9	0.03	0	0	0					0	None
Toxicity Equivalency	9	9	0.013	0.005	0.0032 J	0.047 J					0.014013386	SBP-SS-503A-000.5

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Metals (MG/KG)												
Aluminum	36	36	6850	6975	2030	16300					3680.366042	SBP-SS-707A-000.5
Antimony	0	36	0.5	0	0	0	27	0			0	None
Arsenic	21	36	1.7	1.275	0.43 J	10.7	10	1			1.805097297	SBP-SO-451A-0002-MAX
Barium	36	36	247	59.65	9.6	2330	4700	0			463.1735265	SBP-SO-482A-0002
Beryllium	25	36	0.59	0.3525	0.051 J	3.7	2	3			0.81287943	SBP-SO-569A-0002
Cadmium	11	36	0.38	0.1075	0.059	3.5	34	0			0.664499059	SBP-SS-501A-000.5
Calcium	36	36	14400	12850	1110	48000					12502.47138	SBP-SO-353A-0002
Chromium	36	36	22.6	21	11	40.6	100	0			7.790744916	SBP-SS-482A-000.5
Cobalt	36	36	5.1	4.4	1.2	15.5	1000	0			3.098124112	SBP-SO-451A-0002-MAX
Copper	64	132	544	75	20.2 J	10300	2500	8			1472.853938	SBP-SO-492-0002
Iron	36	36	10100	9975	1110	20700					5034.345365	SBP-SS-707A-000.5
Lead	87	134	219	33.35	7.3 J	3520	400	20			512.7370528	SBP-SO-492-0002
Magnesium	36	36	3360	3040	1060	9530					1959.590498	SBP-SO-622A-0002
Manganese	36	36	240	212.5	48.1	545	1600	0			154.2070571	SBP-SS-707A-000.5
Mercury	13	31	0.1	0.029	0.059 J	0.51	20	0			0.130248782	SBP-SO-741A-0002
Nickel	36	36	18.3	14.05	4.7	72	1400	0			15.46146131	SBP-SO-622A-0002
Potassium	36	36	951	692	225	3200					787.1718011	SBP-SO-707A-0002-MAX
Selenium	9	36	0.45	0.41	0.49 J	1 J	340	0			0.174304229	SBP-SS-701A-000.5
Silver	13	36	1.2	0.33	0.69	11.1	340	0			2.03344927	SBP-SS-501A-000.5
Sodium	19	36	161	104	63	1970					318.6064295	SBP-SO-501A-0002-MAX
Thallium	1	36	0.43	0.37	0.66 J	0.66 J	5.4	0			0.139121107	SBP-SO-480A-0002
Vanadium	36	36	18.9	18.1	4.7	38.5	470	0			10.5908481	SBP-SS-707A-000.5
Zinc	36	36	144	97.05	36.1	598	20000	0			132.5901192	SBP-SS-701A-000.5
Metals/SPLP (UG/L)												
Antimony	0	1	1	0	0	0			60	0	0	None
Arsenic	0	1	1	0	0	0			500	0	0	None
Barium	1	1	51.7	51.7	51.7	51.7			10000	0	-1	SBP-SO-492A-0002
Beryllium	0	1	0.1	0	0	0			40	0	0	None
Cadmium	0	1	0.1	0	0	0			50	0	0	None
Chromium	1	1	3	3	3	3			500	0	-1	SBP-SO-492A-0002

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Metals/SPLP (UG/L) (cont.)												
Copper	1	1	345	345	345	345			13000	0	-1	SBP-SO-492A-0002
Lead	1	1	74.3	74.3	74.3	74.3			150	0	-1	SBP-SO-492A-0002
Mercury	0	1	0.065	0	0	0			20	0	0	None
Nickel	1	1	2.4	2.4	2.4	2.4			1000	0	-1	SBP-SO-492A-0002
Selenium	0	1	1	0	0	0			500	0	0	None
Silver	0	1	0.6	0	0	0			360	0	0	None
Thallium	0	1	1	0	0	0			50	0	0	None
Vanadium	0	1	0.5	0	0	0			500	0	0	None
Zinc	1	1	34.4	34.4	34.4	34.4			50000	0	-1	SBP-SO-492A-0002
Semivolatile Organic Compounds (UG/KG)												
1,1'-Biphenyl	0	35	15	0	0	0					0	None
2,2'-oxybis(1-Chloropropane)	0	35	190	0	0	0					0	None
2,4,5-Trichlorophenol	0	35	480	0	0	0					0	None
2,4,6-Trichlorophenol	0	35	190	0	0	0					0	None
2,4-Dichlorophenol	0	35	190	0	0	0					0	None
2,4-Dimethylphenol	6	35	180	185	36 J	440 J	1000000	0	28000	0	62.70119884	SBP-SO-622A-0002
2,4-Dinitrophenol	0	35	480	0	0	0					0	None
2,4-Dinitrotoluene	0	35	190	0	0	0					0	None
2,6-Dinitrotoluene	0	35	190	0	0	0					0	None
2-Chloronaphthalene	0	35	190	0	0	0					0	None
2-Chlorophenol	0	35	190	0	0	0					0	None
2-Methylnaphthalene	1	35	17	14.5	95	95	474000	0	9800	0	13.64064613	SBP-SO-504A-0002
2-Methylphenol	5	35	180	185	31 J	490	1000000	0	70000	0	73.43918767	SBP-SO-622A-0002
2-Nitroaniline	0	35	480	0	0	0					0	None
2-Nitrophenol	0	35	190	0	0	0					0	None
3,3'-Dichlorobenzidine	0	35	190	0	0	0	1400	0	330	0	0	None
3-Nitroaniline	0	35	480	0	0	0					0	None
4,6-Dinitro-2-methylphenol	0	35	480	0	0	0					0	None
4-Bromophenyl-phenylether	0	35	190	0	0	0	500000	0	82000	0	0	None
4-Chloro-3-methylphenol	0	35	190	0	0	0					0	None

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
4-Chloroaniline	5	35	180	185	48 J	170 J	270000	0	5600	0	41.01147616	SBP-SS-501A-000.5
4-Chlorophenyl-phenylether	0	35	190	0	0	0					0	None
4-Methylphenol	6	35	180	185	34 J	400	340000	0	7000	0	63.72001519	SBP-SO-622A-0002
4-Nitroaniline	0	35	480	0	0	0	200000	0	4200	0	0	None
4-Nitrophenol	0	35	480	0	0	0	540000	0	11000	0	0	None
Acenaphthene	1	35	16	14.5	71	71	1000000	0	84000	0	9.602345652	SBP-SO-504A-0002
Acenaphthylene	4	35	34	14.5	89	320 J	1000000	0	84000	0	62.72245118	SBP-SO-451A-0002-MAX
Acetophenone	6	35	180	185	42 J	190 J					37.96931534	SBP-SO-431A-0002
Anthracene	7	35	38	14.5	34	340	1000000	0	400000	0	65.1568792	SBP-SO-504A-0002
Atrazine	0	35	190	0	0	0					0	None
Benzaldehyde	3	35	180	185	41 J	160 JEB					37.78139242	SBP-SO-501A-0002-MAX
Benzo(a)anthracene	25	35	130	58	35	980 J	1000	0	1000	0	223.1950639	SBP-SO-451A-0002-MAX
Benzo(a)pyrene	25	35	130	69	38	920	1000	0	1000	0	201.7144302	SBP-SO-451A-0002-MAX
Benzo(b)fluoranthene	30	35	190	89	38	1300 J	1000	1	1000	1	276.0219613	SBP-SO-451A-0002-MAX
Benzo(g,h,i)perylene	19	35	85	33	32 J	830 J	1000000	0	42000	0	159.9660849	SBP-SO-451A-0002-MAX
Benzo(k)fluoranthene	16	35	69	17.5	37	500 J	8400	0	1000	0	106.8174875	SBP-SO-451A-0002-MAX
Bis(2-Chloroethoxy)methane	0	35	190	0	0	0					0	None
Bis(2-Chloroethyl)ether	1	35	190	190	270 J	270 J					19.66953879	SBP-SS-501A-000.5
bis(2-Ethylhexyl)phthalate	27	35	170	140	37 J	930	44000	0	11000	0	162.9449719	SBP-SO-622A-0002
Butylbenzylphthalate	1	35	190	190	70 J	70 J	1000000	0	200000	0	25.163332	SBP-SO-561A-0002
Caprolactam	0	35	190	0	0	0					0	None
Carbazole	3	35	180	190	37 J	82 J	31000	0	360	0	42.40649625	SBP-SO-504A-0002
Chrysene	27	35	160	83	32	1100	84000	0	1000	1	252.5252604	SBP-SO-451A-0002-MAX
Dibenzo(a,h)anthracene	5	35	26	14.5	30	210 J	84	3	1000	0	38.49676948	SBP-SO-451A-0002-MAX
Dibenzofuran	1	35	16	14.5	79	79	270000	0	5600	0	10.94693081	SBP-SO-504A-0002
Diethylphthalate	0	35	190	0	0	0	1000000	0	1100000	0	0	None
Dimethylphthalate	0	35	190	0	0	0	1000000	0	1100000	0	0	None
Di-n-Butylphthalate	4	35	180	185	43 JEB	55 J	1000000	0	140000	0	48.67344452	SBP-SO-333A-0002
Di-n-octylphthalate	1	35	200	190	360 J	360 J	1000000	0	20000	0	31.833337	SBP-SO-482A-0002
Fluoranthene	31	35	250	120	48	1900	1000000	0	56000	0	405.5051093	SBP-SO-504A-0002

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
Fluorene	3	35	25	14.5	46	300	1000000	0	56000	0	48.86402846	SBP-SO-504A-0002
Hexachlorobenzene	0	35	190	0	0	0	1000	0	1000	0	0	None
Hexachlorobutadiene	0	35	190	0	0	0					0	None
Hexachlorocyclopentadiene	0	35	190	0	0	0					0	None
Hexachloroethane	0	35	190	0	0	0					0	None
Indeno(1,2,3-cd)pyrene	18	35	81	29	29	690 J	840	0	1000	0	136.6802916	SBP-SO-451A-0002-MAX
Isophorone	0	35	190	0	0	0					0	None
Naphthalene	1	35	17	14.5	110	110	1000000	0	56000	0	16.16927265	SBP-SO-504A-0002
Nitrobenzene	0	35	190	0	0	0					0	None
N-Nitroso-di-n-propylamine	0	35	190	0	0	0	88	0	1000	0	0	None
N-Nitroso-diphenylamine	0	35	190	0	0	0	130000	0	1400	0	0	None
Pentachlorophenol	1	35	470	475	80 J	80 J	5100	0	1000	0	77.72446485	SBP-SO-333A-0002
Phenanthrene	25	35	150	66	31	2200	1000000	0	40000	0	372.2048631	SBP-SO-504A-0002
Phenol	9	35	180	185	49 JEB	260 JEB	1000000	0	800000	0	45.30883751	SBP-SS-701A-000.5
Pyrene	33	35	290	140	30	2200	1000000	0	40000	0	450.4373132	SBP-SO-504A-0002
Volatile Organic Compounds (UG/KG)												
1,1,1-Trichloroethane	0	35	5	0	0	0	500000	0	40000	0	0	None
1,1,2,2-Tetrachloroethane	0	35	5	0	0	0	3100	0	100	0	0	None
1,1,2-Trichloro-1,2,2-trifluoroethane	0	35	5	0	0	0					0	None
1,1,2-Trichloroethane	0	35	5	0	0	0	11000	0	1000	0	0	None
1,1-Dichloroethane	1	35	5	4	1 J	1 J	500000	0	14000	0	3.012578672	SBP-SO-622A-0002
1,1-Dichloroethene	0	35	5	0	0	0	1000	0	1400	0	0	None
1,2,4-Trichlorobenzene	0	35	5	0	0	0	680000	0	14000	0	0	None
1,2-Dibromo-3-chloropropane	0	35	5	0	0	0					0	None
1,2-Dibromoethane	0	35	5	0	0	0					0	None
1,2-Dichlorobenzene	0	35	5	0	0	0	500000	0	3100	0	0	None
1,2-Dichloroethane	0	35	5	0	0	0	6700	0	200	0	0	None
1,2-Dichloropropane	0	35	5	0	0	0					0	None
1,3-Dichlorobenzene	0	35	5	0	0	0					0	None

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
1,4-Dichlorobenzene	0	35	5	0	0	0	26000	0	15000	0	0	None
2-Butanone	13	35	8	6	1 J	84	500000	0	80000	0	14.02643063	SBP-SO-407A-0002
2-Hexanone	0	35	5	0	0	0	500000	0	56000	0	0	None
4-Methyl-2-Pentanone	0	35	5	0	0	0	500000	0	14000	0	0	None
Acetone	11	35	390	9.5	2 J	7300 J	500000	0	140000	0	1350.979258	SBP-SS-333A-000.5
Benzene	1	35	5	4	7 J	7 J	21000	0	200	0	2.968320126	SBP-SO-407A-0002
Bromodichloromethane	0	35	5	0	0	0	9900	0	110	0	0	None
Bromoform	0	35	5	0	0	0	78000	0	800	0	0	None
Bromomethane	0	35	5	0	0	0					0	None
Carbon Disulfide	4	35	5	3.5	1 J	5 J	500000	0	140000	0	3.003849071	SBP-SO-407A-0002
Carbon Tetrachloride	0	35	5	0	0	0					0	None
Chlorobenzene	4	35	5	3.5	1 J	3 J	500000	0	20000	0	3.141147358	SBP-SO-407A-0002
Chloroethane	0	35	5	0	0	0	210000	0	2400	0	0	None
Chloroform	0	35	5	0	0	0	100000	0	1200	0	0	None
Chloromethane	0	35	5	0	0	0	47000	0	540	0	0	None
cis-1,2-Dichloroethene	2	35	6	4	1 J	28					4.915974646	SBP-SO-622A-0002
cis-1,3-Dichloropropene	0	35	5	0	0	0					0	None
Cyclohexane	1	35	5	4	10	10					3.067312074	SBP-SO-407A-0002
Dibromochloromethane	0	35	5	0	0	0					0	None
Dichlorodifluoromethane	0	35	5	0	0	0					0	None
Ethylbenzene	1	35	5	4	1 J	1 J	500000	0	10100	0	3.026354825	SBP-SO-407A-0002
Isopropylbenzene	1	35	6	4	22	22					4.115966043	SBP-SO-407A-0002
Methyl Acetate	0	35	5	0	0	0					0	None
Methyl tert-Butyl Ether	0	35	5	0	0	0					0	None
Methylcyclohexane	2	35	5	4	2 J	7 J					2.95078682	SBP-SO-407A-0002
Methylene Chloride	0	35	6	0	0	0	82000	0	1000	0	0	None
Styrene	2	35	5	3.5	1 J	2 J	500000	0	20000	0	3.024618873	SBP-SO-482A-0002
Tetrachloroethene	0	35	5	0	0	0	12000	0	1000	0	0	None
Toluene	5	35	5	4	2 J	17	500000	0	67000	0	3.075724961	SBP-SO-622A-0002
Total Xylenes	4	35	5	4	1 J	10	500000	0	19500	0	3.173352812	SBP-SO-407A-0002

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
trans-1,2-Dichloroethene	1	35	5	4	1 J	1 J					3.012578672	SBP-SO-622A-0002
trans-1,3-Dichloropropene	0	35	5	0	0	0					0	None
Trichloroethene	1	35	5	4	1 J	1 J	56000	0	1000	0	3.012578672	SBP-SO-622A-0002
Trichlorofluoromethane	0	35	5	0	0	0					0	None
Vinyl Chloride	1	35	5	4	2 J	2 J	320	0	400	0	2.978776468	SBP-SO-622A-0002
Pesticide/PCB (UG/KG)												
4,4'-DDD	5	35	3.3	1.9	1.9 J	47	2600	0	29	1	7.61257998	SBP-SO-741A-0002
4,4'-DDE	26	35	21	4.3	1.4 J	200 *	1800	0	21	7	42.24614532	SBP-SO-622A-0002
4,4'-DDT	19	35	5.8	2.35	1.1 J	28 #	1800	0	21	1	6.337520656	SBP-SO-504A-0002
Aldrin	0	35	0.99	0	0	0	36	0	0.41	0	0	None
alpha-BHC	0	35	0.99	0	0	0	97	0	1.1	0	0	None
alpha-Chlordane	10	35	2	1	1.6 J	10 J	490	0	66	0	2.246444436	SBP-SO-501A-0002-MAX
Aroclor, Total (4)	26	50	630	125	32	6500	1000	8			1273.102321	SBP-SO-504-0002
Aroclor, Total (Conservative) (5)	26	50	720	238.5	212	6500	1000	9			1333.087106	SBP-SO-504-0002
Aroclor-1016	0	37	26	0	0	0	1000	0			0	None
Aroclor-1221	0	37	45	0	0	0	1000	0			0	None
Aroclor-1232	0	37	26	0	0	0	1000	0			0	None
Aroclor-1242	0	37	26	0	0	0	1000	0			0	None
Aroclor-1248	0	37	26	0	0	0	1000	0			0	None
Aroclor-1254	1	39	33	19	73	73	1000	0			39.44448943	SBP-SO-451A-0002-MAX
Aroclor-1260	0	39	31	0	0	0	1000	0			0	None
Aroclor-1262	23	48	380	75	32 J	4000	1000	4			814.6316858	SBP-SO-504-0002
Aroclor-1268	20	50	280	23.25	56	2500	1000	4			532.6071804	SBP-SO-504-0002
beta-BHC	1	35	1	0.95	2.8	2.8	340	0	3.9	0	0.315842211	SBP-SO-504A-0002
delta-BHC	0	35	0.99	0	0	0	97	0	1.1	0	0	None
Dieldrin	3	35	2.2	1.9	5	6	38	0	7	0	0.997774835	SBP-SO-501A-0002-MAX
Endosulfan I	0	35	0.99	0	0	0	410000	0	8400	0	0	None
Endosulfan II	0	35	1.9	0	0	0	410000	0	8400	0	0	None
Endosulfan Sulfate	4	35	2.7	1.9	3.9 #	15 #	410000	0	8400	0	2.584856513	SBP-SO-622A-0002
Endrin	1	35	2.6	1.9	27 J	27 J	20000	0			4.241272799	SBP-SO-451A-0002-MAX

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Pesticide/PCB (UG/KG) (cont.)												
Endrin Aldehyde	2	35	2	1.9	1.9 J	3.9	20000	0			0.36159079	SBP-SO-482A-0002
Endrin Ketone	0	35	1.9	0	0	0	20000	0			0	None
gamma-BHC	0	35	0.99	0	0	0	20000	0	40	0	0	None
gamma-Chlordane	9	35	1.6	1	1.1 J	6.6	490	0	66	0	1.50143069	SBP-SO-501A-0002-MAX, SBP-SS-501A-000.5
Heptachlor	0	35	0.99	0	0	0	140	0	13	0	0	None
Heptachlor Epoxide	1	35	1.1	0.95	4.3	4.3	67	0	20	0	0.565321356	SBP-SO-501A-0002-MAX
Methoxychlor	2	35	9.6	9.5	4.6 J	6.2 J	340000	0	8000	0	1.305952758	SBP-SO-521A-0002
Toxaphene	0	35	99	0	0	0	560	0	600	0	0	None
PCB (SPLP) (UG/L)												
Aroclor, Total (4)	0	1	1.6	0	0	0			5	0	0	None
Aroclor, Total (Conservative) (5)	0	1	1.6	0	0	0			5	0	0	None
Aroclor-1016	0	1	1.6	0	0	0					0	None
Aroclor-1221	0	1	1.6	0	0	0					0	None
Aroclor-1232	0	1	1.6	0	0	0					0	None
Aroclor-1242	0	1	1.6	0	0	0					0	None
Aroclor-1248	0	1	1.6	0	0	0					0	None
Aroclor-1254	0	1	1.6	0	0	0					0	None
Aroclor-1260	0	1	1.6	0	0	0					0	None
Aroclor-1262	0	1	1.6	0	0	0					0	None
Aroclor-1268	0	1	1.6	0	0	0					0	None

TABLE 4-4 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Qualifier	Definition
#	Possible false positive due to interference
*	From dilution analysis or Estimated Maximum Possible Concentration (Dioxins only)
*	Type of asbestos detected was chrysotile (Asbestos only)
EB	Equipment blank contamination
J	Quantitation approximate

Notes:

(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation. Trace amounts of asbestos are reported on this table as 0.9%.

(2) CT DEC - Direct Exposure Criteria for Residential Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.

(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

TABLE 4-5
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Asbestos (%) (1)												
Asbestos	100	107	12	7.7	0.9 *	48 *	1	75			12.248302	SBP-SO-480-0204, SBP-SO-745A-0406
Dioxins (UG/KG)												
1,2,3,4,6,7,8-HpCDD	13	13	0.15	0.107	0.017	0.366					0.105961293	SBP-SO-451A-0204-MAX
1,2,3,4,6,7,8-HpCDF	13	13	0.12	0.0621	0.0052	0.512					0.169988154	SBP-SO-337A-0204
1,2,3,4,7,8,9-HpCDF	9	13	0.0091	0.0027	0.0012 J	0.0485					0.013943046	SBP-SO-480A-0204
1,2,3,4,7,8-HxCDD	6	13	0.002	0.0008	0.00098 J	0.0124					0.00325692	SBP-SO-486A-0204
1,2,3,4,7,8-HxCDF	13	13	0.083	0.0218	0.00086 J	0.53					0.153979504	SBP-SO-480A-0204
1,2,3,6,7,8-HxCDD	11	13	0.0091	0.0063	0.0029 J	0.0219					0.007019513	SBP-SO-569A-0204
1,2,3,6,7,8-HxCDF	11	13	0.023	0.0056	0.0017 J	0.139					0.040360845	SBP-SO-480A-0204
1,2,3,7,8,9-HxCDD	10	13	0.0066	0.0057	0.0034 J	0.0166					0.005324141	SBP-SO-486A-0204
1,2,3,7,8,9-HxCDF	5	13	0.0024	0.0005	0.001 J	0.0135					0.003955554	SBP-SO-486A-0204
1,2,3,7,8-PeCDD	6	13	0.0021	0.00077	0.00077 J	0.0158					0.004156246	SBP-SO-486A-0204
1,2,3,7,8-PeCDF	9	13	0.018	0.0081	0.00047 J	0.104					0.027872969	SBP-SO-480A-0204
2,3,4,6,7,8-HxCDF	11	13	0.038	0.0105	0.0013 J	0.25					0.070324419	SBP-SO-480A-0204
2,3,4,7,8-PeCDF	12	13	0.072	0.0168	0.0017 J	0.507					0.144828715	SBP-SO-480A-0204
2,3,7,8-TCDD	5	13	0.0011	0.00045	0.00049 J	0.0087					0.002298205	SBP-SO-486A-0204
2,3,7,8-TCDF	13	13	0.046	0.0136	0.00085 J#	0.228 #					0.076432436	SBP-SO-480A-0204
OCDD	13	13	1.4	0.817	0.0818	4.64 &					1.387577811	SBP-SO-451A-0204-MAX
OCDF	10	13	0.094	0.05	0.0137	0.41					0.12314621	SBP-SO-480A-0204
Total HpCDD	13	13	0.28	0.192	0.043 J	0.721 J					0.201135463	SBP-SO-451A-0204-MAX
Total HpCDF	6	13	0.15	0.0566	0.0489 J	0.689 J					0.227982588	SBP-SO-480A-0204
Total HxCDD	3	13	0.044	0.0439	0.0439 J	0.0782 J					0.026792517	SBP-SO-486A-0204
Total HxCDF	4	13	0.26	0.061	0.0342 J	2.06 J					0.559696012	SBP-SO-480A-0204
Total PeCDD	0	13	0.031	0	0	0					0	None
Total PeCDF	1	13	0.15	0.0495	0.0064 J	0.0064 J					0.264740786	SBP-SO-521A-0608
Total TCDD	3	13	0.017	0.0136	0.0136 J	0.0679 J					0.017479636	SBP-SO-745A-0406
Total TCDF	0	13	0.12	0	0	0					0	None
Toxicity Equivalency	13	13	0.064	0.018	0.0011 J	0.38 J					0.108896477	SBP-SO-480A-0204

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Metals (MG/KG)												
Aluminum	64	64	6670	6380	1840	16900					2952.945895	SBP-SO-451A-0204-MAX
Antimony	3	59	1.3	0.47	1.4 J	38.6	27	1			4.974963764	SBP-SO-707A-0608
Arsenic	51	64	6.6	5.75	0.61 J	31.3 J	10	11			5.470497222	SBP-SO-451A-0204-MAX
Barium	64	64	1770	377	38.5	9900	4700	9			2511.821663	SBP-SO-745A-0406
Beryllium	29	63	0.3	0.15	0.068 J	2.9	2	1			0.422325454	SBP-SO-521A-0204
Cadmium	30	63	0.75	0.36	0.13 J	4.7 J	34	0			1.012815068	SBP-SO-519A-0810
Calcium	64	64	9100	7275	1120 J	41700					7527.979449	SBP-SO-353A-0608
Chromium	64	64	54.8	32.5	7.5 J	267	100	9			53.52901414	SBP-SO-355A-0204
Cobalt	64	64	9	7.25	1.9	30.7 J	1000	0			6.516115363	SBP-SO-745A-0406
Copper	124	169	4440	295	13.6 J	32500	2500	49			7917.82157	SBP-SO-745A-0406
Iron	64	64	18700	14950	2960	98400					14555.26828	SBP-SO-451A-0204-MAX
Lead	152	169	1920	336	5.2 J	20500	400	82			3517.968255	SBP-SO-745A-0406
Magnesium	64	64	13000	4650	1290	81700					17934.42136	SBP-SO-355A-0204
Manganese	64	64	244	213	61.4	869 J	1600	0			166.6008362	SBP-SO-741A-0204
Mercury	43	60	0.24	0.1	0.045 J	2.4 J	20	0			0.420847727	SBP-SO-519A-0810
Nickel	64	64	110	33.7	6.5	647	1400	0			150.9025102	SBP-SO-355A-0204
Potassium	62	64	927	833	276	2670					546.0367124	SBP-SO-451A-0204-MAX
Selenium	28	64	1.3	0.4825	0.45 J	43.7 J	340	0			5.409280806	SBP-SO-451A-0204-MAX
Silver	35	63	1.6	0.9	0.29	7.8	340	0			1.676672599	SBP-SO-407A-0406
Sodium	16	63	120	55	73	1800					241.7807546	SBP-SO-431A-0204
Thallium	2	64	0.52	0.3725	0.86 J	5.7 J	5.4	1			0.682552431	SBP-SO-451A-0204-MAX
Vanadium	64	64	48.7	21.3	4.8	1220 J	470	2			163.8931398	SBP-SO-480A-0204
Zinc	64	64	1210	484.5	31.5 J	12000	20000	0			1949.643962	SBP-SO-431A-0204
Metals/SPLP (UG/L)												
Antimony	0	13	1.3	0	0	0			60	0	0	None
Arsenic	3	13	1.5	1	2 J	4.1			500	0	1.127340869	SBP-SO-451A-0204-MAX
Barium	13	13	209	189	27	437			10000	0	128.9831673	SBP-SO-355A-0204
Beryllium	0	13	0.1	0	0	0			40	0	0	None
Cadmium	1	13	0.11	0.1	0.23 J	0.23 J			50	0	0.036055513	SBP-SO-501A-0204
Chromium	9	13	1.4	1.2	0.41 J	5.3			500	0	1.492409427	SBP-SO-492A-0204

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Metals/SPLP (UG/L) (cont.)												
Copper	11	13	1030	823	281	2080			13000	0	730.4614012	SBP-SO-355A-0204
Lead	13	13	294	245	6.7 J	663			150	9	230.0364355	SBP-SO-355A-0204
Mercury	0	13	0.068	0	0	0			20	0	0	None
Nickel	13	13	9.8	9.9	1.8	19			1000	0	5.309196182	SBP-SO-355A-0204
Selenium	0	13	1	0	0	0			500	0	0	None
Silver	0	13	0.17	0	0	0			360	0	0	None
Thallium	0	13	1	0	0	0			50	0	0	None
Vanadium	2	13	7	0.6	3.3	81.5			500	0	22.40546115	SBP-SO-480A-0204
Zinc	12	13	155	182	20	259			50000	0	86.75241739	SBP-SO-482A-0204-MAX
Semivolatile Organic Compounds (UG/KG)												
1,1'-Biphenyl	35	64	110	37	33	1500					247.6113525	SBP-SO-480A-0406
2,2'-oxybis(1-Chloropropane)	0	64	220	0	0	0					0	None
2,4,5-Trichlorophenol	0	64	540	0	0	0					0	None
2,4,6-Trichlorophenol	0	64	220	0	0	0					0	None
2,4-Dichlorophenol	1	64	210	202.5	47 J	47 J					41.60151752	SBP-SO-357A-1012
2,4-Dimethylphenol	27	64	650	205	46 J	6500 *	1000000	0	28000	0	1158.777976	SBP-SO-355A-0406
2,4-Dinitrophenol	0	64	540	0	0	0					0	None
2,4-Dinitrotoluene	0	64	220	0	0	0					0	None
2,6-Dinitrotoluene	0	64	220	0	0	0					0	None
2-Chloronaphthalene	1	64	220	205	360 J	360 J					40.19784591	SBP-SO-622A-0608
2-Chlorophenol	0	64	220	0	0	0					0	None
2-Methylnaphthalene	46	64	610	115	34 , J	12000 *	474000	0	9800	1	1700.040284	SBP-SO-622A-0406
2-Methylphenol	22	64	280	202.5	71 J	1000	1000000	0	70000	0	193.6645811	SBP-SO-486A-0406
2-Nitroaniline	0	64	540	0	0	0					0	None
2-Nitrophenol	0	64	220	0	0	0					0	None
3,3'-Dichlorobenzidine	0	64	370	0	0	0	1400	0	330	0	0	None
3-Nitroaniline	0	64	540	0	0	0					0	None
4,6-Dinitro-2-methylphenol	0	64	540	0	0	0					0	None
4-Bromophenyl-phenylether	0	64	220	0	0	0	500000	0	82000	0	0	None
4-Chloro-3-methylphenol	0	64	220	0	0	0					0	None

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
4-Chloroaniline	1	64	210	205	110 J	110 J	270000	0	5600	0	38.11198711	SBP-SO-707A-0204
4-Chlorophenyl-phenylether	0	64	220	0	0	0					0	None
4-Methylphenol	30	64	390	202.5	39 J	2500	340000	0	7000	0	432.4328372	SBP-SO-480A-0204
4-Nitroaniline	0	64	540	0	0	0	200000	0	4200	0	0	None
4-Nitrophenol	0	64	540	0	0	0	540000	0	11000	0	0	None
Acenaphthene	39	64	710	53	30	8300 *	1000000	0	84000	0	1701.348988	SBP-SO-480A-0406
Acenaphthylene	45	64	510	115	36	12000 *	1000000	0	84000	0	1547.258635	SBP-SO-480A-0406
Acetophenone	21	64	200	200	43 J	420 J					76.44345742	SBP-SO-622A-0204
Anthracene	48	64	1500	190	38	28000 *	1000000	0	400000	0	4061.24947	SBP-SO-480A-0406
Atrazine	0	64	220	0	0	0					0	None
Benzaldehyde	19	64	190	190	43 JEB	530 JEB					82.2660162	SBP-SO-337A-0204
Benzo(a)anthracene	59	64	2500	600	34	33000 *	1000	27	1000	27	5141.346715	SBP-SO-480A-0406
Benzo(a)pyrene	59	64	2000	545	36	24000 *	1000	26	1000	26	3838.006061	SBP-SO-480A-0406
Benzo(b)fluoranthene	62	64	2600	765	30	31000 *	1000	28	1000	28	4818.473272	SBP-SO-480A-0406
Benzo(g,h,i)perylene	52	64	970	300	31	12000 *	1000000	0	42000	0	1894.198649	SBP-SO-480A-0406
Benzo(k)fluoranthene	54	64	1000	285	31	12000 *	8400	1	1000	16	1920.482479	SBP-SO-480A-0406
Bis(2-Chloroethoxy)methane	0	64	220	0	0	0					0	None
Bis(2-Chloroethyl)ether	0	64	220	0	0	0					0	None
bis(2-Ethylhexyl)phthalate	49	64	1100	470	46 JEB	12000 *	44000	0	11000	1	1941.898129	SBP-SO-357A-1012
Butylbenzylphthalate	9	64	910	205	38 J	40000 *J	1000000	0	200000	0	4977.568669	SBP-SO-561A-0406
Caprolactam	3	64	220	202.5	140 J	450					47.66679154	SBP-SO-622A-0406
Carbazole	42	64	650	195	43 J	18000 *	31000	0	360	10	2282.88296	SBP-SO-480A-0406
Chrysene	63	64	2800	860	27	32000 *	84000	0	1000	28	5159.859994	SBP-SO-480A-0406
Dibenzo(a,h)anthracene	40	64	310	88	37	4300 *	84	33	1000	5	634.783268	SBP-SO-480A-0406
Dibenzofuran	41	64	580	65	31	13000 *	270000	0	5600	1	1759.361678	SBP-SO-480A-0406
Diethylphthalate	1	64	220	205	430 J	430 J	1000000	0	1100000	0	44.34648648	SBP-SO-451A-0204-MAX
Dimethylphthalate	7	64	200	195	75 J	200 J	1000000	0	1100000	0	41.77024032	SBP-SO-486A-0406
Di-n-Butylphthalate	19	64	170	190	39 J	140 J	1000000	0	140000	0	62.49665864	SBP-SO-355A-0406, SBP-SO-486A-0406
Di-n-octylphthalate	0	64	390	0	0	0	1000000	0	20000	0	0	None

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
Fluoranthene	64	64	6200	1200	45	88000 *	1000000	0	56000	1	13488.88441	SBP-SO-480A-0406
Fluorene	49	64	1500	120	39	30000 *	1000000	0	56000	0	4362.287494	SBP-SO-480A-0406
Hexachlorobenzene	0	64	220	0	0	0	1000	0	1000	0	0	None
Hexachlorobutadiene	0	64	220	0	0	0					0	None
Hexachlorocyclopentadiene	0	64	220	0	0	0					0	None
Hexachloroethane	0	64	220	0	0	0					0	None
Indeno(1,2,3-cd)pyrene	51	64	990	315	36 J	13000 *	840	20	1000	15	1950.244362	SBP-SO-480A-0406
Isophorone	0	64	220	0	0	0					0	None
Naphthalene	46	64	610	160	33	8400 *	1000000	0	56000	0	1490.584557	SBP-SO-357A-0608
Nitrobenzene	0	64	220	0	0	0					0	None
N-Nitroso-di-n-propylamine	1	64	220	205	420	420	88	1	1000	0	43.94027501	SBP-SO-357A-0810
N-Nitroso-diphenylamine	14	64	260	197.5	44 J	3700 *	130000	0	1400	1	442.8137953	SBP-SO-357A-1012
Pentachlorophenol	2	64	530	500	56 J	89 J	5100	0	1000	0	124.6686312	SBP-SO-337A-0406
Phenanthrene	62	64	6800	825	31	130000 *	1000000	0	40000	2	18551.91625	SBP-SO-480A-0406
Phenol	39	64	840	205	40 J	8200 *	1000000	0	800000	0	1391.504203	SBP-SO-486A-0406
Pyrene	64	64	6100	1400	43	69000 *	1000000	0	40000	2	11892.53017	SBP-SO-480A-0406
Volatile Organic Compounds (UG/KG)												
1,1,1-Trichloroethane	3	64	21	5.25	0.9 J	8 J	500000	0	40000	0	118.0126276	SBP-SO-480A-0204
1,1,2,2-Tetrachloroethane	0	64	22	0	0	0	3100	0	100	0	0	None
1,1,2-Trichloro-1,2,2-trifluoroethane	0	64	22	0	0	0					0	None
1,1,2-Trichloroethane	0	64	22	0	0	0	11000	0	1000	0	0	None
1,1-Dichloroethane	9	64	21	5	1 J	21 J	500000	0	14000	0	118.0123066	SBP-SO-486A-0406
1,1-Dichloroethene	1	64	21	5.25	2 J	2 J	1000	0	1400	0	118.0037031	SBP-SO-504A-0204
1,2,4-Trichlorobenzene	0	64	22	0	0	0	680000	0	14000	0	0	None
1,2-Dibromo-3-chloropropane	0	64	22	0	0	0					0	None
1,2-Dibromoethane	0	64	22	0	0	0					0	None
1,2-Dichlorobenzene	8	64	23	5.75	1 J	51	500000	0	3100	0	118.0055981	SBP-SO-519A-0810
1,2-Dichloroethane	0	64	22	0	0	0	6700	0	200	0	0	None
1,2-Dichloropropane	0	64	22	0	0	0					0	None

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
1,3-Dichlorobenzene	3	64	22	5.5	3 J	18 J					117.9817453	SBP-SO-519A-0810
1,4-Dichlorobenzene	13	64	26	6.25	2 J	120	26000	0	15000	0	118.6631219	SBP-SO-519A-0810
2-Butanone	51	64	36	13	2 J	190	500000	0	80000	0	120.0623143	SBP-SO-519A-0810
2-Hexanone	0	64	22	0	0	0	500000	0	56000	0	0	None
4-Methyl-2-Pentanone	1	64	47	5.5	2600	2600	500000	0	14000	0	324.1808609	SBP-SO-482A-0204-MAX
Acetone	26	64	63	22.25	3 J	1200 J	500000	0	140000	0	154.9318583	SBP-SO-482A-0608
Benzene	23	64	6	4	0.7 J	21	21000	0	200	0	5.132675969	SBP-SO-622A-0406
Bromodichloromethane	0	64	22	0	0	0	9900	0	110	0	0	None
Bromoform	0	64	22	0	0	0	78000	0	800	0	0	None
Bromomethane	0	64	22	0	0	0					0	None
Carbon Disulfide	41	64	8	5	0.7 J	56	500000	0	140000	0	9.886951152	SBP-SO-519A-0810
Carbon Tetrachloride	0	64	22	0	0	0					0	None
Chlorobenzene	29	64	28	6	0.8 J	730 *	500000	0	20000	0	103.7356087	SBP-SO-519A-0810
Chloroethane	6	64	7	5	3 J	55 J	210000	0	2400	0	7.482614605	SBP-SO-486A-0406
Chloroform	0	64	22	0	0	0	100000	0	1200	0	0	None
Chloromethane	1	64	21	5.25	2 J	2 J	47000	0	540	0	118.002849	SBP-SO-355A-0204
cis-1,2-Dichloroethene	10	64	8	5	1 J	49 J					9.16255319	SBP-SO-622A-0204
cis-1,3-Dichloropropene	0	64	22	0	0	0					0	None
Cyclohexane	12	64	22	5.5	0.7 J	55					118.0735297	SBP-SO-504A-0406
Dibromochloromethane	0	64	22	0	0	0					0	None
Dichlorodifluoromethane	1	64	22	5.5	4 J	4 J					117.9898004	SBP-SO-407A-0204
Ethylbenzene	18	64	9	5	0.8 J	160 J	500000	0	10100	0	19.81167579	SBP-SO-486A-0406
Isopropylbenzene	27	64	12	6	1 J	230 J					29.46020655	SBP-SO-482A-0204-MAX
Methyl Acetate	2	64	22	5.5	2 J	5 J					117.9924962	SBP-SO-707A-0608
Methyl tert-Butyl Ether	0	64	22	0	0	0					0	None
Methylcyclohexane	33	64	59	6	0.8 J	3000 *					373.8850896	SBP-SO-486A-0406
Methylene Chloride	2	64	23	6.75	6 J	14 J	82000	0	1000	0	117.9072074	SBP-SO-501A-0406
Styrene	1	64	22	5.5	3 J	3 J	500000	0	20000	0	117.9910645	SBP-SO-482A-0608
Tetrachloroethene	1	64	21	5.25	2 J	2 J	12000	0	1000	0	118.0010383	SBP-SO-480A-0204
Toluene	30	64	850	5.25	0.5 J	15000 *J	500000	0	67000	0	3188.950869	SBP-SO-482A-0204-MAX

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
Total Xylenes	30	64	25	5.5	0.9 J	540 J	500000	0	19500	0	85.17872503	SBP-SO-486A-0406
trans-1,2-Dichloroethene	3	64	21	4.75	2 J	2 J					118.0225754	SBP-SO-480A-0204, SBP-SO-622A-0204, SBP-SO-622A-0406
trans-1,3-Dichloropropene	0	64	22	0	0	0					0	None
Trichloroethene	9	64	22	4.75	0.8 J	53	56000	0	1000	0	118.0901585	SBP-SO-480A-0204
Trichlorofluoromethane	1	64	22	5.5	3 J	3 J					117.9910645	SBP-SO-482A-0608
Vinyl Chloride	1	64	22	5.25	5 J	5 J	320	0	400	0	117.9897332	SBP-SO-622A-0204
Pesticide/PCB (UG/KG)												
4,4'-DDD	30	64	16	3	2 J#	290 *	2600	0	29	7	42.26847006	SBP-SO-561A-0608
4,4'-DDE	53	64	38	6	1.2 J	590 *	1800	0	21	11	102.696836	SBP-SO-482A-0204-MAX
4,4'-DDT	27	64	5.8	2.375	1.4 J	53 #	1800	0	21	4	8.265754408	SBP-SO-337A-0204
Aldrin	1	64	1.3	1.05	4.2	4.2	36	0	0.41	1	1.25457076	SBP-SO-745A-0406
alpha-BHC	1	64	1.3	1.05	2.5	2.5	97	0	1.1	1	1.209449402	SBP-SO-506A-0204
alpha-Chlordane	12	64	2.3	1.1	1.2 J	45	490	0	66	0	5.632377823	SBP-SO-622A-0608
Aroclor, Total (4)	72	108	3300	390	68	91000	1000	38			10354.09092	SBP-SO-697-0204
Aroclor, Total (Conservative) (5)	72	108	3400	506	225	91000	1000	40			10415.00989	SBP-SO-697-0204
Aroclor-1016	0	67	29	0	0	0	1000	0			0	None
Aroclor-1221	0	67	54	0	0	0	1000	0			0	None
Aroclor-1232	0	67	29	0	0	0	1000	0			0	None
Aroclor-1242	1	67	62	20.5	2400 *J	2400 *J	1000	1			290.7208508	SBP-SO-745A-0608-MAX
Aroclor-1248	2	67	680	20.5	88	44000 *J	1000	1			5372.11776	SBP-SO-745A-0608-MAX
Aroclor-1254	10	67	99	21.5	72 J	1300	1000	3			249.7395344	SBP-SO-519A-0810
Aroclor-1260	8	67	53	22	23 J	1100	1000	1			136.391744	SBP-SO-357A-0810
Aroclor-1262	59	108	1600	250	50	47000	1000	25			5076.382537	SBP-SO-697-0204
Aroclor-1268	53	108	1200	250	51	44000	1000	22			4483.289027	SBP-SO-697-0204
beta-BHC	9	64	2.2	1.1	2	43	340	0	3.9	4	5.428043855	SBP-SO-745A-0608-MAX
delta-BHC	0	64	1.3	0	0	0	97	0	1.1	0	0	None
Dieldrin	4	64	8.9	2.05	1.1 J	420 J	38	1	7	2	52.22074406	SBP-SO-745A-0608-MAX
Endosulfan I	3	64	2.7	1.05	6.1 J	73 J	410000	0	8400	0	9.293528935	SBP-SO-745A-0608-MAX

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Residential) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Pesticide/PCB (UG/KG) (cont.)												
Endosulfan II	1	64	2.6	2.05	11	11	410000	0	8400	0	2.518849574	SBP-SO-482A-0204-MAX
Endosulfan Sulfate	15	64	7.6	2.05	5.7 #	130 J	410000	0	8400	0	18.07120655	SBP-SO-745A-0608-MAX
Endrin	1	64	3.1	2.05	58	58	20000	0			6.992226409	SBP-SO-745A-0608-MAX
Endrin Aldehyde	8	64	3.2	2.075	3.8	14	20000	0			3.20735104	SBP-SO-353A-0406
Endrin Ketone	7	64	3.4	2.05	5.1	20	20000	0			3.74294235	SBP-SO-519A-0406
gamma-BHC	0	64	1.3	0	0	0	20000	0	40	0	0	None
gamma-Chlordane	9	64	8.1	1.05	0.88 J	230 J	490	0	66	3	32.93254664	SBP-SO-745A-0608-MAX
Heptachlor	2	64	1.3	1.05	2.7	3.5	140	0	13	0	1.243837737	SBP-SO-482A-0204-MAX
Heptachlor Epoxide	4	64	1.5	1.05	2.7	8.2	67	0	20	0	1.56060679	SBP-SO-506A-0810
Methoxychlor	7	64	14	10.5	18 J	62 J	340000	0	8000	0	10.1924804	SBP-SO-622A-0406
Toxaphene	0	64	130	0	0	0	560	0	600	0	0	None
PCB (SPLP) (UG/L)												
Aroclor, Total (4)	0	13	1.6	0	0	0			5	0	0	None
Aroclor, Total (Conservative) (5)	0	13	1.6	0	0	0			5	0	0	None
Aroclor-1016	0	13	1.6	0	0	0					0	None
Aroclor-1221	0	13	1.6	0	0	0					0	None
Aroclor-1232	0	13	1.6	0	0	0					0	None
Aroclor-1242	0	13	1.6	0	0	0					0	None
Aroclor-1248	0	13	1.6	0	0	0					0	None
Aroclor-1254	0	13	1.6	0	0	0					0	None
Aroclor-1260	0	13	1.6	0	0	0					0	None
Aroclor-1262	0	13	1.6	0	0	0					0	None
Aroclor-1268	0	13	1.6	0	0	0					0	None

TABLE 4-5 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
SHORT BEACH PARK - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Qualifier	Definition
#	Possible false positive due to interference
*	From dilution analysis or Estimated Maximum Possible Concentration (Dioxins only)
*	Type of asbestos detected was chrysotile (Asbestos only)
EB	Equipment blank contamination
J	Quantitation approximate

Notes:

(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation. Trace amounts of asbestos are reported on this table as 0.9%.

(2) CT DEC - Direct Exposure Criteria for Residential Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.

(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

TABLE 4-6
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Asbestos (%) (1)												
Asbestos	6	7	7	5	0.9 *	21 *	1	4			7.533630947	SBP-SO-774-0002
Metals (mg/kg)												
Aluminum	2	2	5640	5635	4580 J	6690 J					1491.995308	SBP-SO-532A-0002
Antimony	0	2	0.32	0	0	0	8200	0			0	None
Arsenic	0	2	0.52	0	0	0	10	0			0	None
Barium	2	2	87.5	87.5	67	108	140000	0			28.99137803	SBP-SO-528A-0002
Beryllium	2	2	0.56	0.555	0.44	0.67	2	0			0.16263456	SBP-SO-528A-0002
Cadmium	0	2	0.022	0	0	0	1000	0			0	None
Calcium	2	2	4300	4295	4030 J	4560 J					374.766594	SBP-SO-532A-0002
Chromium	2	2	9.4	9.4	8.4 J	10.4 J	100	0			1.414213562	SBP-SO-528A-0002
Cobalt	2	2	6.2	6.25	5.5	7	2500	0			1.060660172	SBP-SO-532A-0002
Copper	17	51	251	75	27.2 J	4650	76000	0			683.4363196	SBP-SO-774-0002
Iron	2	2	12800	12850	10200	15500					3747.66594	SBP-SO-532A-0002
Lead	39	52	181	73.5	13.3 J	2420	1000	2			395.1638448	SBP-SO-774-0002
Magnesium	2	2	3160	3155	2720 J	3590 J					615.1828996	SBP-SO-532A-0002
Manganese	2	2	452	452	442 J	462 J	47000	0			14.14213562	SBP-SO-532A-0002
Mercury	0	2	0.026	0	0	0	610	0			0	None
Nickel	2	2	9.7	9.7	8.6	10.8	7500	0			1.555634919	SBP-SO-528A-0002
Potassium	2	2	1060	1060	1010	1110					70.71067812	SBP-SO-528A-0002
Selenium	1	2	0.37	0.3725	0.52 J	0.52 J	10000	0			0.2085965	SBP-SO-532A-0002
Silver	0	2	0.11	0	0	0	10000	0			0	None
Sodium	0	2	89.3	0	0	0					0	None
Thallium	0	2	0.37	0	0	0	160	0			0	None
Vanadium	2	2	24.7	24.7	16.8	32.6	14000	0			11.17228714	SBP-SO-532A-0002
Zinc	2	2	34.4	34.35	34 J	34.7 J	610000	0			0.494974747	SBP-SO-532A-0002
Semivolatile Organic Compounds (UG/KG)												
1,1'-Biphenyl	0	2	14	0	0	0					0	None
2,2'-oxybis(1-Chloropropane)	0	2	190	0	0	0					0	None
2,4,5-Trichlorophenol	0	2	470	0	0	0					0	None
2,4,6-Trichlorophenol	0	2	190	0	0	0					0	None
2,4-Dichlorophenol	0	2	190	0	0	0					0	None
2,4-Dimethylphenol	0	2	190	0	0	0	2500000	0	28000	0	0	None
2,4-Dinitrophenol	0	2	470	0	0	0					0	None

TABLE 4-6 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
2,4-Dinitrotoluene	0	2	190	0	0	0					0	None
2,6-Dinitrotoluene	0	2	190	0	0	0					0	None
2-Chloronaphthalene	0	2	190	0	0	0					0	None
2-Chlorophenol	0	2	190	0	0	0					0	None
2-Methylnaphthalene	0	2	14	0	0	0	2500000	0	9800	0	0	None
2-Methylphenol	0	2	190	0	0	0	2500000	0	70000	0	0	None
2-Nitroaniline	0	2	470	0	0	0					0	None
2-Nitrophenol	0	2	190	0	0	0					0	None
3,3'-Dichlorobenzidine	0	2	190	0	0	0	13000	0	330	0	0	None
3-Nitroaniline	0	2	470	0	0	0					0	None
4,6-Dinitro-2-methylphenol	0	2	470	0	0	0					0	None
4-Bromophenyl-phenylether	0	2	190	0	0	0	1000000	0	82000	0	0	None
4-Chloro-3-methylphenol	0	2	190	0	0	0					0	None
4-Chloroaniline	0	2	190	0	0	0	2500000	0	5600	0	0	None
4-Chlorophenyl-phenylether	0	2	190	0	0	0					0	None
4-Methylphenol	0	2	190	0	0	0	2500000	0	7000	0	0	None
4-Nitroaniline	0	2	470	0	0	0	2500000	0	4200	0	0	None
4-Nitrophenol	0	2	470	0	0	0	2500000	0	11000	0	0	None
Acenaphthene	0	2	14	0	0	0	2500000	0	84000	0	0	None
Acenaphthylene	1	2	22	22	30	30	2500000	0	84000	0	11.3137085	SBP-SO-528A-0002
Acetophenone	0	2	190	0	0	0					0	None
Anthracene	0	2	14	0	0	0	2500000	0	400000	0	0	None
Atrazine	0	2	190	0	0	0					0	None
Benzaldehyde	0	2	190	0	0	0					0	None
Benzo(a)anthracene	2	2	220	215.5	91 J	340	7800	0	1000	0	176.0695885	SBP-SO-528A-0002
Benzo(a)pyrene	2	2	200	200	100 J	300	1000	0	1000	0	141.4213562	SBP-SO-528A-0002
Benzo(b)fluoranthene	2	2	340	340	110 J	570	7800	0	1000	0	325.2691193	SBP-SO-528A-0002
Benzo(g,h,i)perylene	2	2	150	152.5	45 J	260	2500000	0	42000	0	152.027958	SBP-SO-528A-0002
Benzo(k)fluoranthene	2	2	130	134	48 J	220	78000	0	1000	0	121.6223664	SBP-SO-528A-0002
Bis(2-Chloroethoxy)methane	0	2	190	0	0	0					0	None
Bis(2-Chloroethyl)ether	0	2	190	0	0	0					0	None
bis(2-Ethylhexyl)phthalate	1	2	180	180	170 JEB	170 JEB	410000	0	11000	0	14.14213562	SBP-SO-532A-0002
Butylbenzylphthalate	0	2	190	0	0	0	2500000	0	200000	0	0	None

TABLE 4-6 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
Caprolactam	0	2	190	0	0	0					0	None
Carbazole	0	2	190	0	0	0	290000	0	360	0	0	None
Chrysene	2	2	280	279.5	99 J	460	780000	0	1000	0	255.265548	SBP-SO-528A-0002
Dibenzo(a,h)anthracene	1	2	40	40.5	67	67	780	0	1000	0	37.4766594	SBP-SO-528A-0002
Dibenzofuran	0	2	14	0	0	0	2500000	0	5600	0	0	None
Diethylphthalate	0	2	190	0	0	0	2500000	0	1100000	0	0	None
Dimethylphthalate	0	2	190	0	0	0	2500000	0	1100000	0	0	None
Di-n-Butylphthalate	0	2	190	0	0	0	2500000	0	140000	0	0	None
Di-n-octylphthalate	0	2	190	0	0	0	2500000	0	20000	0	0	None
Fluoranthene	2	2	360	365	170 J	560	2500000	0	56000	0	275.7716447	SBP-SO-528A-0002
Fluorene	0	2	14	0	0	0	2500000	0	56000	0	0	None
Hexachlorobenzene	0	2	190	0	0	0	3600	0	1000	0	0	None
Hexachlorobutadiene	0	2	190	0	0	0					0	None
Hexachlorocyclopentadiene	0	2	190	0	0	0					0	None
Hexachloroethane	0	2	190	0	0	0					0	None
Indeno(1,2,3-cd)pyrene	2	2	140	145	60 J	230 J	7800	0	1000	0	120.2081528	SBP-SO-528A-0002
Isophorone	0	2	190	0	0	0					0	None
Naphthalene	0	2	14	0	0	0	2500000	0	56000	0	0	None
Nitrobenzene	0	2	190	0	0	0					0	None
N-Nitroso-di-n-propylamine	0	2	190	0	0	0	820	0	1000	0	0	None
N-Nitroso-diphenylamine	0	2	190	0	0	0	1200000	0	1400	0	0	None
Pentachlorophenol	0	2	470	0	0	0	48000	0	1000	0	0	None
Phenanthrene	2	2	120	118.5	77 J	160	2500000	0	40000	0	58.68986284	SBP-SO-528A-0002
Phenol	0	2	190	0	0	0	2500000	0	800000	0	0	None
Pyrene	2	2	380	375	170 J	580	2500000	0	40000	0	289.9137803	SBP-SO-528A-0002
Volatile Organic Compounds (UG/KG)												
1,1,1-Trichloroethane	0	2	6	0	0	0	1000000	0	40000	0	0	None
1,1,2,2-Tetrachloroethane	0	2	6	0	0	0	29000	0	100	0	0	None
1,1,2-Trichloro-1,2,2-trifluoroethane	0	2	6	0	0	0					0	None
1,1,2-Trichloroethane	0	2	6	0	0	0	100000	0	1000	0	0	None
1,1-Dichloroethane	0	2	6	0	0	0	1000000	0	14000	0	0	None
1,1-Dichloroethene	0	2	6	0	0	0	9500	0	1400	0	0	None

TABLE 4-6 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
1,2,4-Trichlorobenzene	0	2	6	0	0	0	2500000	0	14000	0	0	None
1,2-Dibromo-3-chloropropane	0	2	6	0	0	0					0	None
1,2-Dibromoethane	0	2	6	0	0	0					0	None
1,2-Dichlorobenzene	0	2	6	0	0	0	1000000	0	3100	0	0	None
1,2-Dichloroethane	0	2	6	0	0	0	63000	0	200	0	0	None
1,2-Dichloropropane	0	2	6	0	0	0					0	None
1,3-Dichlorobenzene	0	2	6	0	0	0					0	None
1,4-Dichlorobenzene	0	2	6	0	0	0	240000	0	15000	0	0	None
2-Butanone	0	2	6	0	0	0	1000000	0	80000	0	0	None
2-Hexanone	0	2	6	0	0	0	1000000	0	56000	0	0	None
4-Methyl-2-Pentanone	0	2	6	0	0	0	1000000	0	14000	0	0	None
Acetone	1	2	4	4	3 J	3 J	1000000	0	140000	0	1.414213562	SBP-SO-532A-0002
Benzene	0	2	6	0	0	0	200000	0	200	0	0	None
Bromodichloromethane	0	2	6	0	0	0	92000	0	110	0	0	None
Bromoform	0	2	6	0	0	0	720000	0	800	0	0	None
Bromomethane	0	2	6	0	0	0					0	None
Carbon Disulfide	0	2	6	0	0	0	1000000	0	140000	0	0	None
Carbon Tetrachloride	0	2	6	0	0	0					0	None
Chlorobenzene	0	2	6	0	0	0	1000000	0	20000	0	0	None
Chloroethane	0	2	6	0	0	0	1000000	0	2400	0	0	None
Chloroform	0	2	6	0	0	0	940000	0	1200	0	0	None
Chloromethane	0	2	6	0	0	0	440000	0	540	0	0	None
cis-1,2-Dichloroethene	0	2	6	0	0	0					0	None
cis-1,3-Dichloropropene	0	2	6	0	0	0					0	None
Cyclohexane	0	2	6	0	0	0					0	None
Dibromochloromethane	0	2	6	0	0	0					0	None
Dichlorodifluoromethane	0	2	6	0	0	0					0	None
Ethylbenzene	0	2	6	0	0	0	1000000	0	10100	0	0	None
Isopropylbenzene	0	2	6	0	0	0					0	None
Methyl Acetate	0	2	6	0	0	0					0	None
Methyl tert-Butyl Ether	0	2	6	0	0	0					0	None
Methylcyclohexane	0	2	6	0	0	0					0	None
Methylene Chloride	0	2	6	0	0	0	760000	0	1000	0	0	None

TABLE 4-6 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
Styrene	0	2	6	0	0	0	1000000	0	20000	0	0	None
Tetrachloroethene	0	2	6	0	0	0	110000	0	1000	0	0	None
Toluene	0	2	6	0	0	0	1000000	0	67000	0	0	None
Total Xylenes	0	2	6	0	0	0	1000000	0	19500	0	0	None
trans-1,2-Dichloroethene	0	2	6	0	0	0					0	None
trans-1,3-Dichloropropene	0	2	6	0	0	0					0	None
Trichloroethene	0	2	6	0	0	0	520000	0	1000	0	0	None
Trichlorofluoromethane	0	2	6	0	0	0					0	None
Vinyl Chloride	0	2	6	0	0	0	3000	0	400	0	0	None
Pesticide/PCB (UG/KG)												
4,4'-DDD	0	2	1.9	0	0	0	24000	0	29	0	0	None
4,4'-DDE	0	2	1.9	0	0	0	17000	0	21	0	0	None
4,4'-DDT	0	2	1.9	0	0	0	17000	0	21	0	0	None
Aldrin	0	2	0.98	0	0	0	340	0	0.41	0	0	None
alpha-BHC	0	2	0.98	0	0	0	910	0	1.1	0	0	None
alpha-Chlordane	0	2	0.98	0	0	0	2200	0	66	0	0	None
Aroclor, Total (4)	3	7	5300	500	4000	22900	10000	1			8475.250757	SBP-SO-774-0002
Aroclor, Total (Conservative) (5)	3	7	5800	500	4250	24400	10000	2			9139.08211	SBP-SO-774-0002
Aroclor-1016	0	4	120	0	0	0	10000	0			0	None
Aroclor-1221	0	4	130	0	0	0	10000	0			0	None
Aroclor-1232	0	4	120	0	0	0	10000	0			0	None
Aroclor-1242	0	4	120	0	0	0	10000	0			0	None
Aroclor-1248	0	4	120	0	0	0	10000	0			0	None
Aroclor-1254	0	5	120	0	0	0	10000	0			0	None
Aroclor-1260	0	5	120	0	0	0	10000	0			0	None
Aroclor-1262	2	6	3800	375	7000	15000	10000	1			6128.102108	SBP-SO-774-0002
Aroclor-1268	3	7	2100	500	2200	7900	10000	0			2941.107527	SBP-SO-774-0002
beta-BHC	0	2	0.98	0	0	0	3200	0	3.9	0	0	None
delta-BHC	0	2	0.98	0	0	0	910	0	1.1	0	0	None
Dieldrin	0	2	1.9	0	0	0	360	0	7	0	0	None
Endosulfan I	0	2	0.98	0	0	0	1200000	0	8400	0	0	None
Endosulfan II	0	2	1.9	0	0	0	1200000	0	8400	0	0	None
Endosulfan Sulfate	0	2	1.9	0	0	0	1200000	0	8400	0	0	None

TABLE 4-6 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE - 0 - 2 FEET BGS (SURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Pesticide/PCB (UG/KG)												
Endrin	0	2	1.9	0	0	0	610000	0			0	None
Endrin Aldehyde	0	2	1.9	0	0	0	610000	0			0	None
Endrin Ketone	0	2	1.9	0	0	0	610000	0			0	None
gamma-BHC	0	2	0.98	0	0	0	610000	0	40	0	0	None
gamma-Chlordane	0	2	0.98	0	0	0	2200	0	66	0	0	None
Heptachlor	0	2	0.98	0	0	0	1300	0	13	0	0	None
Heptachlor Epoxide	0	2	0.98	0	0	0	630	0	20	0	0	None
Methoxychlor	0	2	9.8	0	0	0	10000000	0	8000	0	0	None
Toxaphene	0	2	98	0	0	0	5200	0	600	0	0	None

Qualifier	Definition
#	Possible false positive due to interference
* , &	From dilution analysis
*	Type of asbestos detected was chrysotile (Asbestos only)
EB	Equipment blank contamination
J	Quantitation approximate

Notes:

(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation. Trace amounts of asbestos are reported on this table as 0.9%.
(2) CT DEC - Direct Exposure Criteria for Commercial/Industrial Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.
(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.
(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.
(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

TABLE 4-7
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Asbestos (%) (1)												
Asbestos	53	55	11	4	0.9 *	48 *	1	39			12.71213245	SBP-SO-528A-0204
Dioxins (UG/KG)												
1,2,3,4,6,7,8-HpCDD	2	2	0.14	0.135	0.123	0.147					0.016970563	SBP-SO-532A-0204
1,2,3,4,6,7,8-HpCDF	2	2	1.5	1.52	1.2	1.84					0.45254834	SBP-SO-532A-0204
1,2,3,4,7,8,9-HpCDF	2	2	0.16	0.1619	0.0238	0.3					0.195302893	SBP-SO-528A-0204
1,2,3,4,7,8-HxCDD	1	2	0.0028	0.002825	0.0036 J	0.0036 J					0.001096016	SBP-SO-532A-0204
1,2,3,4,7,8-HxCDF	2	2	1.1	1.0955	0.561	1.63					0.755897149	SBP-SO-532A-0204
1,2,3,6,7,8-HxCDD	0	2	0.0052	0	0	0					0	None
1,2,3,6,7,8-HxCDF	2	2	0.33	0.33	0.206	0.454					0.175362482	SBP-SO-532A-0204
1,2,3,7,8,9-HxCDD	1	2	0.0092	0.00915	0.0163	0.0163					0.010111627	SBP-SO-532A-0204
1,2,3,7,8,9-HxCDF	2	2	0.042	0.0424	0.0018 J	0.083					0.057417071	SBP-SO-528A-0204
1,2,3,7,8-PeCDD	1	2	0.0021	0.0021	0.0029 J	0.0029 J					0.001131371	SBP-SO-532A-0204
1,2,3,7,8-PeCDF	1	2	0.17	0.1675	0.146	0.146					0.030405592	SBP-SO-528A-0204
2,3,4,6,7,8-HxCDF	2	2	0.49	0.4945	0.183	0.806					0.440527525	SBP-SO-532A-0204
2,3,4,7,8-PeCDF	2	2	0.92	0.9185	0.327	1.51					0.836507322	SBP-SO-532A-0204
2,3,7,8-TCDD	2	2	0.0021	0.0021	0.0014	0.0028					0.000989949	SBP-SO-528A-0204
2,3,7,8-TCDF	2	2	0.66	0.655	0.353 #	0.957 &					0.427092496	SBP-SO-532A-0204
OCDD	2	2	2.1	2.06	0.47	3.65 &					2.248599564	SBP-SO-532A-0204
OCDF	2	2	0.17	0.167	0.108	0.226					0.0834386	SBP-SO-528A-0204
Total HpCDD	2	2	0.26	0.2625	0.212 J	0.313 J					0.071417785	SBP-SO-532A-0204
Total HpCDF	2	2	1.9	1.935	1.84 J	2.03 J					0.134350288	SBP-SO-532A-0204
Total HxCDD	0	2	0.053	0	0	0					0	None
Total HxCDF	1	2	3.3	3.28	5.5 &J	5.5 &J					3.139554108	SBP-SO-532A-0204
Total PeCDD	0	2	0.029	0	0	0					0	None
Total PeCDF	0	2	1.6	0	0	0					0	None
Total TCDD	0	2	0.01	0	0	0					0	None
Total TCDF	0	2	1.1	0	0	0					0	None
Toxicity Equivalency	2	2	0.76	0.765	0.33 J	1.2 J					0.6151829	SBP-SO-532A-0204
Metals (MG/KG)												
Aluminum	5	5	9650	8920	5960	13900 J					3259.079625	SBP-SO-532A-0406
Antimony	0	5	0.34	0	0	0	8200	0			0	None
Arsenic	5	5	8	7.4	4.9	14.5	10	1			3.894483278	SBP-SO-528A-0608
Barium	5	5	1530	765	59.9	4970	140000	0			2038.859439	SBP-SO-528A-0204
Beryllium	2	5	0.16	0.16	0.16	0.25 J	2	0			0.06164414	SBP-SO-528A-0204
Cadmium	3	5	0.48	0.24	0.24	1.3	1000	0			0.562389834	SBP-SO-532A-0406

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Metals (MG/KG) (cont.)												
Calcium	5	5	3070	3510	1720	4330 J					1186.241965	SBP-SO-528A-0406
Chromium	5	5	45.8	36.4	16.3	102 J	100	1			34.98864101	SBP-SO-528A-0204
Cobalt	5	5	11.6	13	6.6	17.6	2500	0			4.727790181	SBP-SO-528A-0204
Copper	83	167	693	75	26.3 J	25700	76000	0			2362.655598	SL-SO-TP02-1.92.6
Iron	5	5	26200	17300	16300	58600					18253.57499	SBP-SO-528A-0608
Lead	157	167	745	148	17.2 J	28700	1000	18			2724.621077	SL-SO-TP04-0203
Magnesium	5	5	11300	5230	4920 J	32100					11747.87555	SBP-SO-528A-0204
Manganese	5	5	330	293	288 J	451 J	47000	0			69.45358162	SBP-SO-528A-0608
Mercury	2	5	0.075	0.0335	0.096 J	0.19 J	610	0			0.070703253	SBP-SO-532A-0406
Nickel	5	5	88.2	31	18.7	277 J	7500	0			109.695875	SBP-SO-528A-0204
Potassium	5	5	1350	1240	761	1790					427.0529241	SBP-SO-532A-0204
Selenium	4	5	0.98	0.7	0.48 J	1.9 J	10000	0			0.562920954	SBP-SO-528A-0608
Silver	2	4	2.8	1.5	2.3	8	10000	0			3.612417242	SBP-SO-532A-0406
Sodium	2	5	117	101	101	236					87.23237358	SBP-SO-532A-0204
Thallium	0	5	0.34	0	0	0	160	0			0	None
Vanadium	5	5	25.7	24.7	19.7	32.3	14000	0			5.095390073	SBP-SO-532A-0204
Zinc	5	5	532	461	42.1 J	1360 J	610000	0			503.034792	SBP-SO-528A-0204
Metals/SPLP (UG/L)												
Antimony	0	2	1	0	0	0			60	0	0	None
Arsenic	1	2	1.7	1.7	2.4 J	2.4 J			500	0	0.989949494	SBP-SO-532A-0204
Barium	2	2	77.3	77.3	60.1	94.5			10000	0	24.32447327	SBP-SO-528A-0204
Beryllium	1	2	0.16	0.165	0.23 J	0.23 J			40	0	0.091923882	SBP-SO-532A-0204
Cadmium	0	2	0.1	0	0	0			50	0	0	None
Chromium	1	2	2.8	2.75	5.3	5.3			500	0	3.606244584	SBP-SO-532A-0204
Copper	2	2	520	520.5	248	793			13000	0	385.3731957	SBP-SO-528A-0204
Lead	2	2	264	263.5	231	296			150	2	45.96194078	SBP-SO-528A-0204
Mercury	0	2	0.07	0	0	0			20	0	0	None
Nickel	2	2	7.6	7.6	6.5	8.7			1000	0	1.555634919	SBP-SO-532A-0204
Selenium	0	2	1	0	0	0			500	0	0	None
Silver	0	2	0.15	0	0	0			360	0	0	None
Thallium	0	2	1	0	0	0			50	0	0	None
Vanadium	1	2	3.5	3.5475	6.6	6.6			500	0	4.316886899	SBP-SO-532A-0204
Zinc	2	2	108	108.05	57.1	159			50000	0	72.054181	SBP-SO-532A-0204

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG)												
1,1'-Biphenyl	4	5	300	150	46	970					392.8182786	SBP-SO-528A-0204
2,2'-oxybis(1-Chloropropane)	0	5	220	0	0	0					0	None
2,4,5-Trichlorophenol	0	5	540	0	0	0					0	None
2,4,6-Trichlorophenol	0	5	220	0	0	0					0	None
2,4-Dichlorophenol	0	5	220	0	0	0					0	None
2,4-Dimethylphenol	1	5	250	220	380 J	380 J	2500000	0	28000	0	72.93833012	SBP-SO-532A-0204
2,4-Dinitrophenol	0	5	540	0	0	0					0	None
2,4-Dinitrotoluene	0	5	220	0	0	0					0	None
2,6-Dinitrotoluene	0	5	220	0	0	0					0	None
2-Chloronaphthalene	0	5	220	0	0	0					0	None
2-Chlorophenol	0	5	220	0	0	0					0	None
2-Methylnaphthalene	5	5	720	650	430	1000	2500000	0	9800	0	267.3013281	SBP-SO-528A-0608, SBP-SO-532A-0406
2-Methylphenol	2	5	260	200	73 J	600	2500000	0	70000	0	198.8310841	SBP-SO-528A-0204
2-Nitroaniline	0	5	540	0	0	0					0	None
2-Nitrophenol	0	5	220	0	0	0					0	None
3,3'-Dichlorobenzidine	0	5	220	0	0	0	13000	0	330	0	0	None
3-Nitroaniline	0	5	540	0	0	0					0	None
4,6-Dinitro-2-methylphenol	0	5	540	0	0	0					0	None
4-Bromophenyl-phenylether	0	5	220	0	0	0	1000000	0	82000	0	0	None
4-Chloro-3-methylphenol	0	5	220	0	0	0					0	None
4-Chloroaniline	0	5	220	0	0	0	2500000	0	5600	0	0	None
4-Chlorophenyl-phenylether	0	5	220	0	0	0					0	None
4-Methylphenol	4	5	340	200	78 J	900	2500000	0	7000	0	324.7472864	SBP-SO-528A-0204
4-Nitroaniline	0	5	540	0	0	0	2500000	0	4200	0	0	None
4-Nitrophenol	0	5	540	0	0	0	2500000	0	11000	0	0	None
Acenaphthene	5	5	890	890	370	1400	2500000	0	84000	0	419.7975703	SBP-SO-532A-0406
Acenaphthylene	5	5	910	810	260	2200	2500000	0	84000	0	786.8799146	SBP-SO-532A-0204
Acetophenone	0	5	220	0	0	0					0	None
Anthracene	5	5	1400	1700	400	2700 *	2500000	0	400000	0	952.1974585	SBP-SO-532A-0204
Atrazine	0	5	220	0	0	0					0	None
Benzaldehyde	3	5	390	370	370 JEB	580 JEB					182.9480801	SBP-SO-532A-0204
Benzo(a)anthracene	5	5	2700	2200	850	7100 *	7800	0	1000	3	2569.498005	SBP-SO-532A-0204
Benzo(a)pyrene	5	5	2200	1600	770	5800 *	1000	3	1000	3	2079.093552	SBP-SO-532A-0204

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Semivolatile Organic Compounds (UG/KG) (cont.)												
Benzo(b)fluoranthene	5	5	3000	2300	930	7800 *	7800	0	1000	4	2803.33373	SBP-SO-532A-0204
Benzo(g,h,i)perylene	5	5	820	880	240	1500	2500000	0	42000	0	480.7078115	SBP-SO-528A-0204
Benzo(k)fluoranthene	5	5	1600	1100	340	2900	78000	0	1000	3	1194.185915	SBP-SO-528A-0204
Bis(2-Chloroethoxy)methane	0	5	220	0	0	0					0	None
Bis(2-Chloroethyl)ether	0	5	220	0	0	0					0	None
bis(2-Ethylhexyl)phthalate	4	5	21000	2200	290 JEB	100000 *EB	410000	0	11000	1	44058.67134	SBP-SO-532A-0406
Butylbenzylphthalate	0	5	220	0	0	0	2500000	0	200000	0	0	None
Caprolactam	0	5	220	0	0	0					0	None
Carbazole	5	5	620	460	78 J	1600	290000	0	360	3	598.7827653	SBP-SO-532A-0204
Chrysene	5	5	3100	2400	930	7600 *	780000	0	1000	3	2739.430598	SBP-SO-532A-0204
Dibenzo(a,h)anthracene	5	5	380	220	120	1100	780	1	1000	1	410.9987835	SBP-SO-532A-0204
Dibenzofuran	5	5	790	870	270	1100	2500000	0	5600	0	324.7614509	SBP-SO-528A-0608
Diethylphthalate	0	5	220	0	0	0	2500000	0	1100000	0	0	None
Dimethylphthalate	0	5	220	0	0	0	2500000	0	1100000	0	0	None
Di-n-Butylphthalate	2	5	170	200	50 J	170 J	2500000	0	140000	0	71.20393248	SBP-SO-532A-0406
Di-n-octylphthalate	0	5	220	0	0	0	2500000	0	20000	0	0	None
Fluoranthene	5	5	6400	5700	2200	16000 *	2500000	0	56000	0	5657.119408	SBP-SO-532A-0204
Fluorene	5	5	1700	2100	530	2400	2500000	0	56000	0	809.802445	SBP-SO-532A-0204
Hexachlorobenzene	0	5	220	0	0	0	3600	0	1000	0	0	None
Hexachlorobutadiene	0	5	220	0	0	0					0	None
Hexachlorocyclopentadiene	0	5	220	0	0	0					0	None
Hexachloroethane	0	5	220	0	0	0					0	None
Indeno(1,2,3-cd)pyrene	5	5	1300	790	380	3600 *	7800	0	1000	2	1337.29204	SBP-SO-532A-0204
Isophorone	0	5	220	0	0	0					0	None
Naphthalene	5	5	530	600	160	840	2500000	0	56000	0	280.1428207	SBP-SO-528A-0204
Nitrobenzene	0	5	220	0	0	0					0	None
N-Nitroso-di-n-propylamine	0	5	220	0	0	0	820	0	1000	0	0	None
N-Nitroso-diphenylamine	2	5	240	220	220 J	330 J	1200000	0	1400	0	52.15361924	SBP-SO-532A-0204
Pentachlorophenol	0	5	540	0	0	0	48000	0	1000	0	0	None
Phenanthrene	5	5	7500	8300	1900	16000 *	2500000	0	40000	0	5749.347789	SBP-SO-532A-0204
Phenol	4	5	710	370	62 JEB	1900	2500000	0	800000	0	757.5848467	SBP-SO-528A-0204
Pyrene	5	5	6200	4900	1500	17000 *	2500000	0	40000	0	6295.792246	SBP-SO-532A-0204

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG)												
1,1,1-Trichloroethane	0	5	8	0	0	0	1000000	0	40000	0	0	None
1,1,2,2-Tetrachloroethane	0	5	8	0	0	0	29000	0	100	0	0	None
1,1,2-Trichloro-1,2,2-trifluoroethane	0	5	8	0	0	0					0	None
1,1,2-Trichloroethane	0	5	8	0	0	0	100000	0	1000	0	0	None
1,1-Dichloroethane	0	5	8	0	0	0	1000000	0	14000	0	0	None
1,1-Dichloroethene	0	5	8	0	0	0	9500	0	1400	0	0	None
1,2,4-Trichlorobenzene	0	5	8	0	0	0	2500000	0	14000	0	0	None
1,2-Dibromo-3-chloropropane	0	5	8	0	0	0					0	None
1,2-Dibromoethane	0	5	8	0	0	0					0	None
1,2-Dichlorobenzene	1	5	7	7	2 J	2 J	1000000	0	3100	0	4.522167622	SBP-SO-532A-0406
1,2-Dichloroethane	0	5	8	0	0	0	63000	0	200	0	0	None
1,2-Dichloropropane	0	5	8	0	0	0					0	None
1,3-Dichlorobenzene	0	5	8	0	0	0					0	None
1,4-Dichlorobenzene	2	5	6	6	2 J	6 J	240000	0	15000	0	4.159326869	SBP-SO-532A-0406
2-Butanone	4	5	9	9	3 J	13 J	1000000	0	80000	0	4.38178046	SBP-SO-532A-0406
2-Hexanone	0	5	8	0	0	0	1000000	0	56000	0	0	None
4-Methyl-2-Pentanone	0	5	8	0	0	0	1000000	0	14000	0	0	None
Acetone	2	5	20	16	19 J	40	1000000	0	140000	0	11.51086443	SBP-SO-532A-0406
Benzene	1	5	6	7	3 J	3 J	200000	0	200	0	3.041381265	SBP-SO-528A-0204
Bromodichloromethane	0	5	8	0	0	0	92000	0	110	0	0	None
Bromoform	0	5	8	0	0	0	720000	0	800	0	0	None
Bromomethane	0	5	8	0	0	0					0	None
Carbon Disulfide	2	5	6	7	5 J	8 J	1000000	0	140000	0	1.816590212	SBP-SO-528A-0608
Carbon Tetrachloride	0	5	8	0	0	0					0	None
Chlorobenzene	4	5	18	7	5 J	41 J	1000000	0	20000	0	16.64932431	SBP-SO-532A-0204
Chloroethane	0	5	8	0	0	0	1000000	0	2400	0	0	None
Chloroform	0	5	8	0	0	0	940000	0	1200	0	0	None
Chloromethane	0	5	8	0	0	0	440000	0	540	0	0	None
cis-1,2-Dichloroethene	0	5	8	0	0	0					0	None
cis-1,3-Dichloropropene	0	5	8	0	0	0					0	None
Cyclohexane	0	5	8	0	0	0					0	None
Dibromochloromethane	0	5	8	0	0	0					0	None
Dichlorodifluoromethane	0	5	8	0	0	0					0	None
Ethylbenzene	2	5	12	8	2 J	35	1000000	0	10100	0	12.95183385	SBP-SO-528A-0204

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Volatile Organic Compounds (UG/KG) (cont.)												
Isopropylbenzene	4	5	4	3	2 J	8 J					2.880972058	SBP-SO-528A-0204
Methyl Acetate	0	5	8	0	0	0					0	None
Methyl tert-Butyl Ether	0	5	8	0	0	0					0	None
Methylcyclohexane	2	5	5	5	3 J	5 J					2.073644135	SBP-SO-528A-0204
Methylene Chloride	0	5	8	0	0	0	760000	0	1000	0	0	None
Styrene	0	5	8	0	0	0	1000000	0	20000	0	0	None
Tetrachloroethene	0	5	8	0	0	0	110000	0	1000	0	0	None
Toluene	2	5	12	7	3 J	38	1000000	0	67000	0	14.67991826	SBP-SO-528A-0204
Total Xylenes	3	5	47	10	10 J	190	1000000	0	19500	0	80.27951171	SBP-SO-528A-0204
trans-1,2-Dichloroethene	0	5	8	0	0	0					0	None
trans-1,3-Dichloropropene	0	5	8	0	0	0					0	None
Trichloroethene	0	5	8	0	0	0	520000	0	1000	0	0	None
Trichlorofluoromethane	0	5	8	0	0	0					0	None
Vinyl Chloride	0	5	8	0	0	0	3000	0	400	0	0	None
Pesticide/PCB (UG/KG)												
4,4'-DDD	3	5	5.5	5.6	5.6 #	11 #	24000	0	29	0	3.631528604	SBP-SO-528A-0204
4,4'-DDE	4	5	5.8	4	3.8 J	9.8 J#	17000	0	21	0	3.583573635	SBP-SO-532A-0406
4,4'-DDT	2	5	33	2.4	17 #	140 *#	17000	0	21	1	60.33831287	SBP-SO-528A-0204
Aldrin	0	5	1.1	0	0	0	340	0	0.41	0	0	None
alpha-BHC	0	5	1.1	0	0	0	910	0	1.1	0	0	None
alpha-Chlordane	0	5	1.1	0	0	0	2200	0	66	0	0	None
Aroclor, Total (4)	18	46	5000	500	61	101000	10000	6			15439.68323	SL-SO-TP02-1.92.6
Aroclor, Total (Conservative) (5)	18	46	5000	500	225	101000	10000	6			15440.83293	SL-SO-TP02-1.92.6
Aroclor-1016	0	8	55	0	0	0	10000	0			0	None
Aroclor-1221	0	8	69	0	0	0	10000	0			0	None
Aroclor-1232	0	8	55	0	0	0	10000	0			0	None
Aroclor-1242	1	8	60	23	61	61	10000	0			67.51507768	SL-SO-304-0608
Aroclor-1248	0	8	55	0	0	0	10000	0			0	None
Aroclor-1254	1	8	140	22	700	700	10000	0			236.236328	SBP-SO-532A-0406
Aroclor-1260	0	8	55	0	0	0	10000	0			0	None
Aroclor-1262	15	46	3300	500	600	60000	10000	5			9327.6867	SL-SO-TP02-1.92.6
Aroclor-1268	16	46	2000	500	290	41000	10000	1			6096.850436	SL-SO-TP02-1.92.6
beta-BHC	0	5	1.1	0	0	0	3200	0	3.9	0	0	None
delta-BHC	0	5	1.1	0	0	0	910	0	1.1	0	0	None

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Median	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (2)	Number of Exceedances of CT DEC (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)	Standard Deviation	Location of Maximum Concentration
Pesticide/PCB (UG/KG) (cont.)												
Dieldrin	0	5	2.2	0	0	0	360	0	7	0	0	None
Endosulfan I	0	5	1.1	0	0	0	1200000	0	8400	0	0	None
Endosulfan II	0	5	2.2	0	0	0	1200000	0	8400	0	0	None
Endosulfan Sulfate	1	5	2.9	2.2	6 #	6 #	1200000	0	8400	0	1.729739865	SBP-SO-528A-0608
Endrin	0	5	2.2	0	0	0	610000	0			0	None
Endrin Aldehyde	2	5	54	2.4	5.2	260 *	610000	0			114.9863992	SBP-SO-528A-0204
Endrin Ketone	0	5	2.2	0	0	0	610000	0			0	None
gamma-BHC	0	5	1.1	0	0	0	610000	0	40	0	0	None
gamma-Chlordane	3	5	3.5	3.1	3.1 #	7.7	2200	0	66	0	2.794771905	SBP-SO-528A-0204
Heptachlor	0	5	1.1	0	0	0	1300	0	13	0	0	None
Heptachlor Epoxide	0	5	1.1	0	0	0	630	0	20	0	0	None
Methoxychlor	1	5	18	11.5	43	43	10000000	0	8000	0	14.22322045	SBP-SO-528A-0204
Toxaphene	0	5	110	0	0	0	5200	0	600	0	0	None
PCB (SPLP) (UG/L)												
Aroclor, Total (4)	0	2	1.6	0	0	0			5	0	0	None
Aroclor, Total (Conservative) (5)	0	2	1.6	0	0	0			5	0	0	None
Aroclor-1016	0	2	1.6	0	0	0					0	None
Aroclor-1221	0	2	1.6	0	0	0					0	None
Aroclor-1232	0	2	1.6	0	0	0					0	None
Aroclor-1242	0	2	1.6	0	0	0					0	None
Aroclor-1248	0	2	1.6	0	0	0					0	None
Aroclor-1254	0	2	1.6	0	0	0					0	None
Aroclor-1260	0	2	1.6	0	0	0					0	None
Aroclor-1262	0	2	1.6	0	0	0					0	None
Aroclor-1268	0	2	1.6	0	0	0					0	None

TABLE 4-7 (cont.)
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
STRATFORD LANDFILL - INSIDE ESTIMATED AREAS OF RAYMARK WASTE -GREATER THAN 2 FEET BGS (SUBSURFACE)
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Qualifier	Definition
#	Possible false positive due to interference
* , &	From dilution analysis
*	Type of asbestos detected was chrysotile (Asbestos only)
EB	Equipment Blank
J	Quantitation approximate

Notes:

(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation. Trace amounts of asbestos are reported on this table as 0.9%.
(2) CT DEC - Direct Exposure Criteria for Commercial/Industrial Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.
(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.
(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.
(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

TABLE 6-1
SUMMARY OF RECEPTOR RISKS AND HAZARDS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Property	Maximum Asbestos (1)	Lead (2)	Scenario/ Receptor	CR>1E-04 or HI>1	Total Cancer Risks (3)	Total Cancer Risks (4)	Major contributors to cancer risk above 1E-04 (individual cancer risk >1E-06)	Total Noncancer Hazard Index	Major contributors to noncancer Hazard Index (HI>1.0)
Stratford Landfill(5) 0 to 15 feet bgs	48%	1.4-2.7%	Commercial Worker	YES	1.3E-04	3.8E-04	PCBs, Dioxin TEQ, PAHs, Arsenic	3.5	PCBs
Stratford Landfill(6) Area #1 of Raymark Waste 0 to 15 feet bgs	30%	33-36%	Commercial Worker	YES	1.4E-04	NA	PCBs	9.5	PCBs
Stratford Landfill(6) Area #2 of Raymark Waste 0 to 15 feet bgs	24%	0.8-1.8%	Commercial Worker	NO	1.5E-05	NA	NA	1	NA
Stratford Landfill(6) Area #3 of Raymark Waste 0 to 15 feet bgs	48%	2.7-4.5%	Commercial Worker	YES	1.0E-04	3.5E-04	PCBs, Dioxin TEQ, PAHs, Arsenic	1.5	PCBs
Short Beach Park 0 to 2 feet bgs	32%	1.5%	Recreational Visitor	NO	1.2E-05	2.1E-05	NA	0.94	NA
Short Beach Park 0 feet bgs to water table	48%	4.1-6.2%	Commercial Worker/ Groundskeeper	NO	4.7E-05	6.6E-05	NA	1	NA
Short Beach Park 0 feet bgs to water table	48%	54.5%	Future Resident	YES	1.7E-04	2.4E-04	PCBs, Dioxin TEQ, PAHs, Arsenic, N-Nitroso-di-n-propylamine	10	PCBs

Notes:

(1) Maximum Detected Asbestos; asbestos-containing material is material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61) (EPA, 1990).
(2) Probability that blood lead levels exceed 10 ug/dL; EPA's goal is that no more than 5% of individuals will have blood lead concentrations above 10 ug/dL.
(3) Cancer risks estimated using the dioxin slope factor of 1.5E+5 (mg/kg/d)-1.
(4) Cancer risks estimated using the Draft Dioxin Reassessment recommended dioxin slope factor of 1E+6 $(mg/kg/d)^{-1}$.
(5) Samples meeting the definition of Raymark waste were found at varying depths throughout the landfill portion of the study area. For this reason, samples from the entire landfill were used in this evaluation.
(6) Samples collected from 0 to 15 feet bgs that met the definition of Raymark waste were found at only three distinct areas of the landfill portion of the study area. For this reason, samples from a small area of the landfill were used in this evaluation.

NA- Not Applicable
NE- Not evaluated due to insufficient data.

TABLE 7-1a
SPECIE LISTS - PLANTS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name
Algae, Green	[No scientific name]
Arrow-Leaved Tearthumb	*Polygonum sagittatum*
Arrowwood, Northern	*Viburnum recognitum*
Aspen, Bigtooth	*Populus grandidentata*
Autumn Olive	*Elaegnus umbellate*
Bayberry, Northern	*Myrica pennsylvanica*
Beach Clotbur	Xanthium echinatum
Birch, Gray	*Betula populifolia*
Bittersweet, Asiatic	*Celastrus orbiculatus*
Blackberry	*Rubus Allegheniensis*
Blue Vervain	*Verbena hastate*
Broomsedge	*Andropogon virginicus*
Burdock, Common	*Arctium minus*
Catalpa, Common	*Catalpa bignonioides*
Cherry, Black	*Prunus serotina*
Chickweed, Common	*Stellaria media*
Chicory	*Cichorium intybus*
Crabapple	*Pyrus sp.*
Cressleaf Groundsel (Ragwort)	*Senecio glabellus*
Crownvetch	*Coronilla varia*
Dandelion	*Taraxacum officinale*
Duckweed	*Lemna minor*
Elderberry	*Sambucus canadensis*
Elm, Slippery	*Ulmus rubra*
Fescue, Tall	*Festuca arundinacea*
Fesque, Red	*Festuca rubra*
Glasswort, Common	*Salicornia europaea*
Goldenrod, Lance-Leaved	*Euthamia graminifolia*
Goldenrod, Rough-Stemmed	*Solidago rugosa*
Goldenrod, Seaside	Solidago sempervirens
Goldenrods, Other	*Solidago spp.*
Grape Vine	*Vitis sp.*
Hedge Bindweed	*Convolvulus sepium*
Honeysuckle, Japanese	*Lonicera japonica*
Honeysuckle, Tartarian	*Lonicera tatarica*
Horseweed (Marestail)	*Conyza canadensis*
Japanese Knotweed	*Polygonum cuspidatum*
Joe-Pye Weed	*Eupatorium maculatum*

TABLE 7-1a (cont.)
SPECIES LISTS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name
Knapweed, Black	*Centaurea maculosa*
Locust, Black	*Robinia pseudoacacia*
Maple, Norway	*Acer platonoides*
Maple, Silver	Acer saccharunum
Maple, Sycamore	*Acer pseudoplatanus*
Marsh Elder	*Iva frutescens*
Meadowsweet	*Spirea latifolia*
Milkweed, Common	*Asclepias syriaca*
Morning Glory	*Convolvulus arvensis*
Mulberry, Red	*Morus rubra*
Mullein, Common	*Verbascum thapsus*
Multiflora Rose	*Rosa multiflora*
Mustard, Wild	*Brassica kaber*
Nightshade, Bittersweet	*Solanum dulcamura*
Oak, Northern Red	*Quercus rubra*
Pickerelweed	*Pontederiacordata*
Pine, Scotch	*Pinus sylvestris*
Pine, White	*Pinus strobes*
Plantain, Common	*Plantago sp.*
Poison Ivy	*Toxicodendron radicans*
Pokeweed	*Phytolacca Americana*
Purple Loosestrife	*Lythrum salicaria*
Quackgrass	*Agropyron repens*
Queen Anne's Lace	*Daucus carota*
Ragweed, Common	*Ambrosia artemiisifolia*
Red Cedar, Eastern	*Juniperus virginiana*
Red Maple	*Acer rubrum*
Reed, Canary Grass	*Phalaris arundinacea*
Reed, Common	*Phragmites australis*
Rugosa Rose/Beach Rose	*Rosa rugosa*
Rush, Common Three-square	*Scirpus americanus*
Salt Meadow Grass	*Spartina patens*
Saltwort	*Salsola kali*
Scirpus (Unidentified)	*Scirpus sp.*
Sea Lavender	*Limonium nashii*
Smooth Saltwater Cordgrass	*Spartina alterniflora*
Soft Rush	*Juncus effuses*

TABLE 7-1a (cont.)
SPECIES LISTS
REMEDIAL INVESTIGATION
RAYMARK OU9 - SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name
Steeplebush	*Spiraea tomentosa*
Sumac, Staghorn	*Rhus typhina*
Tansy	*Tanicetum vulgare*
Tree-Of-Heaven	Ailanthus altissima
Upland grasses	*Unidentified*
White Sweet Clover	*Melilotis alba*
Wild Carrot	Daucus carota
Willow	Salix sp.
Willow, Black	*Salix nigra*
Wirestem Muhly	*Muhlenbergia frondosa*
Wool-Grass	*Scirpus cyperinus*
Yarrow, Common	*Achillea millefolium*

TABLE 7-1b
SPECIES LIST – WILDLIFE
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name	Habitat Requirements[1]	Key Food Habits[1]	Important Functions[1]
Chipmunk, Eastern(O)	*Taniias striatus*	Tree or shrub cover. Edges or interiors of deciduous woodlands with abundant cover of undergrowth, old logs, stone walls. Semi-open brushlands with ample cover.	Many kinds of seeds, fruits, nuts, bulbs, insects, meat, and eggs. Feeds during daylight hours.	Home range is typically less than 91 m in diameter or 0.5 to 1 acre.
Cottontail, Eastern(O)	*Sylvilagus floridanus*	Open fields, fallow fields, open woodlands, thickets, swamps and marshes, suburban areas with adequate food and cover.	Crepusular and nocturnal feeder. Summer foods: tender parts of grasses and herbs. Winter foods: bark, twigs and buds of shrubs and young trees such as maple, birch, and oak.	Home range size ranges from ½ to 40 acres.
Coyote(O)	*Canis latrans*	Edges of second growth forest, open brushy fields. Open or semi-open country for hunting and secluded den sights.	Opportunistic feeders consuming mainly carrion, small live vertebrates, invertebrates, and vegetation.	Habitat range size may exceed an area 5 miles in diameter depending on food supply and time of year.
Deer, Whitetail(O)	*Odocorleus viginianus*	Forest edges, swamp borders, areas interspersed with fields and woodland openings. In winter (when snow exceeds 16") will "yard" in stands of conifers forming a central resting area with trails packed through snow.	Mainly crepuscular. Beer browse on a variety of woody deciduous plants and some coniferous growth, feeding on twigs and stripping young bark. Adaptable in its food habits.	Home range size is generally 2 to 3 square miles. Size depends on quality of the habitat. Home range is from 40 acres in excellent habitat to 300 acres in poor habitat.
Fox, Red(P)	*Vulpes vulpes*	Found in a variety of habitats. A mixture of forest and open areas is preferred. Edges used heavily.	Opportunistic feeders consuming animals ranging from insects to small mammals. Commonly takes birds, turtles, frogs, snakes and their eggs. Berries and fruits when available.	Home range size is less than 3 miles in diameter. Home range is shared by a male-female pair and seasonally by their pups.
Mole, Star-nosed(O)	*Condylura cristata*	Prefers low wet ground near bodies of water, swamps, wet meadows, occasionally wet spots in fields or low-lying woods.	Forages above ground at night. Aquatic insects, earthworms, isopods, crustaceans, slugs, snails, and occasionally small fish, small amounts of vegetation.	Home Range is assumed to be approximately 1 acre, commonly found on ground surface.
Mouse, White-footed(P)	*Peromyscus leucopus*	Brushy woodland clearing, pastures, streamside thickets, buildings, interiors and edges of forests.	Acorns, nuts, seeds, fruits, young plants, insects.	Home range from 0.16 to 0.54 acres.
Muskrat(P)	*Ondatra zibethicus*	Wetlands with dense emergent vegetation and stable water levels, ponds sluggish stream, drainage ditches.	Variety of aquatic plants especially cattails, clams, and small aquatic animals.	Home range is usually 200 yards.
Opossum, Virginia(P)	*Didelphis virginiana*	Common near human habitation where they are attracted to garbage. Dry to wet wooded areas.	Almost any animal or vegetable food such as Insects, worms, fruits, nuts, carrion and garbage.	Home range from 0.33 to 58 acres, not territorial.
Raccoon (O)	*Procyon lotor*	Wooded areas interrupted by fields and water courses. Commonly found in wetlands near human habitation.	Omnivorous and opportunistic. Animal matter is the major food in spring and early summer. Fruits and seeds are eaten in summer, fall, and winter. Crayfish, worms, insects, carrion, tender buds and shots, grass, and garbage are typical foods.	The home range is usually between 1 and 3 km in diameter. Size varies with individual, food availability, and weather.
Squirrel, Gray(O)	*Sciurus carolinensis*	Deciduous and mixed forests or woodlots, especially those with trees that produce mast.	Diurnal feeder. Consumes nuts, buds, seeds and grains, fungi, fruits, birds' eggs, inner bark of trees. Will eat insects and then pupae in spring and summer when preferred foods are scarce.	Home range size is 2 to 7 acres depending on food availability and weather.
Vole, Meadow(O)	*Microtus pennsylvanicus*	Fields, pastures, fresh and saltwater marshes and meadows with herbaceous vegetation and organic soils.	Eats mainly vegetable material and takes small amounts of meat when available.	Home range seldom exceeds 0.06 acres. May defend territory.
Woodchuck(O)	*Marmota monax*	Open land. Edges of woodlands, open cultivated land, pastures, meadows, open brushy hillsides.	Open land with succulent green vegetation such as greases clover, and herbs, occasionally eats small amounts of insects.	Home range is approximately 0.25 to 0.5 mile.

[1] - Sources: DeGraff and Rudis 1986; Martin, Zim, and Nelson, 1951; Redington, 1994; Audubon Society, 1983

(O) Observed on or in site vicinity either visually or by sign, including tracks, scat, etc.

(p) Species is probably present in site vicinity since species habitat requirements are met, species is common in the area, and access to the site is available.

TABLE 7-1c
SPECIES LIST – BIRDS
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name	Habitat Requirements[1]	Key Food Habits[1]	Important Functions[1]
Belted Kingfisher(P)	*Ceryle alcyon*	Banks near ponds, lakes, rivers and streams for breeding.	Major foods are fish, crayfish, insects, mollusks, tadpoles.	Permanent where water remains unfrozen in winter.
Black-capped Chickadee(O)	*Parus atricapillus*	Deciduous or coniferous woodlands, frequents both heavily forested and residential areas.	Major foods: insects, seeds, fruits.	Wintering: frequent city parks and residential areas with feeding stations adjacent to breeding habitat.
Black-crowned Night Heron(O)	*Nycticorax nycticorax*	Breeding habitat is varied, occupies fresh, brackish, and salt water areas.	Major foods: fishes, crustaceans, mollusks, worms, aquatic terrestrial insects, reptiles and amphibians, occasionally young birds and mammals.	Wintering: Coastal wetlands and islands; Range is permanent in RI.
Blue Jay(P)	*Cyanocitta cristata*	Prefers mixed woodlands, wooded islands, farms, cities, suburbs, parks.	Major foods: seeds, fruits, mast, occasionally takes insects, nestlings, young mice. Acorns are staple food item throughout the year.	Will overwinter in New England but some northern birds move to more southern New England.
Brown-headed cowbird(O)	*Molothrus ater*	Open coniferous and deciduous woodlands and edges.	Major foods: seeds of weeds, grasses, grains, insects.	Will overwinter in RI using agricultural land and feeding stations.
Canada goose(O)	*Branta Canadensis*	Shallow waterbodies with abundant plant foods.	Tender shoots of grasses, sedges, and other marsh plants, submerged vegetation, cultivated grains, wild seeds, and fruits.	Wintering: in New England where bare ground and open water.
Clapper Rail(P)	*Rallus longirostris*	Coastal and inland brackish marshes with abundant vegetation.	Major foods include aquatic and terrestrial insects, amphibians, crustaceans, mollusks, seeds.	Migratory.
Crow, American(O)	*Corvus brachyrynchos*	Interior and edges of open deciduous, coniferous, and mixed forests and woodlots. Prefers woodland with adjacent farmland.	Major foods: Omnivorous, taking mammals (mainly carrion), insects, small birds (nestlings), fruit, garbage, and grain.	Common, Will overwinter in New England; will congregate in coastal areas where food is more accessible.
Egret, Cattle(O)	*Bubuleus ibis*	Shallow shores of ponds, lakes, streams, rivers, etc.	Major Foods: Aquatic and terrestrial insects, fishes, amphibians, reptiles, mollusks, and crustaceans.	Wintering: mainly coastal areas with bare ground and open water in New England.
Egret, Great(O)	*Arlea alba*	Shallow shores of ponds, lakes, streams, rivers, etc.	Major Foods: Aquatic and terrestrial insects, fishes, amphibians, reptiles, crustaceans, and occasionally small birds and mammals.	Wintering: mainly coastal areas with bare ground and open water in New England.
Egret, Snowy (O)	*Egretta thula*	Shallow shores of ponds, lakes, streams, rivers, etc.	Major Foods: Prefers fish; also insects, amphibians, crustaceans.	Migratory, New England provides breeding habitat.
European Starling(P)	*Sturnus vulgaris*	Farms, cities, orchards, gardens, parks.	Major food: Insects, seeds, fruits, grain.	Overwinters in New England. Wintering: roost in dense vegetation or on buildings.
Goldfinch, American(O)	*Carduelis tristis*	Open weedy fields, pasture with scattered trees, forest edges.	Major foods: insects, buds, succulent vegetation in summer; seeds of weeds, birches, alders, conifers in winter.	Wintering: present in New England and common at feeding stations.
Grackle, Common(O)	*Quiscalus quiscula*	Farmlands, suburbs, marshes, meadows.	Major foods: ground-dwelling insects, fruits, mast, waste grains, small quantities of fish. Amphibians, nestlings, and eggs.	Will overwinter in RI in areas with open water and bare ground.
Heron, Great Blue(O)	*Ardea herodias*	Shallow shores of ponds, lakes, streams, rivers, etc.	Major Foods: Aquatic and terrestrial insects, fishes, amphibians, reptiles, crustaceans, and occasionally small birds and mammals.	Wintering: mainly coastal areas with bare ground and open water in New England.
Heron, Green-backed(P)	*Butorides striatus*	All fresh and saltwater habitats.	Major foods include small fishes, crustaceans, mollusks, insects, reptiles, amphibians.	Migratory, may nest away from water.
Herring Gull(O)	*Larus argentatus*	Mainly breeding on islands in estuaries, rivers, and lakes or coastal beaches.	Major foods: fish and shell fish, offal from fishing boats and fish processing plants; Also scavenge along shoreline and garbage dumps.	Wintering: same as breeding habitat except where water bodies freeze over.
Killdeer(O)	*Characdrius vociferus*	Heavily grazed meadows, edges of pasture ponds, dry uplands.	Major foods: insects, centipedes, spiders, worms, snails, crayfish, weed seeds.	Will overwinter in RI in plowed or sparsely vegetated fields, coastal flats and beaches, river and lake shores that are free of ice.
Mallard(O)	*Anas platyrhynchos*	Ponds, lakes, rivers, swamps, etc. Prefers water less than 16" deep, avoids salt water.	Major foods: seeds of sedges, grasses and smartweed are staples; also eats leaves, stems and seeds of other marsh plants, snails, and insects.	Wintering: Coastal marshes, inland ice-free ponds and rivers.
Morning Dove(O)	*Zenaida macroura*	Open land with bare ground that produces adequate food seeds.	Major foods: weed seeds, occasionally takes small snails. Walking and ground gleaning.	Common in New England. Overwinters in New England
Mute Swan(O)	*Cygnus olor*	Coastal bays with shallow waters and abundant aquatic vegetation.	Major foods include fish, crustaceans and aquatic insects.	Birds remain in breeding territories all year long if not frozen over.
Northern Cardinal(O)	*Cardinalis cardinalis*	Groves, parks, suburban gardens, open woodlands, forest edges.	Major foods include seeds, fruits, insects.	Home range ~ 1 to 5 acres, Permanent.

TABLE 7-1c (cont.)
SPECIES LIST – BIRDS
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name	Habitat Requirements[1]	Key Food Habits[1]	Important Functions[1]
Northern Harrier(O)	*Circus cyaneus*	Open country, fresh or saltwater marshes.	Major foods: small mammals, birds, reptiles, amphibians, insects, and occasionally carrion.	Home range is 0.38 to ~ 4 square miles, permanent.
Osprey(O)	*Pandion haliaetus*	Near large bodies of water that support abundant fish.	Major food is fish.	Require elevated nest sites, return to same nest/area year to year.
Red-winged Blackbird(O)	*Agelaius phoeniceus*	Marshes, swamps, wet meadows, ponds, dry fields. Prefers wetlands with extensive emergent growth.	Major foods: insects, weed seeds, grain.	Migratory, New England provides breeding habitat.
Robin, American(O)	*Turdus migratorius*	Open woodland edges and clearings, fields, orchards, shade trees in residential areas.	Major foods: Wild and cultivated fruits, earthworms, insects.	Will overwinter in New England. Frequents sheltered wooded areas and feeds on persistent wild and cultivated fruits.
Semipalmated Sandpiper(O)	*Calidris pusilla*	Coastal beaches and mudflats.	Major foods are terrestrial and aquatic insects.	Migratory.
Sparrow, Field(O)	*Spizella pusilla*	Old fields with scattered woody vegetation, also briar thickets and woodland edges	Major foods: insects (>40%) in summer, with weed seeds and grasses.	Will overwinter in southern New England.
Sparrow, Song(P)	*Melospiza melodia*	Upland edges of marshes, brushy fields, suburbs, cities.	Major foods include insects, weed seeds, fruits.	Permanent. Tolerates a large range of habitat.
Swallow, Barn(O)	*Hirundo rustica*	Man-made structures, especially buildings for nesting.	Major foods include flying insects, occasionally fruits.	Migratory, often moving in large flocks.
Swallow, Tree(P)	*Techycineta bicolor*	Cavity for nesting. Open feeding areas such as meadows, marshes, or water.	Major foods: Flying insects in summer berries and seeds are taken as a supplement when insects are less abundant.	Migratory, New England provides breeding habitat.
Tern, Common(P)	*Sterna hirundo*	Gravelly and sandy beaches, grassy uplands, rock shores for breeding.	Major foods are small fish.	Nest in loose colonies.
Turkey, Wild(O)	*Meleagris gallopavo*	Woodland, clearings where food is available.	Major foods are acorns and other mast, will eat the fruit and seeds of most plants, leaves, tubers.	Home ranges often restricted to 100 to 200 acres.
Yellowthroat, Common(O)	*Geothlypis trichas*	Dense thickets near water, cattail beds of fresh or saltwater marshes, occasionally dry thickets.	Major foods worms, caterpillars, moths, grasshoppers, plant lice, spiders.	Home range is 0.8 to 1.8 acres.

(1) Sources: DeGraff and Rudis, 1986; Martin, Zim, and Nelson, 1951; Redington, 1994; Audubon Society, 1983.
(O) Observed on or in site vicinity either visually or by sign, including tracks, scat, etc.
(P) Species is probably present in site vicinity since species habitat requirements are met, species is common in the area, and access to the site is available.

TABLE 7-1d
SPECIES LIST – REPTILES, AMPHIBIANS, FISH, AND MISCELLANEOUS
REMEDIAL INVESTIGATION
RAYMARK OU9 – SHORT BEACH PARK AND STRATFORD LANDFILL
STRATFORD, CONNECTICUT

Common Name	Scientific Name	Habitat Requirements[1]	Key Food Habits[1]	Important Features[1]
Black Racer, Northern(P)	*Coluber c. constrictor*	Moist or dry areas, fields, roadsides, marshes.	Varied diet includes small mammals and birds (and eggs), insects, frogs, toads, snakes.	Locally abundant.
Bluegill sunfish	*Lepomis macrochirus*	Clear warm pools of streams, ponds or reservoirs, usually in shallow water with vegetation.	Young consume zooplankton, switching to aquatic insects at maturity. Small mouth size limits the size of food particles ingested and almost dictates a diet of insects and similar small organisms. While insects remain the staple food item for adults, crayfish, snails, small fish, and fish eggs are also consumed. Algae and other vegetation are eaten when normal food items are scarce.	Common sunfish and popular gamefish. Commonly stocked in ponds as forage for larger fishes.
Brown Snake, Northern	*St Oreria d. dekay*	Ubiquitous, terrestrial.	Slugs, snails, earthworms, insects, and minnows	Active in evenings.
Crab, Blue(P)	*Callinectes sapidus*	Common in shallow brackish water during the summer.	Opportunistic feeders of, fishes, oysters, clams, snails, shrimp, worms and other crustaceans.	Fished for extensively, winter offshore.
Crab, Fiddler(O)	*Uca spp.*	Chiefly intertidal zone, burrow into flats or banks of mud or sand.	Feed mainly on bacteria, minute algae, and decaying marsh plants in mud/sand.	Colonial, active by day.
Crab, Green(O)	*Carcinus maenas*	Common crabs of rocky shores, estuaries and the edges of tidal marshes.	Omnivorous, with large part of their diet consisting of bivalves.	Used extensively as bait.
Crab, Horseshoe (O)	*Limulus polyphemus*	Common in sandy or muddy bottoms in shallow, brackish water.	Feed on small mollusks, worms, and crustaceans, and algae.	There eggs are and important food source for migrating shorebirds in spring.
Crab, Mud(P)	*Eurypanopeus depressus*	Common in muddy areas of low salinity, and often associated with oysters.	Predators and scavengers of oysters and clams.	Commonly inhabitants of oyster reefs. Important items in diet of fish and birds.
Garter Snake, Eastern(P)	*Thamnophis s. sirtalis*	Ubiquitous, terrestrial.	Earthworms account for 80% of food items, also amphibians, carrion, fish, insects, small birds, and rodents.	Home range estimated at 5 acres.
Green Frog(O)	*Rana clamitans melanota*	Riparian, inhabits margins of shallow fresh water.	Terrestrial feeder among shoreline vegetation, insects, worms, small fish, crayfish spiders, and mollusks.	Home range of 20-200 square meters.
Green snake, Eastern Smoth	*Opheodrys v. vernalis*	Grassy uplands.	Insects account for 73% of food items.	Hibernates in early fall.
Milk Snake, Eastern	*Lampropletis t. triangulum*	Various habitats with cover.	Mice and other small mammals, snakes, snails, and bird eggs.	Forages at night.
Mummichog, Common - Killifishes(O)	*Fundulus spp.*	Aquatic intertidal brackish/saltwater, abundant in estuarine waters and common fish in creeks and mosquito ditches of tidal marshes.	Omnivorous, important consumers of mosquito larvae, seagrass, and other vegetable matter; foraminifera; shrimps and other small Crustaceans.	Winter in a more or less sluggish state on the bottoms of the deeper holes or creeks, no evidence that they move out to sea during the cold season; this is one of the most stationary of fishes.
Periwinkle, Rough(O)	*Littorina saxatilis*	Common in high intertidal areas of coastal marshes.	Algae on aquatic vegetation.	Serve as a food source for fish, aquatic animals, mammals, and shorebirds.
Snapping Turtle, Common (p)	*Chelydra s. serpentina*	Bottom dweller in fresh or brackish water; almost entirely aquatic but will travel over land.	Omnivorous feeder; scavenges for food readily available; animal matter accounts for 54% of prey items including fish (40%) crayfish, aquatic invertebrates, reptiles, birds, mammals; plant material (37%).	Quite migratory distance ranging from 100 m to 1.1 km; females exhibit strong nesting site fidelity; home range from 4.5 to 22.2 acres.
Toad, Eastern American(O)	*Bufo a. americanus*	Found in almost any habitat with cover, damp soils and food supply.	Terrestrial arthropods including insects, sowbugs, spiders, centipedes, millipedes, slugs, and earthworms.	Small home range. Returns to breeding sites.
Water Snake, Northern(P)	*Nerodia s. sipedon*	Aquatic and semi-aquatic fresh or saltwater habitats.	Major foods include fish, frogs, toads, salamanders, and insects.	Hibernates in crevices or banks.

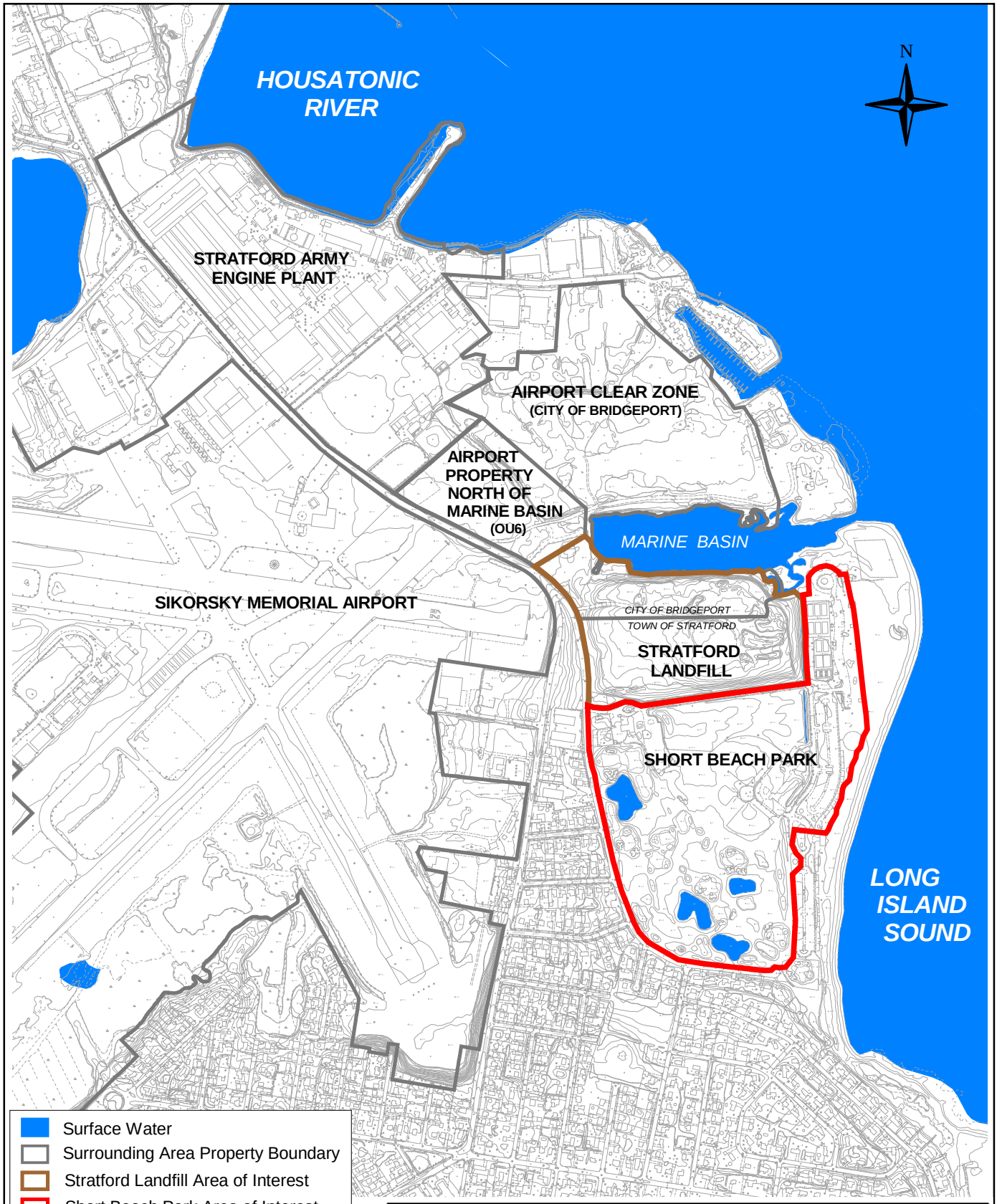
[1] - Sources: DeGraff and Rudis 1986; Martin, Zim, and Nelson, 1951; Redington, 1994; Audubon Society, 1983; Atlantic Seashore Peterson Field Guides 1978.
(O) Observed on or in site vicinity either visually or by sign, including tracks, scat, etc.
(P) Species is probably present in site vicinity since species habitat requirements are met, species is common in the area, and access to the site is available.

FIGURES

BASEMAP: PORTIONS OF THE FOLLOWING U.S.G.S. QUADRANGLE MAPS: BRIDGEPORT, CONN., 1970 (PHOTOREVISE: 1984) AND MILFORD, CONN., 1960 (PHOTOREVISED: 1984)

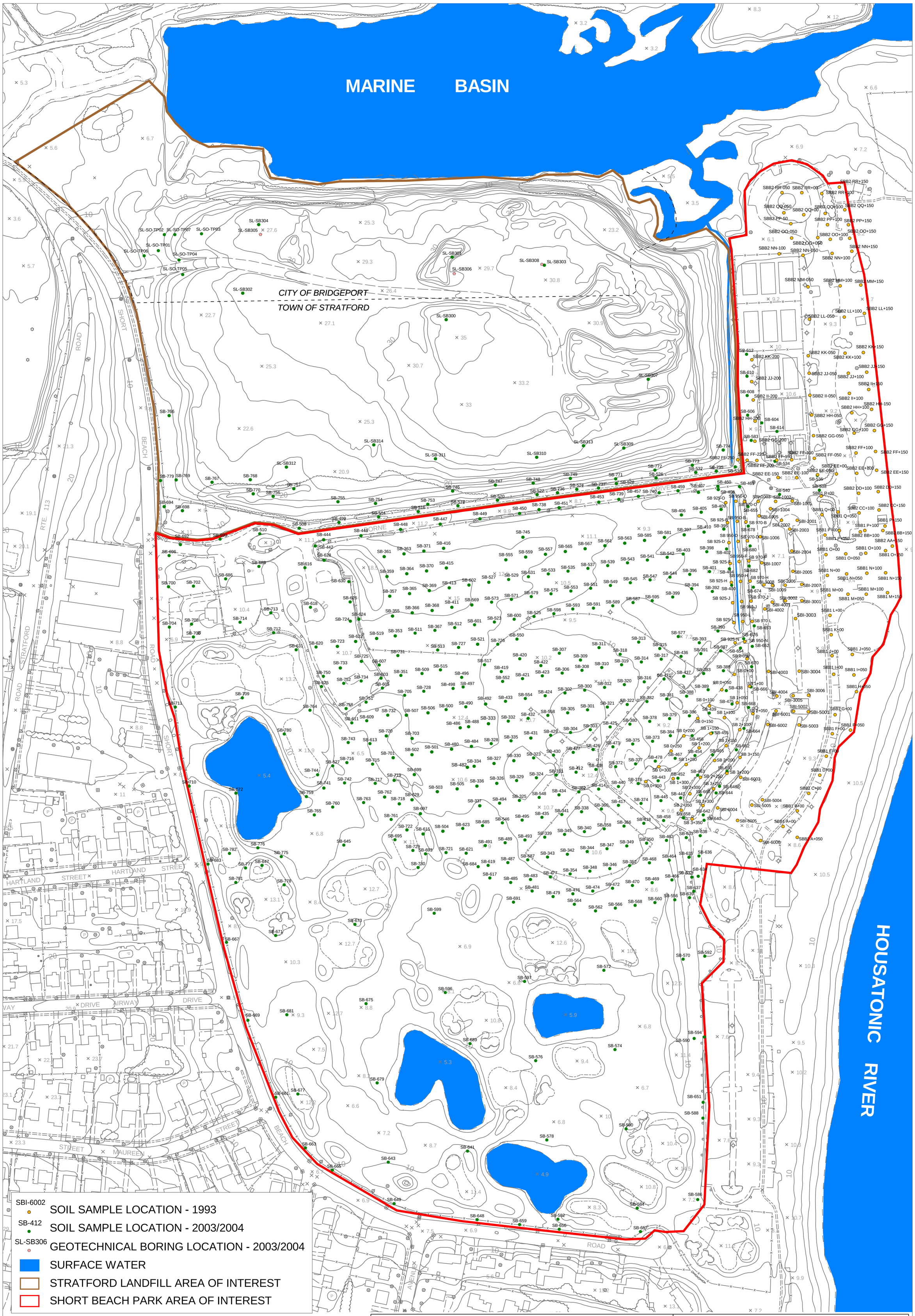
GRAPHIC SCALE
0′ 4000′

SITE LOCUS		FIGURE 1–1	
SHORT BEACH PARK AND STRATFORD/BRIDGEPORT LANDFILL		TETRA TECH NUS, INC.	
RAYMARK – OU9 – STRATFORD, CT		55 Jonspin Road Wilmington, MA 01887 (978)658–7899	
DRAWN BY: D.W. MACDOUGALL	REV.: 0		
CHECKED BY: L. SEYDEWITZ	DATE: JANUARY 2005		
SCALE: AS NOTED	ACAD NAME: DWG\1369\0600\FIG_1–1.DWG		



NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE
3) BASE MAP OBTAINED FROM TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS

SURROUNDING AREAS	FIGURE 1-2
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL STRATFORD, CONNECTICUT	TETRA TECH NUS, INC.
DRAWN BY: L. SEYDEWITZ — DATE: JANUARY 2005	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
CHECKED BY: D. CHISHOLM — FILE: G:\...\RaymkOU9\sbpark.apr	



90 0 90 180 270 360 Feet

N

NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
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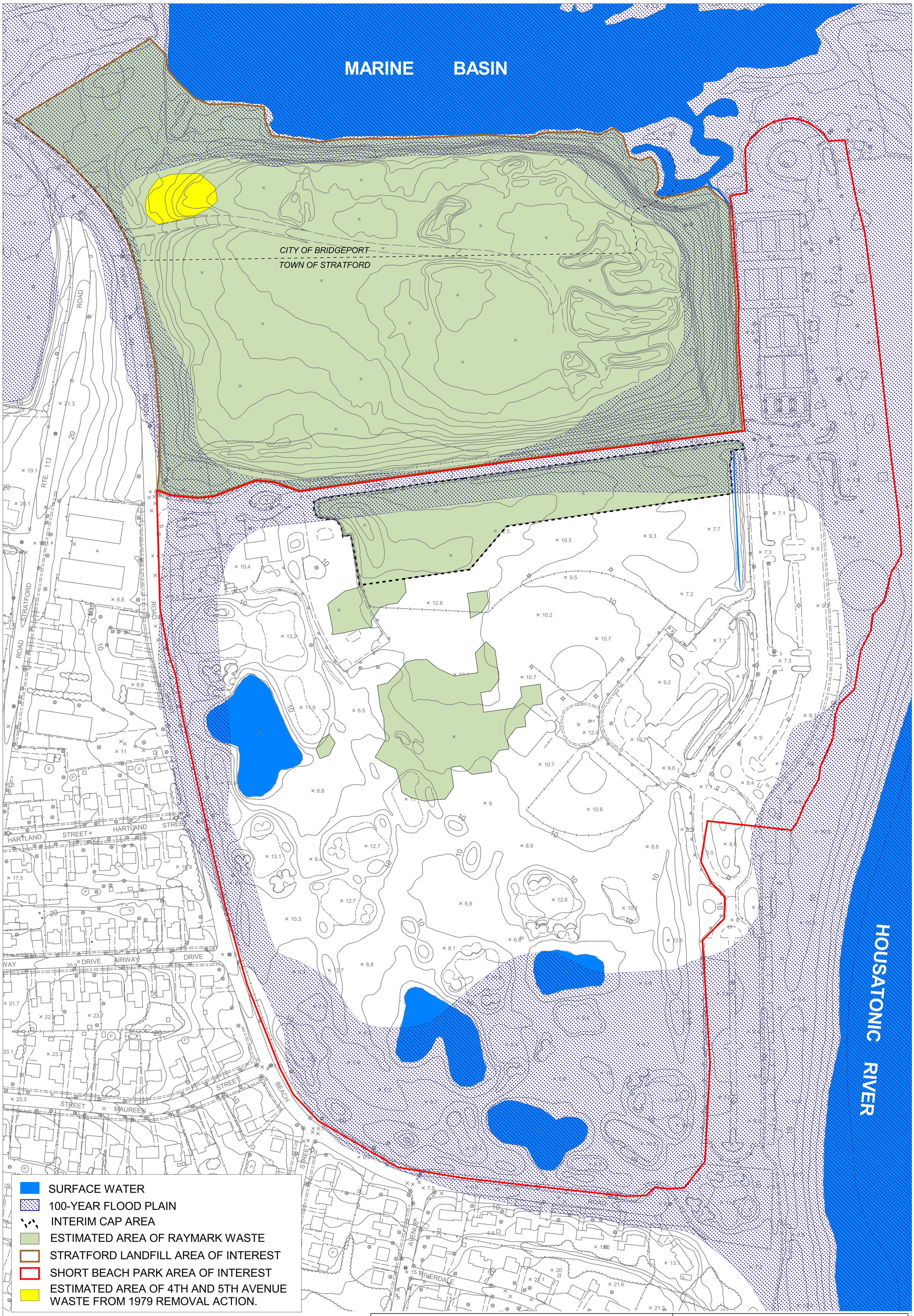
3) BASE MAP OBTAINED FROM TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS

SAMPLE LOCATIONS		FIGURE 2-1
RAYMARK -OU9 SHORT BEACH PARK/STRATFORD LANDFILL		TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT		
DRAWN BY: L. SEYDEWITZ	DATE: JULY 2005	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
CHECKED BY: D. CHISHOLM	FILE: G:\...\RaymkOU9\sbpark.apr	



90 0 90 180 270 360 Feet

N

NOTES:
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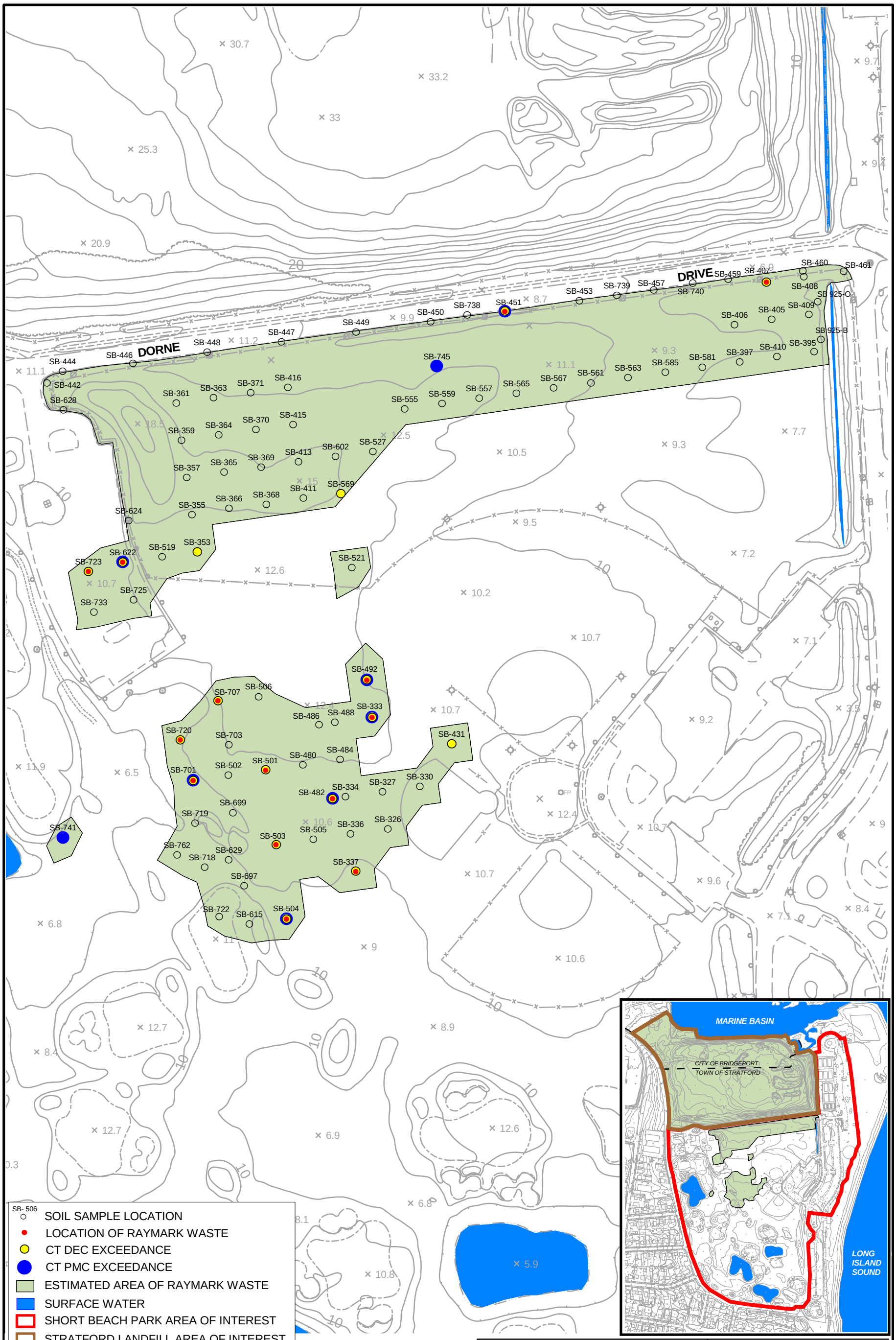
2) ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE
3) BASE MAP OBTAINED FROM TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS

PHYSICAL FEATURES		FIGURE 3-1
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL		TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT		55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
DRAWN BY: L. SEYDEWITZ	DATE: JULY 2005	
CHECKED BY: D. CHISHOLM	FILE: G:\...\RaymkOU9\sbpark.apr	



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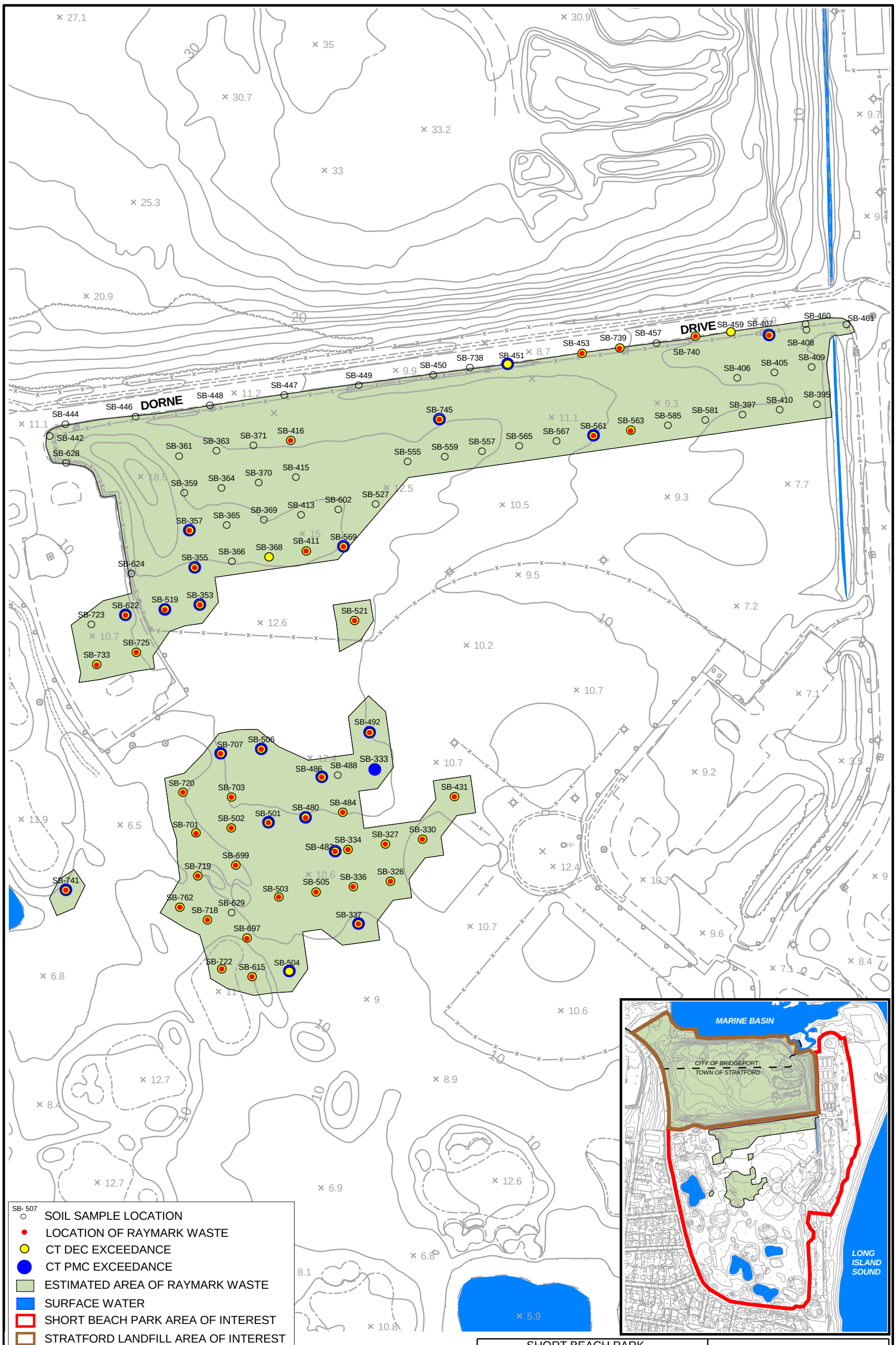
2) ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE
3) BASE MAP OBTAINED FROM TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS
4) CT DIRECT EXPOSURE CRITERIA (CT DEC) FOR RESIDENTIAL SOILS AND CT POLLUTANT MOBILITY CRITERIA FOR GB ACQUIFERS (CT PMC) USED TO DETERMINE EXCEEDANCES.

SHORT BEACH PARK - SOIL SAMPLES (0-2 FEET BGS)	FIGURE 4-1
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
DRAWN BY: L. SEYDEWITZ / DATE: JULY 2005	
CHECKED BY: D. CHISHOLM / FILE: G:\...\RaymkOU9\sbpark.apr	



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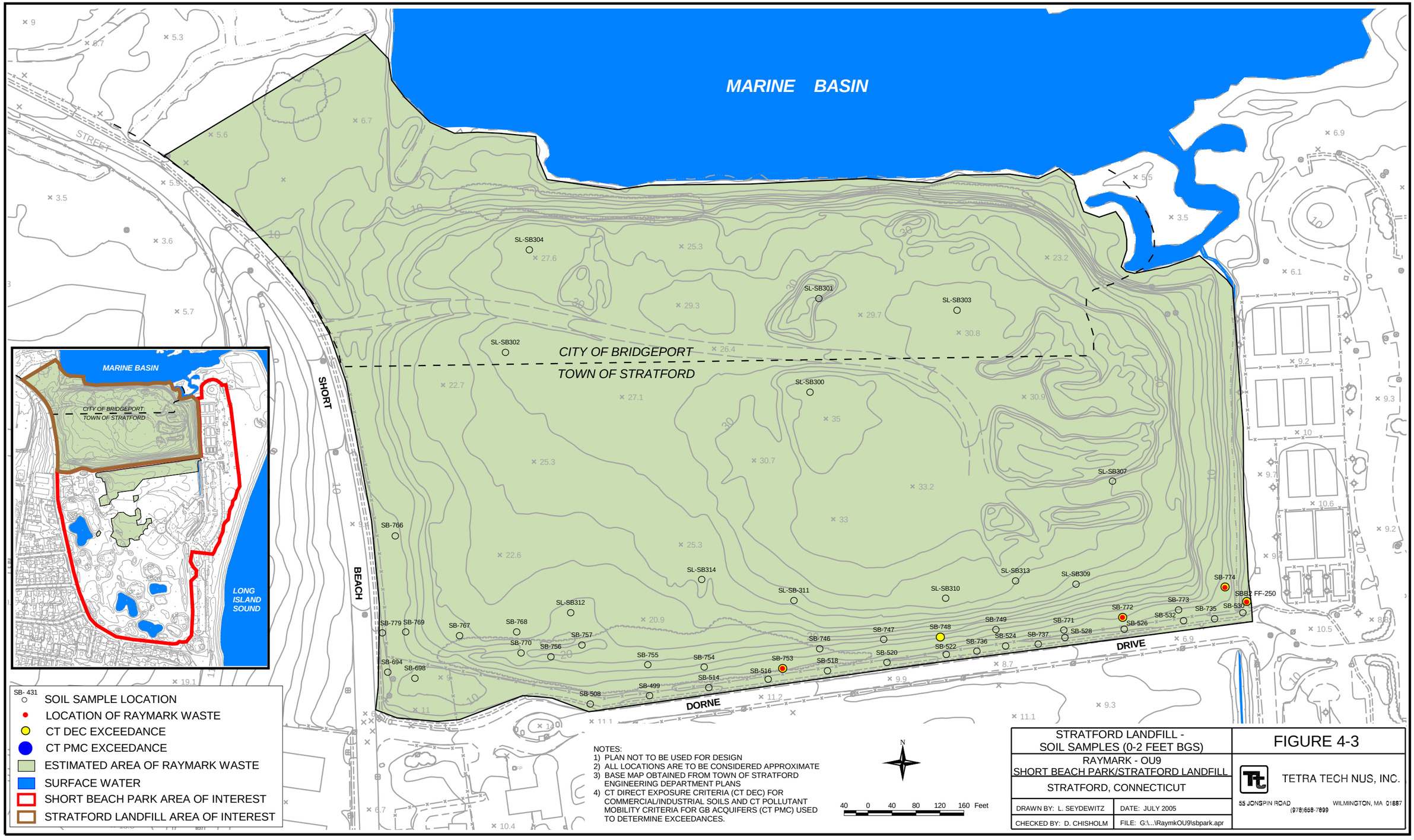
SHORT BEACH PARK - SOIL SAMPLES (>2 FEET BGS)	FIGURE 4-2
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
DRAWN BY: L. SEYDEWITZ / DATE: JULY 2005	
CHECKED BY: D. CHISHOLM / FILE: G:\...\RaymkOU9\sbpark.apr	



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4) CT DIRECT EXPOSURE CRITERIA (CT DEC) FOR COMMERCIAL/INDUSTRIAL SOILS AND CT POLLUTANT MOBILITY CRITERIA FOR GB ACQUIFERS (CT PMC) USED TO DETERMINE EXCEEDANCES.

STRATFORD LANDFILL - SOIL SAMPLES (0-2 FEET BGS)	FIGURE 4-3
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
DRAWN BY: L. SEYDEWITZ / DATE: JULY 2005	
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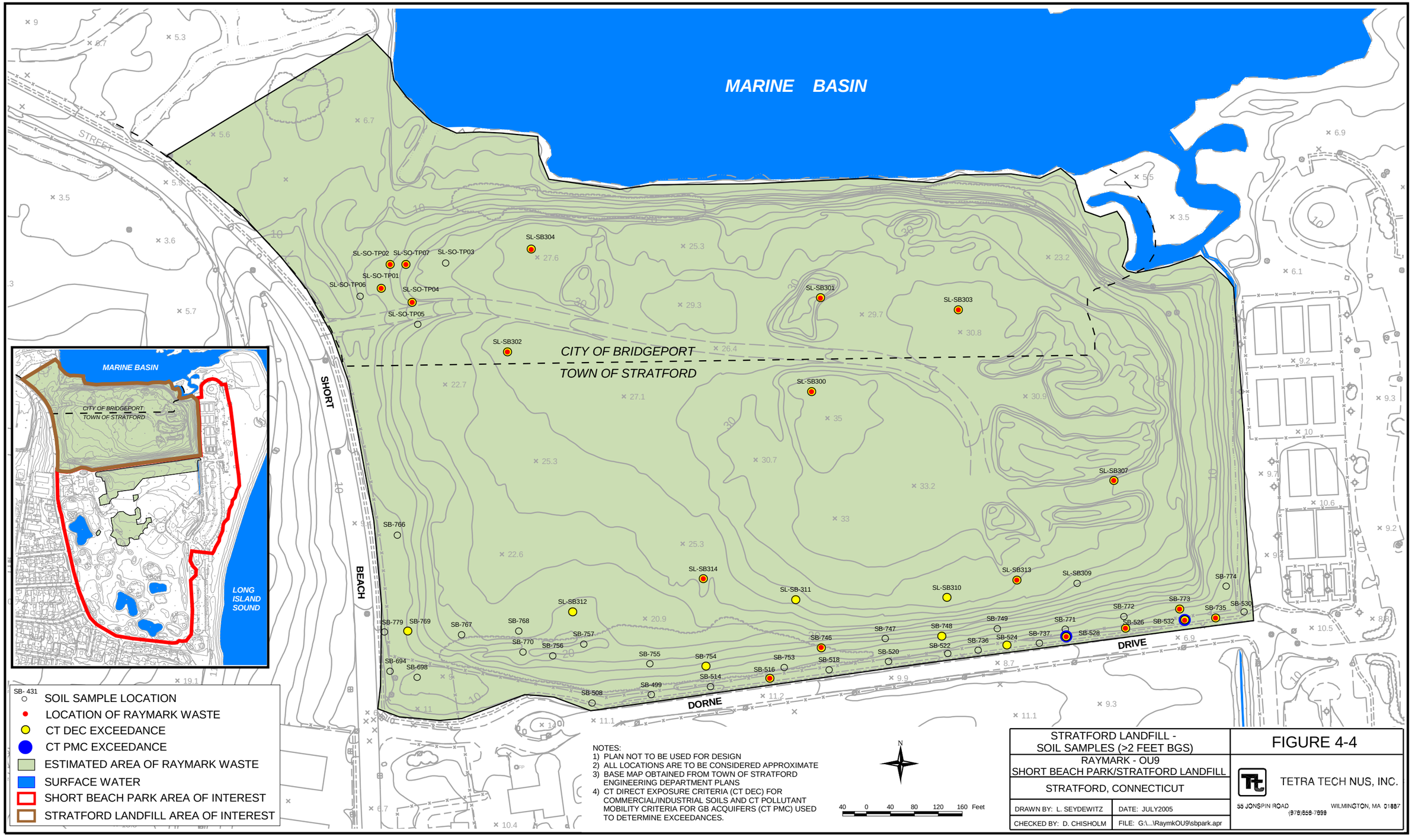

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3) BASE MAP OBTAINED FROM TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS
4) CT DIRECT EXPOSURE CRITERIA (CT DEC) FOR COMMERCIAL/INDUSTRIAL SOILS AND CT POLLUTANT MOBILITY CRITERIA FOR GB ACQUIFERS (CT PMC) USED TO DETERMINE EXCEEDANCES.

STRATFORD LANDFILL - SOIL SAMPLES (>2 FEET BGS)	FIGURE 4-4
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
DRAWN BY: L. SEYDEWITZ / DATE: JULY2005	
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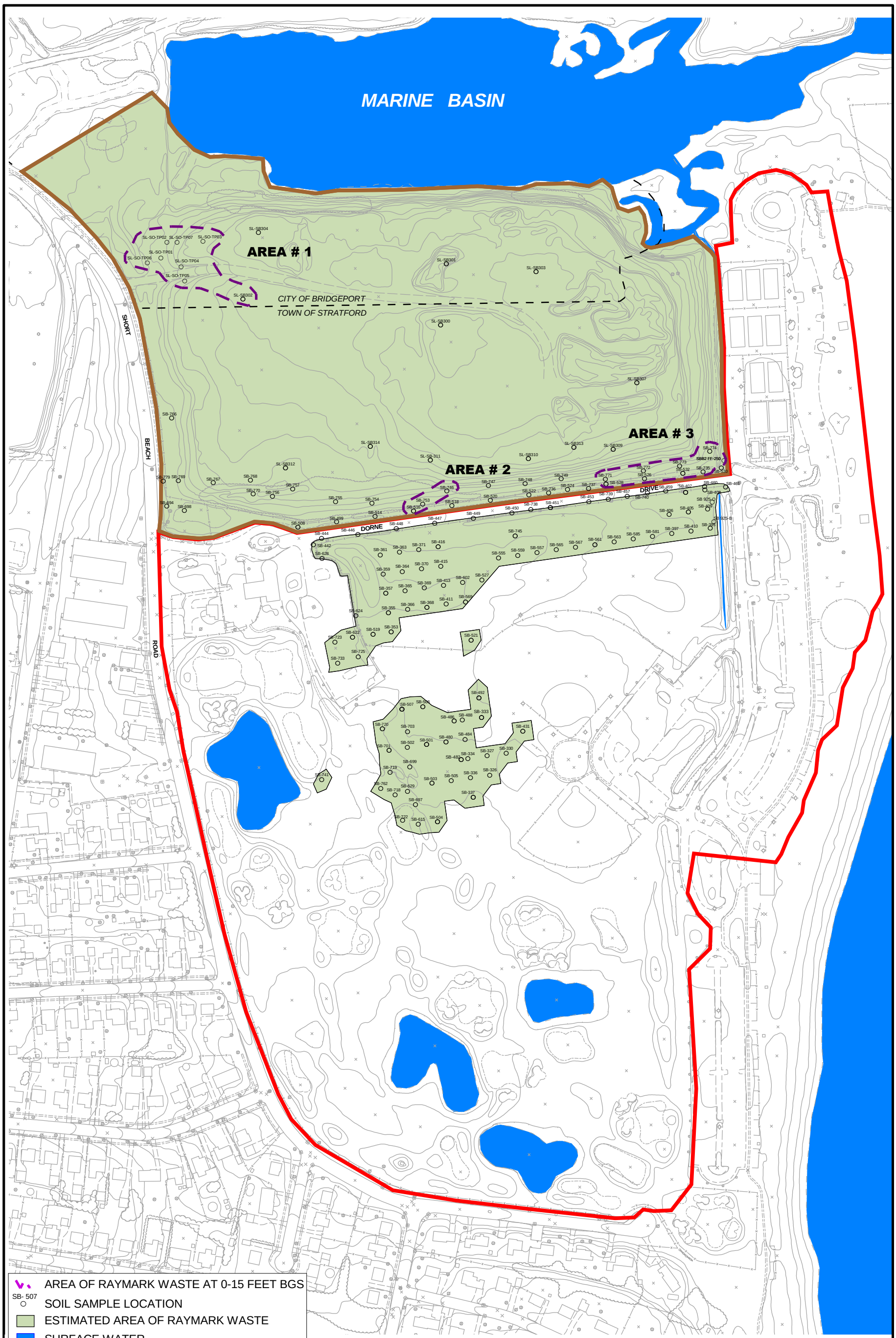

NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE
3) BASE MAP OBTAINED FROM TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS

AREAS OF RAYMARK WASTE AT 0-15 FEET (BGS)	FIGURE 6-1
RAYMARK - OU9 SHORT BEACH PARK/STRATFORD LANDFILL	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	55 JONSPIN ROAD WILMINGTON, MA 01887 (978)658-7899
DRAWN BY: L. SEYDEWITZ — DATE: JANUARY 2005	
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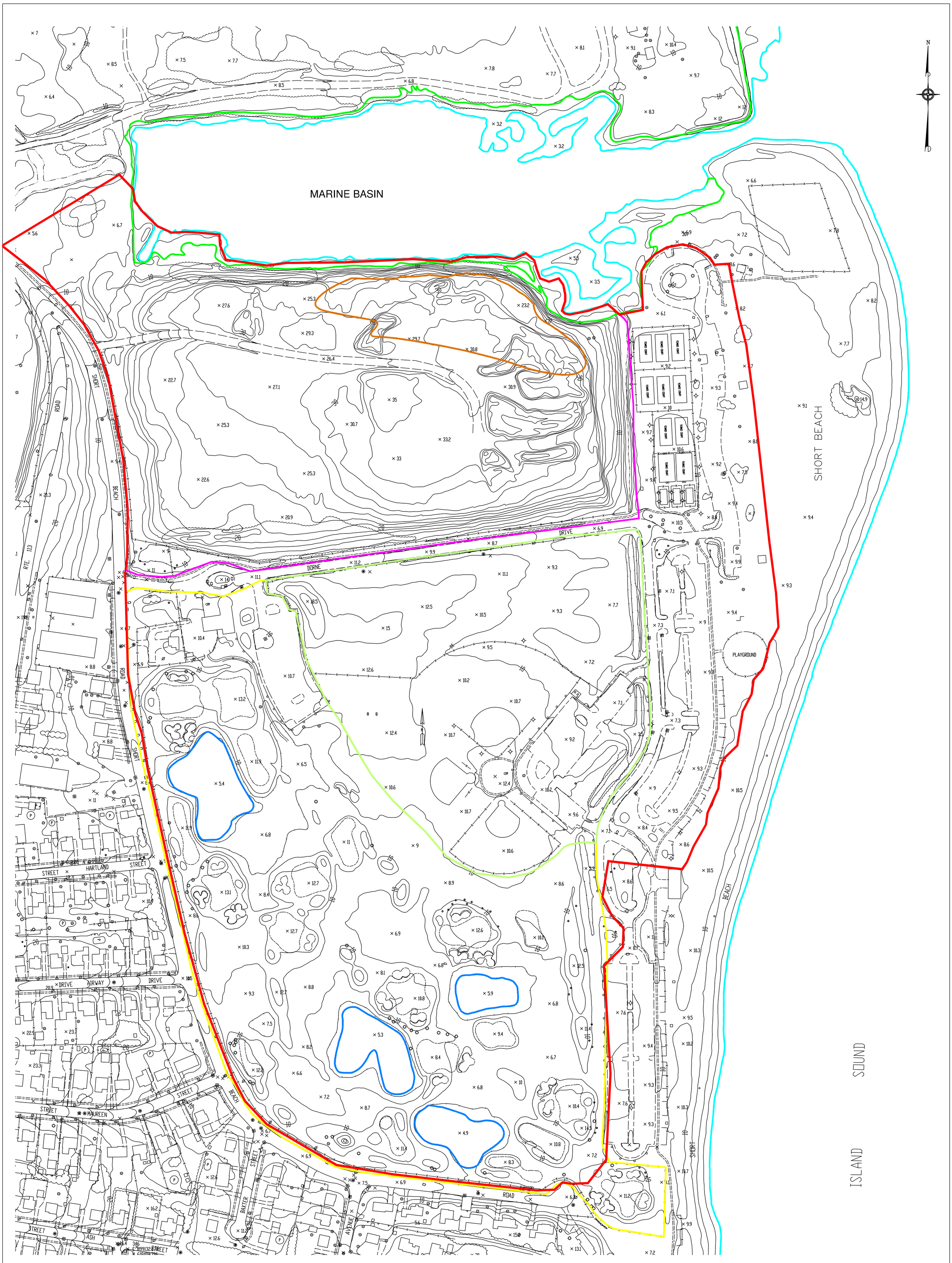

NOTE:

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.

2. PLAN NOT FOR DESIGN.

LEGEND

- STUDY AREA LIMITS
- PAR 3 GOLF COURSE
- PONDS
- COMPOST PILES
- STRATFORD LANDFILL
- SOCCER & BASEBALL FIELDS
- OPEN WATER
- APPROXIMATE EXTENT OF TIDAL WETLANDS

GRAPHIC SCALE

120′ 0′ 120′ 240′

1 INCH = 120 FEET

PROPERTY ID	AREA (sq. ft.)	AREA (acres)
STUDY AREA LIMITS	4,095,946	94.0
PAR 3 GOLF COURSE	1,496,884	34.4
PONDS	114,710	2.6
COMPOST PILES	129,240	3.0
STRATFORD LANDFILL	1,298,056	29.8
SOCCER & BASEBALL FIELDS	738,510	17.0

DRAWN BY: D.W. MACDOUGALL
PREPARED BY: K. O'NEILL
CHECKED BY: H. FORD
PROJECT MANAGER: H. FORD
PROGRAM MANAGER: G. GARDNER

TITLE:
OU9 ECOLOGICAL SETTING
RAYMARK
STRATFORD, CONNECTICUT

SOURCE:

SCALE: 1" = 120'
DATE: JULY 2005
PROJ. NO: 4105
DRAWING NO: 7-1
ACFILE NAME: DWG\1369\0900\FIG_7-1.DWG
REV: 0

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

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REFERENCES

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