Uncertainty is associated with estimation of maternal blood lead concentrations and with the relationship between maternal blood lead concentrations and fetal blood lead concentrations.

This risk characterization does not include a quantitative risk evaluation of the risks associated with potential receptor exposures to asbestos because of the lack of appropriate toxicity criteria. Uncertainty in the risk characterization is associated with the presence of asbestos-containing material, defined as material containing more than 1 percent asbestos (EPA Regulation 40 CFR Subpart M, Part 61). 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. It is chosen as a COPC based on the health effects exhibited in occupationally exposed workers in epidemiological studies. Inhalation studies in animals and humans indicate that exposure to asbestos fibers may lead to asbestosis, lung cancer, tumors of the thin membranes surrounding internal organs such as the pleural and peritoneal membranes (mesotheliomas), and an increased risk of extrathoracic cancers. Asbestos exposure leading to cancer depends not only on dose but on underlying risk factors such as smoking.

6.7 Baseline Human Health Risk Assessment - Area B, Lower Ferry Creek

This section contains the baseline risk assessment performed for soil, wetland soil, sediment, surface water, and biota exposures at Area B, the Lower Ferry Creek. Section 6.7.1 provides an overview of Area B, Section 6.7.2 contains a discussion of the selection of COPCs, Section 6.7.3 contains information on the potential receptors considered and the routes by which they might be exposed, Section 6.7.4 contains the numerical results of the risk assessment, and Section 6.7.5 presents site-specific uncertainties.

6.7.1 Overview of Area B, Lower Ferry Creek

Area B, Lower Ferry Creek, encompasses undeveloped wetlands, Ferry Creek, and a small portion of the Housatonic River. The area covers approximately 18 acres, including wetlands and open water in the creek channel. A more detailed description of Area B is provided in Section 6.7.3.1. The nature and extent of the contamination detected in Area B was discussed in Section 4. Descriptive statistics (frequency of detection, range of positive detections, range

of non-detects, location of maximum detections, and arithmetic mean) for target analytes detected in the Area B environmental media are also summarized in Tables 6-13 through 6-17.

6.7.2 Data Evaluation

Tables 6-13, 6-14, 6-16, and 6-17 present a summary of the COPCs for quantitative risk assessment for Area B surface soils/wetland soils/sediments, "all soils" to a depth of 15 bgs, surface waters, and biota, respectively. COPCs were identified based on a comparison of site data to the COPC screening levels defined in Section 6.2. All validated CLP data collected during recent and historical investigations, except soil data collected from depths greater than 15 feet, were used to identify COPCs. The 1999 data collected by SAIC, Inc. are not included in the human health risk assessment. Soil data at depths greater than 15 feet were not used because human exposure to soils deeper than 15 feet below ground surface is considered very unlikely. Because of the significant correlation observed between field screening data and validated CLP data for lead and copper, screening data were also used for these chemicals at sample locations where no CLP data are available. An evaluation of groundwater is not part of the scope of work for this human health risk assessment, but will be addressed as part of an area-wide groundwater assessment to be provided as a separate document.

Table 6-15A and 6-15B compare maximum chemical concentrations detected in the surface soils, wetland soils, and sediments data set and the "all soils" data set, respectively, to the groundwater protection benchmarks defined in Section 6.2.1.1 (the Generic SSLs for migration from soil to groundwater and State Pollutant mobility GB criteria). Although groundwater data were not addressed in this risk assessment, the comparison allows for a preliminary evaluation of the potential for chemicals to migrate to groundwater and potentially impact the quality of groundwater. Chemicals in excess of groundwater protection benchmarks, but not in excess of direct exposures 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.

A media specific-discussion of COPCs is presented in the following paragraphs.

6.7.2.1 COPCs for Soil/Wetland Material/Sediment

The COPC selection process for soil, wetland material, and sediment is summarized in Tables 6-13 and 6-14. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum Area B concentrations to risk-based COPC screening levels for residential land use, generic SSLs for migration from soil to air, State RSRs, and maximum background concentrations (inorganic chemicals only):

- SVOCs (bis(2-ethylhexyl)phthalate)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors (1242, 1248, 1254, 1260, 1262, and 1268)
- Pesticides (alpha chlordane, and diedrin)
- Metals (antimony, arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, thallium, vanadium, and zinc)
- Dioxins/Furans
- Asbestos

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels.

Aluminum and iron were not selected as COPCs, despite concentrations above the risk-based COPC screening levels. EPA Region I does not advocate quantitative risk assessment of the health effects of these metals due to the lack of adequate toxicity criteria.

EPA Region I does not advocate quantitative risk assessment of the health effects of copper. However, since copper is a significant contaminant in Raymark waste, it was selected as a COPC. A qualitative evaluation of copper exposure is included in the uncertainty section.

Alpha chlordane and zinc were selected as COPCs for the 0 to 15 feet bgs category only, since the maximum concentrations of these chemicals in the surface soil samples (from depths of 0 to 2 feet bgs) were less than the direct exposure screening levels.

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

- VOCs (benzene and vinyl chloride)
- SVOCs (bis(2-ethylhexyl)phthalate, carbazole, N-nitrosodiphenylamine, and pentachlorophenol)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, delta-BHC, alpha chlordane, and dieldrin)
- Metals (antimony, barium, cadmium, chromium, mercury, nickel, and thallium)

Maximum detections in soil, wetland material, and sediment of N-nitrosodiphenylamine and alpha chlordane exceeded the groundwater benchmarks for the 0 to 15 feet bgs category only since the maximum concentrations of these chemicals in the surface soil samples (from depths of 0 to 2 feet bgs) were less than the Generic SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area.

6.7.2.2 COPCs for Surface Water

Table 6-16 presents a summary of the COPC selection process for surface water. Based on a comparison of maximum Area B concentrations to risk-based COPC screening levels for tap water use and drinking water standards (federal and state MCLs), the following chemicals were identified as COPCs:

- VOCs (1,1,1-trichloroethane, 1,1-dichloroethene, 1,2-dichloroethene(total), chloroform, chloromethane, trichloroethene, and vinyl chloride)
- SVOCs (bis(2-ethylhexyl)phthalate)
- Pesticides (dieldrin and heptaclor epoxide)
- Metals (antimony, arsenic, chromium, lead, manganese, mercury, and thallium)

Although surface water in the area is not currently used or expected to be used in the future as a drinking water supply, drinking water criteria (federal and state MCLs) were included for informational purposes and to conservatively identify COPCs for Area B. Iron was not selected as a COPC, despite concentrations above the risk-based COPC screening level. EPA Region 1 does not advocate quantitative risk assessment of the health effects of this metal due to the lack of adequate toxicity criteria. The Connecticut State MCL for sodium is a state notification level and is not risk based. For this reason, sodium was not selected as a COPC, despite concentrations above the state MCL.

6.7.2.3 COPCs for Biota

A summary of the COPC selection process for biota (mussels and oysters) is provided in Table 6-17. Based on a comparison of maximum Area B mussel concentrations to risk-based COPC screening levels for fish, the following chemicals were identified as COPCs for mussels:

- Aroclors (1254)

- Metals (cadmium and mercury)
- PAH (benzo(a)anthracene and benzo(b)fluoranthene)

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels.

Based on a comparison of maximum site oyster concentrations to risk-based COPC screening levels for fish, the following chemicals were identified as COPCs for oysters:

- Aroclors 1254
- Metals (cadmium and mercury)
- PAHs (benzo(b)fluoranthene)

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels.

6.7.3 Area B, Exposure Assessment

The exposure assessment contains a discussion of the potential for human exposure at Area B and identifies the rationale for the selection of exposure input parameters used to estimate exposure intakes. A detailed description of the potential receptors, exposure routes, and intake estimation methods used in the exposure assessment is presented in Section 6.4. Area-specific information regarding exposure is provided in this section.

The potential for exposure at Area B is based on several factors, including current and future land uses, activity patterns, site access controls, chemical behavior in the environment, and the presence of human receptors. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under both current and future area conditions. The future scenario accounts for likely or anticipated changes in land use and area characteristics that may alter exposure and/or concentrations of COPCs in a given medium.

The exposure assessment is based on the assumptions that, in general, chemical compositions for environmental media are identical under current and future conditions. Under current conditions, potential human receptors (the wetland/marsh receptor, trespasser, and commercial worker) are assumed to be exposed to surface soil and/or sediment (0 to 2 feet bgs). In the future, contaminated soils currently located at depth and/or beneath pavement to a maximum depth of 15 feet bgs may be brought to the surface during land development (excavation/construction). Under future conditions, commercial workers are evaluated for exposure to soils collected from depths of 0 to 15 feet bgs at two portions of Area B. With the exception of the receptors involved in commercial activities, similar soil/sediment exposure is likely for potential receptors under current and future conditions. Given that future changes to the chemical composition of the creek/marshy waters are difficult to predict, it is assumed for purposes of this risk assessment that chemical concentrations in surface water would not change in the future. It is assumed for the purposes of this risk assessment that chemical concentrations in biota would not change in the future.

A summary of the potentially significant exposures identified for quantitative evaluation for Area B is provided in Table 6-18.

6.7.3.1 Area B, Land Use and Access

Area B, Lower Ferry Creek, is approximately 50 feet south of Area A2, as shown in Figure 1-2. It encompasses undeveloped wetlands, Ferry Creek, and a small portion of the Housatonic River. The area covers approximately 18 acres, including approximately 3.1 acres of wetlands of which approximately 1.9 acres are open water in the creek channel at high tide.

Area B is bounded by Broad Street to the north, the Housatonic River to the east, Ferry Boulevard and Lockwood Avenue to the west, residential properties along Stratford Avenue to the southwest, and a public boat launch area at the end of Stratford Avenue to the south.

6.7.3.2 Area B, Potential Receptors

As identified in Section 6.4, 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 users, commercial workers, construction workers, trespassers, and fishermen), the receptors retained for quantitative evaluation are wetland/marsh receptors (infrequent recreational users), commercial workers, trespassers, and local shellfishers.

Possible exposures of wetland/marsh receptors to site-related contaminants would be through limited recreational activities, such as walking, wading, or boating. Persons involved in recreational activities (the wetland/marsh receptor) may visit Area B, thereby coming in contact with potentially contaminated media. These receptors are assumed to be exposed to media in a limited area (sediments and wetland soil within the creek and river and along the north and east banks or Ferry Creek, but not in the wetlands along the Lockwood Avenue). It is not anticipated that these receptors will contact sediments found within the creek or river in areas covered by 4 or more feet of water at low tide.

Although signs warning of health hazards are posted at the wetlands, and these wetlands are not attractive for recreational use, adolescents may trespass on the wetlands. These receptors are assumed to be exposed to media in a limited area (soils, sediments, and wetland soil within the wetlands along Lockwood Avenue. A portion of Area B bordering the wetlands along Lockwood Avenue is primarily used for commercial purposes. This area has not been evaluated for trespassers. Trespassers also are not evaluated for exposures to creek and river sediment and surface water or to soils from the wetland area on the far side of the creek.

Possible exposures of commercial workers to site-related contaminants would be through commercial/industrial activities in Area B. These receptors are assumed to be exposed to soils in a limited area (soils within the commercial area between the wetlands along Lockwood Avenue and the houses along Stratford Avenue). No major construction projects are planned for Area B or the surrounding areas. However, the baseline risk assessment was conducted assuming that the commercial worker may be exposed to soils as deep as 15 feet bgs in the

future. A second portion of Area B was evaluated for possible future commercial use. This area is the western portion of the wetlands along Lockwood Avenue that lies between Lockwood Avenue and Ferry Creek. Portions of this area are considered wetland, however, it is assumed that the area may be filled and used for commercial purposes in the future.

Possible exposures of local fishermen to site-related contaminants would be through consumption of oysters or mussels from Ferry Creek or the Housatonic River within Area B. As noted in Section 6.4.1, oysters from oyster beds in near vicinity of Area B are commercially shipped through the region. Local fishermen are assumed to consume one or the other species of shellfish as their sole source of seafood. Consumers purchasing oysters commercially are assumed to consume seafood from multiple sources. The percentage of site-contaminated seafood in the diet is likely to be much lower for consumers of commercially purchased seafood, therefore, these receptors are not evaluated separately in this report.

Future on-site residents were not included in the baseline risk assessment for Area B. Current land use suggests that the area is valuable as commercial property. Additionally, much of the soils in Area B surrounding Ferry Creek and the Housatonic River is wetland material and local construction practices preclude subsurface excavation and/or development of Area B for residential purposes. In addition, groundwater in the area is not used or expected to be used in the future as a potable water supply because of brackish conditions.

6.7.3.2.1 Wetland/Marsh Receptors

Area B, Lower Ferry Creek, is primarily recreational. Wetland/marsh receptors are infrequent recreational users, evaluated for exposure to surficial soils, sediments, and wetland soils (0 to 2 feet bgs) near Ferry Creek, the mouth of the Housatonic River, and north and eastern banks of Ferry Creek under current and future land use. The nature of the creek in this area precludes swimming. Therefore, direct but limited contact with surface water in Ferry Creek and the mouth of the Housatonic River is anticipated for these receptors. Wetland/marsh receptors, both adult and pre-adolescent child (ages 6 to 11 years), are assumed to be exposed to area media infrequently (20 days/year). These receptors are assumed to ingest an average of 100 mg/day for 6 years for the child and 100 mg/day for 24 years for the adult for the RME, and an average of 50 mg/day for 2 years for the child and 50 mg/day for 7 years for

the adult for the CTE. Face, hands, forearms, and lower legs are expected to be available for dermal contact with soils/wetland soils/sediments. Hands, lower legs, and feet are expected to be available for dermal contact with surface waters.

6.7.3.2.2 Adolescent Trespassers

All areas of Area B are accessible to adolescent trespassers (ages 9 to 18). However, only the wetlands along Lockwood Avenue area is evaluated for trespasser exposures, since all other portions of Area B are evaluated for more sensitive receptors. The trespassers are evaluated for exposure to surficial (0 to 2 feet bgs) soils, wetland soils, and sediments within the wetlands along Lockwood Avenue portion of Area B. These receptors are assumed to ingest an average of 50 mg/day for 5 years for the CTE and 100 mg/day for 10 years for the RME. Trespassing is assumed to occur at a frequency of 1 day/week throughout the year. Face, hands, forearms, and lower legs are expected to be available for dermal contact with soils/wetland soils/sediments.

6.7.3.2.3 Commercial Workers

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact. Under the current land use, commercial workers are evaluated for exposure to currently exposed surficial soils (0 to 2 feet bgs) at the commercial property only. In the future, contaminated soils currently located at depth and/or beneath pavement may be brought to the surface through excavation and land development. Commercial workers are evaluated for exposure to soils at 0 to 15 feet bgs under future land use. In addition to the portion of Area B evaluated for current and future commercial exposures (commercial area #1); a second portion of Area B is evaluated for future commercial use, assuming that the western portion of the wetlands along Lockwood Avenue may be filled and developed for commercial use in the future (commercial area #2). Workers are not expected to be exposed to contaminated wetland soil, sediments, or surface water in the creek bed or along the banks of the creek or the river. Commercial workers are assumed to be exposed to site media 250 days/year. These receptors are assumed to ingest an average of 50 mg/day for 9 years for the CTE and 100 mg/day for 25 years for the RME. Face, hands, forearms, and lower legs are expected to be available for dermal contact with soils.

6.7.3.2.4 Local Fishermen

Due to the presence of oyster and mussel populations in the Housatonic River, local shellfishermen may visit the Housatonic River. Local fishermen were evaluated for exposure to contaminants through consumption of oysters or mussels obtained from the Housatonic River. These receptors are assumed to ingest an average of 17 g/day of either mussels or oysters for 9 years for the CTE and 30 years for the RME.

6.7.3.3 Area B, Exposure Pathways

The primary routes of exposure for potential human receptors at Area B are incidental ingestion of and dermal contact with soil, sediment, and wetland soils, and dermal contact with surface water. Exposure routes associated with soil contact are evaluated for commercial workers. Wetland soils are included in the data set for future commercial exposures for the western portion of the wetlands along Lockwood Avenue. Exposure routes associated with soil, sediment, and wetland soils contact are evaluated for trespassers. Exposure routes associated with soil, sediment, and wetland soils, and surface water contact are evaluated for wetland/marsh receptors. Fish ingestion was considered for adult fishermen only. Children were not evaluated for this exposure route because the anticipated risks for children are expected to be similar to the risks for adult receptors (EPA, 1989a and 1989b). Although children are expected to eat less fish than adults, the lower body weight for children as compared to the adult body weight would compensate for the differences in ingestion rates. Therefore, an evaluation of the risks for adult receptors is considered to adequately address potential risks associated with this exposure route for all receptors.

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

- The shallow aquifer at Area B is not used as a potable water supply either at Area B or in the surrounding areas. Shallow groundwater in the area discharges to Ferry Creek and its tributaries. Thus, domestic groundwater exposures by nearby residents are eliminated. In addition, as previously mentioned, groundwater in the area is not used or

expected to be used in the future as a potable water supply because of brackish conditions and productivity constraints. It should be noted that groundwater quality at Ferry Creek is being investigated as a separate operable unit.

- Potential exposure to volatile emissions and fugitive dust from Area B is considered to be minimal, thereby eliminating the need for quantitative evaluation of this exposure pathway. As shown in Tables 6-13 and 6-14, all reported surface and subsurface soil concentrations are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a) with the exception of dieldrin (C_{max} = 2600 ug/kg) and chromium (C_{max} = 799 mg/kg). However, the mean dieldrin concentration (37 ug/kg) is approximately two orders of magnitude less than the SSL_{air} (1000 ug/kg). Additionally, the SSL_{AIR} for chromium assumes that chromium is present in the hexavalent state. The assumption that all chromium is in the hexavalent state is overly conservative. Additionally, the average chromium concentration detected in the solid matrix samples (152 mg/kg) is less than the SSL_{AIR} (270 mg/kg).

- Potential exposure to contaminants in surface water from Area B through incidental ingestion is considered to be minimal due to the limited nature of contact with surface water in this area.

6.7.3.4 Area B, Exposure Point Concentrations

Current EPA risk assessment guidance (EPA, 1992 and 1994c) was used to identify appropriate exposure point concentrations for CTE and RME conditions. Exposure point concentrations used in the risk assessment are presented in Table 6-19. For wetland soil, soil, sediment, and surface water, 95 percent UCLs of the arithmetic mean were used as exposure point concentrations in estimating chemical intakes for the RME and CTE. In data sets with 10 samples or less and data sets in which the calculated 95 percent UCL exceeded the maximum detected concentration, the maximum detected concentration was used as the exposure point concentration for the RME and the average concentration was used for the CTE case. Listings of sample locations included in the evaluation of each receptor group are included in Appendix F-5. Support documentation for the calculation of dioxin TEQ concentrations, 95 percent UCLs, and distributions of data sets for COPCs are presented in Appendix F-6.

6.7.3.5 Area B, Estimates of Chemical Intake

Estimates of chemical intake were calculated using equations presented in Section 6.4. Tables 6-10, 6-11, and 6-12 contain the various assumptions used as input parameters to determine chemical intakes for each potential receptor and exposure route. Chemical intake estimates for Area B are provided in the site-specific risk assessment spreadsheets contained in Appendix F-9.

6.7.4 Risk Characterization

A summary of the quantitative risk assessment for Area B, Lower Ferry Creek, is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risk for the RME and CTE scenarios, are outlined in Table 6-20 for the wetland/marsh adult and pre-adolescent receptor, adolescent trespasser, commercial worker, and local fisherman. Sample calculations are provided in Appendix F-8. Appendix F-9 also contains the chemical specific risks for Area B.

6.7.4.1 Noncarcinogenic Risks

Hazard indices developed for the commercial worker, wetland/marsh adult and pre-adolescent receptor, adolescent trespasser, and local fisherman were as follows:

	RME Case	CTE Case
Commercial Worker (Current/Future) (Surface Soils)	3.7E-01	4.5E-02
Commercial Worker - Area 1 (Future) (All Soils - 0 to 15 ft.)	3.8E-01	3.2E-02
Commercial Worker - Area 2 (Future) (All Soils - 0 to 15 ft.)	8.4E+00	3.2E-01
Wetland/Marsh Receptor - Adult (Current/Future) (Surface Materials/Surface Waters)	2.6E-01	6.8E-02
Wetland/Marsh Receptor -Pre-adolescent (Current/Future) (Surface Materials/Surface Waters)	9.1E-01	2.3E-01
Adolescent Trespasser (Current/Future) (Surface Materials)	1.3E-01	4.5E-02
Local Fisherman (Current/Future)		
Mussels	5.7E-01	4.7E-01
Oysters	6.5E-01	4.8E-01

Hazard indices (HI) developed potential future commercial workers in the portion of the wetlands along Lockwood Avenue for the RME case exceeds unity (HI is 8.4). When the total hazard index exceeds one, hazard indices for specific target-organs needs to be evaluated. The primary contributor to total risk is total Aroclor. The Hazard Quotient for total Aroclor alone exceeds one, indicating a potential for adverse noncarcinogenic health effects under the conditions established in the exposure assessment.

All other hazard indices (HI) are less than unity, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment for those receptors.

6.7.4.2 Carcinogenic Risks

Incremental cancer risk estimates for the commercial worker, wetland/marsh adult and pre-adolescent receptor, the adolescent trespasser, and local fisherman were as follows:

	RME Case	CTE Case
Commercial Worker (Current/Future) (Surface Soils)	1.7E-05	1.3E-06
Commercial Worker – Area 1 (Future) (All Soils - 0 to 15 ft.)	1.9E-05	1.0E-06
Commercial Worker – Area 2 (Future) (All Soils - 0 to 15 ft.)	1.9E-04	7.5E-06
Wetland/Marsh Receptor - Adult(1)	8.4E-06	5.5E-07

(Current/Future) (Surface Materials/Surface Waters)		
Wetland/Marsh Receptor -Pre-adolescent(1) (Current/Future) (Surface Materials/Surface Waters)	7.2E-06	5.2E-07
Adolescent Trespasser (Current/Future) (Surface Materials)	5.9E-06	7.9E-07
Local Fisherman (Current/Future)		
Mussels	6.9E-06	1.0E-06
Oysters	6.2E-06	8.9E-07

(1) Summation of total risk for wetland/marsh receptor (adult plus pre-adolescent): 1.6E-05 (RME case) and 1.1E-06 (CTE case).

The EPA target risk range is 10^{-4} to 10^{-6}. The CT DEP target risk level is 10^{-6} for any single contaminant and a total risk of 10^{-5} if there are more than 10 contaminants. The risk estimate for future commercial workers in area 2 for the RME case is 1.9E-04. Total Aroclors, PAHs, and dioxins are the primary risk drivers. The risk estimates for all other receptors are within or below the EPA target cancer risk range. Cancer risks for the current/future commercial workers, future commercial workers in areas 1 and 2, and combined adult and pre-adolescent wetland/marsh receptors exceed the CT DEP target total risk level of 10^{-5} when the RME case is evaluated. Cancer risks for all receptors exceed the CT DEP target risk level of 10^{-6} for single contaminants when the RME case is evaluated. As detailed on Table 6-20A, in soils PAH compounds, dioxins, arsenic, and total Aroclors (PCBs) are predominant risk drivers. CTE cancer risks for future commercial workers in area 2 are within the EPA target risk range, but exceed the CT DEP target risk level of 10^{-6} for benzo(a)pyrene, arsenic, and dioxins. CTE cancer risks for all other receptors are within or below the EPA target risk range and below the CT DEP target risk levels.

6.7.4.3 Exposure to Lead

Lead was identified as a COPC in surface and subsurface soil at the Lower Ferry Creek. Lead was detected at a maximum concentration of 6,590 mg/kg.

Exposure to lead in soil by the commercial worker was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The exposure point concentration of 745 mg/kg for surface soil under the current scenario and 464 and 474 mg/kg for "all soil" under the future scenarios (average lead concentrations area 1 and area 2) as well as several default parameters were used to estimate

the probability that the fetal blood-lead levels of fetuses born to workers in a commercial setting will exceed a level of concern of 10 µg/dL. EPA's stated goal for lead is that individuals exposed would have no more than 5 percent probability of exceeding the level of concern of 10 µg/dL. Under the current surface soil RME exposure scenario assuming a soil ingestion rate of 100 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 4.69 to 12.01 percent. Under the current surface soil CTE exposure scenario assuming a soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 1.16 to 5.63 percent. Using EPA's default values for baseline adult blood lead concentration and standard deviation in combination with the CTE soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 3.71 percent. Under the future area 1 "all soil" RME exposure scenario, the probability that the fetal blood lead level exceeds 10 µg/dL is 1.77 to 7.04 percent. Under the future area 1 "all soil" CTE exposure scenario, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.52 to 3.74 percent. Using EPA's default values for baseline adult blood lead concentration and standard deviation in combination with the CTE soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 2.23 percent. Under the future "all soil" RME exposure scenario at the western portion of the wetlands along Lockwood Avenue (area 2), the probability that the fetal blood lead level exceeds 10 µg/dL is 1.84 to 7.2 percent. Under the future "all soil" CTE exposure scenario at the western portion of the wetlands along Lockwood Avenue (area 2), the probability that the fetal blood lead level exceeds 10 µg/dL is 0.54 to 3.8 percent. Using EPA's default values for baseline adult blood lead concentration and standard deviation in combination with the CTE soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 2.28 percent.

Exposure to lead in soil by the trespasser was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The exposure point concentration of 582 mg/kg for surface soil (average lead concentrations) as well as several default parameters were used to estimate the probability that the fetal blood-lead levels of fetuses born to women in a trespasser setting will exceed a level of concern of 10 µg/dL. EPA's stated goal for lead is that individuals exposed would have no more than 5 percent probability of exceeding the level of concern of 10 µg/dL. Under the RME exposure scenario assuming a soil ingestion rate of 100 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.23 to 2.51 percent. Under the CTE exposure scenario assuming a

soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.13 to 1.94 percent. Using EPA's default values for baseline adult blood lead concentration and standard deviation in combination with the CTE soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.97 percent.

6.7.4.4 Asbestos

Asbestos was detected in 42 of 131 solid matrix samples collected in the 0- to 15-foot interval at a concentration range of 0.99 to 50 percent. The average concentration was 2 percent. Although quantitative risk estimates (inhalation risk estimates) can not be developed for this parameter, it should be noted that asbestos-containing material is material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61). 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.

6.7.5 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 6.6. Area-specific uncertainties for Area B are presented in the following narrative.

- Copper concentrations exceeded COPC screening criteria in Area B soils/sediments; however due to the lack of a verifiable toxicity value, no quantitative estimate of risks can be performed. Copper is a significant contaminant in Raymark waste. It is reported in Area B soils/sediments (0 to 15 feet bgs) at concentrations ranging from 8.3 mg/kg to 3,450 mg/kg. The maximum concentration exceeds the EPA Region III residential soil ingestion risk-based concentration of 3,100 mg/kg. The absence of a quantitative risk evaluation of copper may result in an underestimate of total non-cancer risks.

- Several PAHs selected as COPCs were detected at concentrations that are within an order of magnitude of the background concentrations determined for sediments. These include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-

cd)pyrene. Additionally, dibenzo(a,h)anthracene was detected at a maximum concentration of 1,900 µg/kg, which is below its background concentration of 2,000 µg/kg.

- Of the 15 inorganics that were selected as COPCs, arsenic, manganese, and vanadium were detected at maximum concentrations that are less than twice their maximum background concentrations (Table 6-14). Arsenic, with a background concentration of 11.6 mg/kg, was detected at concentrations ranging from 1.5 to 20.1 mg/kg. Manganese concentrations ranged from 41.2 to 1,080 mg/kg, with a background concentration of 660 mg/kg. Vanadium has a background concentration of 81.9 mg/kg, and sample concentrations were between 7 and 140 µg/kg.

6.7.6 Summary of Human Health Risk Assessment

This section and Table 6-21 present a summary of major risk assessment findings for Area B. Four potential receptor groups were evaluated: commercial worker, wetland/marsh receptor, adolescent trespasser, and local fisherman.

- The hazard index developed for potential future commercial workers in the western portion of the wetlands along Lockwood Avenue (area 2) RME case exceeds unity. The hazard quotient for total Aroclor alone exceeds unity, therefore there is a potential for adverse noncarcinogenic health effects.

- Hazard indices are less than unity for current commercial workers, future commercial workers in area 1, wetland/marsh receptors, trespassers, and local fishermen, indicating that adverse noncarcinogenic health effects are not anticipated for these receptors under the conditions established in the exposure assessment.

- The risk estimate developed for potential future commercial workers in the western portion of the wetlands along Lockwood Avenue area (area 2) exceeds the EPA target cancer risk range (10^{-4} to 10^{-6}) and CT DEP target risk levels (10^{-5} for multiple contaminants and 10^{-6} for single contaminants) for the RME case. Primary contributors to this risk are total Aroclors, PAHs, and dioxins.

- The risk estimates for all other receptors are within the EPA target cancer risk range (10^{-4} to 10^{-6}). Cancer risks for current/future commercial workers, future commercial workers in area 1, local fishermen consuming mussels or oysters, trespassers, and adult and preadolescent wetland/marsh receptors exceed the CT DEP target risk level of 10^{-6} for single contaminants when the RME case is evaluated.

- Exposures to lead in soil by the commercial worker and trespasser were evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). Under the commercial worker scenarios, the results of the slope-factor approach indicate that the probability that blood lead levels of fetuses born to women exposed to lead in soil at Area B will exceed the level of concern is greater than EPA's stated goal of 5 percent for some combinations of exposure parameters. However, using EPA default values for exposure parameters, the probability that fetal blood lead levels will exceed the level of concern is less than 5 percent. Under the trespasser scenario, the results of the slope-factor approach indicate that the probability that blood lead levels of fetuses born to women exposed to lead in soil at Area B will exceed the level of concern is within EPA's stated goal.

- Asbestos was detected in 42 of 131 solid matrix samples collected in the 0- to 15-foot interval at a concentration range of 0.99 to 50 percent. The average concentration was 2 percent.

6.8 Baseline Human Health Risk Assessment – Area C, The Housatonic Boat Club Wetlands Area

This section contains the baseline risk assessment performed for soil, wetland soil, sediment, and surface water exposures at Area C, the Housatonic Boat Club Wetlands Area. The Housatonic Boat Club property was studied under the Shore Road EE/CA and is not part of the scope of work for this human health risk assessment. Section 6.8.1 provides an overview of Area C, Section 6.8.2 contains a discussion of the selection of COPCs, Section 6.8.3 contains information on the potential receptors considered and the routes by which they might

be exposed, Section 6.8.4 contains the numerical results of the risk assessment, and Section 6.8.5 presents area-specific uncertainties.

6.8.1 Overview of Area C, the Housatonic Boat Club Wetlands Area

Area C, Housatonic Boat Club Wetlands Area encompasses undeveloped wetlands that are tidally influenced by the Housatonic River. The site covers approximately 23.4 acres, including wetlands. A more detailed description of Area C is provided in Section 6.8.3.1. The nature and extent of the contamination detected in Area C was discussed in Section 4. Descriptive statistics (frequency of detection, range of positive detections, range of non-detects, location of maximum detections, and arithmetic mean) for target analytes detected in the Area C environmental media are also summarized in Tables 6-22 through 6-25.

6.8.2 Data Evaluation

Tables 6-22, 6-23, and 6-25 present a summary of the COPCs for quantitative risk assessment for Area C surface soils/wetland materials/sediments, "all soils" to a depth of 15 feet bgs, and surface waters, respectively. COPCs were identified based on a comparison of site data to the COPC screening levels defined in Section 6.2. All validated CLP data collected during recent and historical investigations, except soil data collected from depths greater than 15 feet, were used to identify COPCs. The 1999 data collected by SAIC, Inc. are not included in the human health risk assessment. Soil data at depths greater than 15 feet were not used because human exposure to soils deeper than 15 feet below ground surface is considered very unlikely. Because of the significant correlation observed between field screening data and validated CLP data for lead and copper, screening data were also used for these chemicals at sample locations where no CLP data are available. An evaluation of groundwater is not part of the scope of work for this human health risk assessment, but will be addressed as part of an area-wide groundwater assessment to be provided as a separate document.

Table 6-24A and B compare maximum chemical concentrations detected in the surface soils, wetland soils, and sediments data set and the "all soils" data set, respectively, to the groundwater protection benchmarks defined in Section 6.2.1.1 (the Generic SSLs for migration from soil to groundwater and State Pollutant mobility GB criteria). Although groundwater data

were not addressed in this risk assessment, the comparison allows for a preliminary evaluation of the potential for chemicals to migrate to groundwater and potentially impact the quality of groundwater. Chemicals in excess of groundwater protection benchmarks, but not in excess of direct exposures 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.

A media specific-discussion of COPCs is presented in the following paragraphs.

6.8.2.1 COPCs for Soil/Wetland Material/Sediment

The COPC selection process for soil, wetland material, and sediment is summarized in Tables 6-22 and 6-23. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum Area C concentrations to risk-based COPC screening levels for residential land use, Generic SSLs for migration from soil to air, State RSRs, and maximum background concentrations (inorganic chemicals only):

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors (1242, 1248, 1254, 1262, and 1268)
- Metals (antimony, arsenic, barium, chromium, copper, lead, manganese, nickel, thallium, and zinc)
- Dioxins/Furans
- Asbestos

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels. Aroclor 1242, Aroclor 1248, and Aroclor 1254 were detected in soil 0 to 15 feet bgs only.

Aluminum and iron were not selected as COPCs, despite concentrations above the risk-based COPC screening levels. EPA Region I does not advocate quantitative risk assessment of the health effects of these metals due to the lack of adequate toxicity criteria.

EPA Region I does not advocate quantitative risk assessment of the health effects of copper. However, since copper is a significant contaminant in Raymark waste, it was selected as a COPC. A qualitative evaluation of copper exposure is included in the uncertainty section.

Zinc was selected as a COPC for the 0 to 15 feet bgs category only since the maximum concentrations in the surface soil samples (from depths of 0 to 2 feet bgs) were less than the direct exposure screening level.

Maximum detections in soil, wetland material, and sediment were also compared to Generic SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area (Table 6-24). Maximum concentrations of the following chemicals exceeded the generic soil pollutant mobility criteria, indicating a potential for these chemicals to migrate to groundwater and potentially impact the quality of groundwater:

- SVOCs (carbazole, N-nitrosodiphenylamine, and pentachlorophenol)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Pesticides (4,4'-DDE, aldrin, alpha-BHC, delta-BHC, and dieldrin)
- Metals (antimony, barium, chromium, nickel, and thallium)

Maximum detections in soil, wetland material, and sediment of benzo(k)fluoranthene exceeded the groundwater benchmarks for the 0 to 15 feet bgs category only since the maximum concentration of this chemical in the surface soil samples (from depths of 0 to 2 feet bgs) was less than the Generic SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area.

6.8.2.2 COPCs for Surface Water

Table 6-25 presents a summary of the COPC selection process for surface water. Based on a comparison of maximum Area C concentrations to risk-based COPC screening levels for tap water use and drinking water standards (federal and state MCLs), the following chemicals were identified as COPCs:

- Pesticide (dieldrin)
- Aroclor (1268)
- Metals (antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, and thallium)

Although surface water in the area is not currently used or expected to be used in the future as a drinking water supply, drinking water criteria (federal and state MCLs) were included for informational purposes and to conservatively identify COPCs for Area C. Aluminum and iron were not selected as COPCs, despite concentrations above the risk-based COPC screening levels and/or federal MCLs. EPA Region I does not advocate quantitative risk assessment of the health effects of these metals due to the lack of adequate toxicity criteria. The Connecticut State MCL for sodium is a state notification level and is not risk based. For this reason, sodium was not selected as a COPC, despite concentrations above the state MCL.

6.8.3 Area C, Exposure Assessment

The exposure assessment contains a discussion of the potential for human exposure at Area C and identifies the rationale for the selection of exposure input parameters used to estimate exposure intakes. A detailed description of the potential receptors, exposure routes, and intake estimation methods used in the exposure assessment is presented in Section 6.4. Area-specific information regarding exposure is provided in this section.

The potential for exposure at Area C is based on several factors, including current and future land uses, activity patterns, area access controls, chemical behavior in the environment, and

the presence of human receptors. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under both current and future conditions. The future scenario accounts for likely or anticipated changes in land use and area characteristics that may alter exposure and/or concentrations of COPCs in a given medium.

The exposure assessment is based on the assumptions that, in general, chemical compositions for environmental media are identical under current and future conditions. Under current conditions, potential human receptors (the wetland/marsh receptors) are assumed to be exposed to surface soil and/or sediment (0 to 2 feet bgs). Similar soil/sediment exposure is likely for potential receptors under future conditions. Given that future changes to the chemical composition of the river/creek/marshy waters are difficult to predict, it is assumed for purposes of this risk assessment that chemical concentrations in surface water would not change in the future.

A summary of the potentially significant exposures identified for quantitative evaluation for Area C is provided in Table 6-26.

6.8.3.1 Area C, Land Use and Access

Area C, Housatonic Boat Club Wetland Area, is located to the south and adjacent to Area B, as shown in Figure 1-2. It encompasses undeveloped wetlands that are tidally influenced by the Housatonic River. The site covers approximately 8.1 acres of wetlands.

Area C is bounded by Shore Road to the west, the Housatonic River to the east, the Tide Harbours Condominium Complex to the south, and a public boat launch area at the end of Stratford Avenue to the north. The Housatonic Boat Club property was formerly included in Area C, but has since been evaluated separately under the Shore Road EE/CA (OU5).

6.8.3.2 Area C, Potential Receptors

As identified in Section 6.4, 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, access, COPCs, and the

likelihood of exposure. Of the receptors initially considered (residents, recreational users, commercial workers, construction workers, and trespassers), the receptors retained for quantitative evaluation are wetland/marsh receptors.

Possible exposures of wetland/marsh receptors to site-related contaminants would be through recreational activities, such as walking, wading, and boating. Persons involved in recreational activities (the wetland/marsh receptor) may visit the river at Area C, thereby coming in contact with potentially contaminated site media. It is not anticipated that these receptors will contact sediments found within the river in areas covered by 4 or more feet of water at low tide.

Future on-site residents were not included in the baseline risk assessment for Area C. Much of the soil in Area C, surrounding the Housatonic River, is wetland material and local construction practices preclude subsurface excavation and/or development of Area C for residential purposes. In addition, groundwater in the area is not used or expected to be used in the future as a potable water supply because of brackish conditions.

6.8.3.2.1 Wetland/Marsh Receptors

Area C, Housatonic Boat Club Wetland Area, is primarily recreational. Wetland/marsh receptors are evaluated for exposure to surficial soils, sediments, and wetland soils (0 to 2 feet bgs) in all of Area C, with the exception of areas covered by 4 or more feet of water at low tide, under current and future land use. Wading is included as a possible recreational use of this area, therefore, direct but limited contact with surface water in the Housatonic River is anticipated for these receptors. Wetland/marsh receptors, both adult and pre-adolescent child (ages 6 to 11 years) are assumed to be exposed to area media infrequently (20 days/year). These receptors are assumed to ingest an average of 100 mg/day for 6 years for the child and 100 mg/day for 24 years for the adult for the RME, and an average of 50 mg/day for 2 years for the child and 50 mg/day for 7 years for the adult for the CTE. Face, hands, forearms, and lower legs are expected to be available for dermal contact with soil/wetland soil/sediment. Hands, lower legs, and feet are expected to be available for dermal contact with surface water while wading.

6.8.3.3 Area C, Exposure Pathways

The primary routes of exposure for potential human receptors at Area C are incidental ingestion of and dermal contact with soil, sediment, and wetland soils and dermal contact with surface water. Exposure routes associated with soil, sediment, and wetland soils, and surface water contact are evaluated for wetland/marsh receptors.

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

- The shallow aquifer at Area C is not used as a potable water supply either at Area C or in the surrounding areas. Shallow groundwater at the site discharges to the Housatonic River and its tributaries. Thus, domestic groundwater exposures by nearby residents are eliminated. In addition, as previously mentioned, groundwater at the site is not used or expected to be used in the future as a potable water supply because of brackish conditions and productivity constraints. It should be noted that groundwater quality at Ferry Creek is being investigated as a separate operable unit.

- Potential exposure to volatile emissions and fugitive dust from Area C is considered to be minimal, thereby eliminating the need for quantitative evaluation of this exposure pathway. As shown in Tables 6-22 and 6-23, all reported surface and subsurface soil concentrations are less than the Generic SSLs for transfers from soil to air (EPA, 1996a) with the exception of chromium (C_{MAX} = 950 mg/kg). However, the SSL_{AIR} for chromium assumes that chromium is present in the hexavalent state. The assumption that chromium is in the hexavalent state is overly conservative. Additionally, the average chromium concentration detected in the solid matrix samples (205 mg/kg) is less than the SSL_{AIR} (270 mg/kg).

6.8.3.4 Area C, Exposure Point Concentrations

Current EPA risk assessment guidance (EPA, 1992 and 1994c) was used to identify appropriate exposure point concentrations for CTE and RME conditions. Exposure point concentrations used in the risk assessment are presented in Table 6-27. For wetland soil, soil,

sediment, and surface water, 95 percent UCLs of the arithmetic mean were used as exposure point concentrations in estimating chemical intakes for the RME and CTE. In data sets with 10 samples or less and data sets in which the calculated 95 percent UCL exceeded the maximum detected concentration, the maximum detected concentration was used as the exposure point concentration for the RME and the average concentration was used for the CTE case. Listings of sample locations included in the evaluation of each receptor group are included in Appendix F-5. Support documentation for the calculation of dioxin TEQ concentrations, 95 percent UCLs, and distributions of data sets for COPCs are presented in Appendix F-6.

6.8.3.5 Area C, Estimates of Chemical Intake

Estimates of chemical intake were calculated using equations presented in Section 6.4. Tables 6-10 and 6-11 contain the various assumptions used as input parameters to determine chemical intakes for each potential receptor and exposure route. Chemical intake estimates for Area C are provided in the site-specific risk assessment spreadsheets contained in Appendix F-10.

6.8.4 Risk Characterization

A summary of the quantitative risk assessment for Area C, the Housatonic Boat Club Wetland Area, is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risk for the RME and CTE scenarios, are summarized in Table 6-28 for the wetland/marsh adult and pre-adolescent receptors. Sample calculations are provided in Appendix F-8. Appendix F-10 also contains the chemical specific risks for Area C.

6.8.4.1 Noncarcinogenic Risks

Hazard indices developed the wetland/marsh adult and pre-adolescent receptors were as follows:

	RME Case	CTE Case
Wetland/Marsh Receptor - Adult (Current/Future) (Surface Materials/Surface water)	2.1E+00	1.9E+00
Wetland/Marsh Receptor - Pre-adolescent (Current/Future) (Surface Materials/Surface Water)	2.9E+00	2.4E+00

All hazard indices (HI) exceed unity for total Aroclors in surface water, indicating that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment.

6.8.4.2 Carcinogenic Risks

Incremental cancer risk estimates for the wetland/marsh adult and pre-adolescent receptors were as follows:

	RME Case	CTE Case
Wetland/Marsh Receptor - Adult[1] (Current/Future) (Surface Materials/Surface Water)	3.3E-05	4.34E-06
Wetland/Marsh Receptor - Pre-adolescent[1] (Current/Future) (Surface Materials/Surface Water)	1.4E-05	1.9E-06

Summation of total risk for wetland/marsh receptor (adult plus pre-adolescent: 4.7E-05 (RME case) and 6.2E-06 (CTE case).

The EPA target risk range is 10^{-4} to 10^{-6}. The risk estimates for the adult and pre-adolescent wetland/marsh receptors are within the EPA target cancer risk range.

The CT DEP target risk level is 10^{-6} for any single contaminant and a total risk of 10^{-5}, if there are more than 10 contaminants. The RME cancer risk estimate for adults exceeds the CT DEP target total risk level. For pre-adolescents, the RME cancer risk estimate is approximately equal to the CT DEP target total risk level. When combined, the total risk for adult and preadolescent wetland/marsh receptors exceeds the CT DEP target total risk level when the RME case is evaluated. RME cancer risk estimates for dioxins, benzo(a)pyrene, and Aroclors in soil and Aroclors in surface water exceed the CT DEP target risk level of 10^{-6} for single contaminants. When the CTE case is evaluated adult risks, pre-adolescent risks, and

combined risks are below the CT DEP target total risk level, however cancer risks for total Aroclor in surface water exceeds the CT DEP target risk level of 10^{-6} for single contaminants.

6.8.4.3 Exposure to Lead

Lead was identified as a COPC in surface and subsurface soil at the Housatonic Boat Club Wetland Area. Lead was detected at a maximum concentration of 7,860 mg/kg. The lead models available are not reliable for evaluation of risks for infrequent exposures. Since the wetland/marsh receptor is the only receptor in this area and frequency of exposure for this receptor is inappropriate to use in the model, no quantitative evaluation of lead is included for this area. Study area average lead concentration in surface soils is 387 ppm.

6.8.4.4 Asbestos

Asbestos was detected in 13 of 90 solid matrix samples collected in the 0- to 2-foot interval at a concentration range of 0.99 to 60 percent. The average concentration was one percent.

6.8.5 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 6.6. Area-specific uncertainties for Area C are presented in the following narrative.

- Copper concentrations exceeded COPC screening criteria in Area C soils/sediments; however due to the lack of a verifiable toxicity value, no quantitative estimate of risks can be performed. Copper is a significant contaminant in Raymark waste. It is reported in Area C soils/sediments (0 to 15 feet bgs) at concentrations ranging from 20.6 mg/kg to 12,700 mg/kg. The maximum concentration exceeds the EPA Region III residential soil ingestion risk-based concentrations of 3,100 mg/kg. The absence of a quantitative risk evaluation of copper may result in an underestimate of total non-cancer risks.

- As detailed in Section 4, the maximum detected concentration of benzo(a)anthracene and benzo(a)pyrene were within an order of magnitude of the maximum background concentration determined for sediments. Additionally, several PAHs were detected at maximum concentrations that were less than their respective background levels. Benzo(b)fluoranthene was detected at a maximum concentration of 6,900 µg/kg (background concentration - 12,000 µg/kg). The maximum detected concentration of 1,300 µg/kg for dibenzo(a,h)anthracene is less than its background concentration of 2,000 µg/kg. Indeno(1,2,3-cd)pyrene has a background concentration of 5,200 µg/kg and had a maximum detected concentration of 2,400 µg/kg.

- Several inorganic COPCs for study area C were detected at concentrations that are less than twice their background concentrations. For example, manganese was detected between 79.4 and 586 mg/kg and has a background concentration of 660 mg/kg.

6.8.6 Summary of Human Health Risk Assessment

This section and Table 6-29 present a summary of major risk assessment findings for Area C. One potential receptor group was evaluated: wetland/marsh receptors.

- The hazard indices are greater than unity for exposures to total Aroclor concentrations in surface water, indicating that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment.

- The risk estimates for all receptors are within or below the EPA target cancer risk range. RME cancer risks exceed the CT DEP target total risk level of 10^{-5}, and the CT DEP single contaminant target risk level of 10^{-6} for dioxins, benzo(a)pyrene, and Aroclors in soil and Aroclors in surface water. CTE cancer risks exceed the CT DEP target risk level of 10^{-6} for Aroclors in surface water.

- Exposure to lead in soil by the wetland/marsh receptor can not be evaluated by use of the EPA Technical Review Workgroup for Lead Model (EPA, December 1996d). Study

area average lead concentration in surface soils is 387 ppm. Maximum lead concentrations of 7860 ppm were detected.

- Asbestos was detected in 13 of 90 solid matrix samples collected in the 0- to 2-foot interval at a concentration range of 0.99 to 60 percent. The average concentration was 1 percent.

6.9 Baseline Human Health Risk Assessment - Area F, Selby Pond

This section contains the baseline risk assessment performed for soil, wetland soil, sediment, surface water, and biota exposures at Area F, Selby Pond. Section 6.9.1 provides an overview of Area F, Section 6.9.2 contains a discussion of the selection of COPCs, Section 6.9.3 contains information on the potential receptors considered and the routes by which they might be exposed, Section 6.9.4 contains the numerical results of the risk assessment, and Section 6.9.5 presents area-specific uncertainties.

6.9.1 Overview of Area F, Selby Pond

Area F, Selby Pond includes open water (Selby Pond) and surrounding vegetated wetlands. Area F covers approximately 6.4 acres, including wetlands and open water. Tidal flow is exchanged between Ferry Creek and Selby Pond. A more detailed description of Area F is provided in Section 6.9.3.1. The nature and extent of the contamination detected in Area F was discussed in Section 4. Descriptive statistics (frequency of detection, range of positive detections, range of non-detects, location of maximum detections, and arithmetic mean) for target analytes detected in the Area F environmental media are also summarized in Tables 6-30 through 6-34.

6.9.2 Data Evaluation

Tables 6-30, 6-31, 6-33, and 6-34 present a summary of the COPCs for quantitative risk assessment for Area F surface soils/wetland soils/sediments, "all soils" to a depth of 15 feet bgs, surface waters, and biota, respectively. COPCs were identified based on a comparison of Area F data to the COPC screening levels defined in Section 6.2. All validated CLP data

collected during recent and historical investigations, except soil data collected from depths greater than 15 feet, were used to identify COPCs. The 1999 data collected by SAIC, Inc. are not included in the human health risk assessment. Soil data at depths greater than 15 feet were not used because human exposure to soils deeper than 15 feet below ground surface is considered very unlikely. Because of the significant correlation observed between field screening data and validated CLP data for lead and copper, screening data were also used for these chemicals at sample locations where no CLP data are available. An evaluation of groundwater is not part of the scope of work for this human health risk assessment, but will be addressed as part of an area-wide groundwater assessment to be provided as a separate document.

Tables 6-32A and 6-32B compare maximum chemical concentrations detected in the surface soils, wetland soils, and sediments data set and the "all soils" data set, respectively, to the groundwater protection benchmarks defined in Section 6.2.1.1 (the Generic SSLs for migration from soil to groundwater and State Pollutant mobility GB criteria). Although groundwater data were not addressed in this risk assessment, the comparison allows for a preliminary evaluation of the potential for chemicals to migrate to groundwater and potentially impact the quality of groundwater. Chemicals in excess of groundwater protection benchmarks, but not in excess of direct exposures 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.

A media-specific discussion of COPCs is presented in the following paragraphs.

6.9.2.1 COPCs for Soil/Wetland Material/Sediment

The COPC selection process for soil, wetland material, and sediment is summarized in Tables 6-30 and 6-31. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum Area F concentrations to risk-based COPC screening levels for residential land use, Generic SSLs for migration from soil to air, State RSRs, and maximum background concentrations (inorganic chemicals only):

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors (1262 and 1268)
- Metals (antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc)
- Dioxins/Furans

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels.

Aluminum and iron were not selected as COPCs, despite concentrations above the risk-based COPC screening levels. EPA Region I does not advocate quantitative risk assessment of the health effects of these metals due to the lack of adequate toxicity criteria.

EPA Region I does not advocate quantitative risk assessment of the health effects of copper. However, since copper is a significant contaminant in Raymark waste, it was selected as a COPC. A qualitative evaluation of copper exposure is included in the uncertainty section.

Nickel was selected as a COPC for the 0 to 15 feet bgs category only since the maximum concentrations of this chemical in the surface soil samples (from depths of 0 to 2 feet bgs) was less than the direct exposure screening levels.

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

- SVOCs (carbazole)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene)
- Pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, dieldrin, and gamma-chlordane)

- Metals (antimony, cadmium, chromium, mercury, nickel, selenium, and silver)

Maximum detections in soil, wetland material, and sediment of nickel exceeded the groundwater benchmarks for the 0 to 15 feet bgs category only since the maximum concentrations of this chemical in the surface soil samples (from depths of 0 to 2 feet bgs) was less than the Generic SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area.

Under the Connecticut RSR guidance (CT DEP, January 1996), concerns regarding the mobility of inorganics are addressed using TCLP and/or SPLP data. A comparison of area-specific TCLP data to State RSRs for pollutant mobility and TCLP criteria is provided in Table 6-32C. Reported concentrations of lead in the TCLP extracts from three sediment samples exceeded the State pollutant mobility criteria.

6.9.2.2 COPCs for Surface Water

Table 6-33 presents a summary of the COPC selection process for surface water. Based on a comparison of maximum Area F concentrations to risk-based COPC screening levels for tap water use and drinking water standards (federal and state MCLs), the following chemicals were identified as COPCs:

- Pesticides (heptaclor epoxide)
- Metals (antimony, arsenic, manganese, and thallium)

Although surface water in the area is not currently used or expected to be used in the future as a drinking water supply, drinking water criteria (federal and state MCLs) were included for informational purposes and to conservatively identify COPCs for Area F. Iron was not selected as a COPC, despite concentrations above the risk-based COPC screening level. EPA Region I does not advocate quantitative risk assessment of the health effects of this metal due to the lack of adequate toxicity criteria. The Connecticut State MCL for sodium is a state notification level and is not risk based. For this reason, sodium was not selected as a COPC, despite concentrations above the state MCL.

6.9.2.3 COPCs for Biota

A summary of the COPC selection process for biota (American Eels and White Perch) are provided in Table 6-34. Based on a comparison of maximum site American Eel concentrations to risk-based COPC screening levels for fish, the following chemicals were identified as COPCs for American Eels:

- Pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, dieldrin, and heptaclor epoxide)
- Aroclor 1262

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels.

Based on a comparison of maximum Area F White Perch concentrations to risk-based COPC screening levels for fish, the following chemicals were identified as COPCs for White Perch:

- Pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, and dieldrin)
- Aroclor 1262

All Aroclors were retained as COPCs because at least one Aroclor was detected at a maximum concentration exceeding COPC screening levels.

6.9.3 Area F, Exposure Assessment

The assessment contains a discussion of the potential for human exposure at Area F and identifies the rationale for the selection of exposure input parameters used to estimate exposure intakes. A detailed description of the potential receptors, exposure routes, and intake estimation methods used in the exposure assessment is presented in Section 6.4. Area-specific information regarding exposure is provided in this section.

The potential for exposure at Area F is based on several factors, including current and future land uses, activity patterns, site access controls, chemical behavior in the environment, and

the presence of human receptors. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under both current and future conditions. The future scenario accounts for likely or anticipated changes in land use and area characteristics that may alter exposure and/or concentrations of COPCs in a given medium.

The exposure assessment is based on the assumptions that, in general, chemical compositions for environmental media are identical under current and future conditions. Under current conditions, potential human receptors (frequent recreational users) are assumed to be exposed to surface soil and/or sediment (0 to 2 feet bgs). Similar soil/sediment exposure is likely for potential receptors under future conditions. Given that future changes to the chemical composition of the creek/marshy waters are difficult to predict, it is assumed for the purposes of this risk assessment that chemical concentrations in surface water would not change in the future. The Agency for Toxic Substances and Disease Registry (ATSDR) has issued a Public Health Advisory for Selby Pond that recommends a reduced eel consumption rate such as one meal per month, thereby reducing current exposures. Under future conditions, potential human receptors (fishermen) are assumed to be exposed to biota. It is assumed for the purposes of this risk assessment that chemical concentrations in biota would not change in the future.

A summary of the potentially significant exposures identified for quantitative evaluation for Area F is provided in Table 6-35.

6.9.3.1 Area F, Land Use and Access

Area F, Selby Pond, is located approximately 500 feet south of Ferry Creek and 400 feet west of the Housatonic River, south of the intersection of Stratford Avenue and Lockwood Avenue, as shown in Figure 1-2. It includes open water (Selby Pond) and surrounding vegetated wetlands. Area F covers approximately 6.4 acres, with approximately 4.1 acres of wetlands, of which approximately 2.1 acres are open water. Tidal flow is exchanged between Ferry Creek and Selby Pond.

Area F is bordered primarily by residential properties to the west, north, and east, and by the American Shakespeare Theater property to the south. Selby Pond and the neighboring

American Shakespeare Theater property are currently owned by the State of Connecticut. Portions of the wetland are located on residential properties.

6.9.3.2 Area F, Potential Receptors

As identified in Section 6.4, 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 users, construction workers, fishermen, and trespassers), the only receptors retained for quantitative evaluation are frequent recreational users and fishermen. As discussed in Section 6.4, the frequent recreational user is evaluated to estimate risks to individuals residing in close proximity to Area F.

Possible exposures of nearby residents to site-related contaminants would be through recreational activities. Since access to the area is not restricted and since some recreational activities (boating, fishing, etc.) are permitted in Selby Pond, persons involved in recreational activities (the frequent recreational user) may visit the area, thereby coming in contact with potentially contaminated area media.

Possible exposures of local fishermen in the future to site-related contaminants would be through consumption of eels or white perch from Selby Pond.

Future on-site residents and construction workers were not included in the baseline risk assessment for Area F. No major construction projects are planned for Area F or the surrounding areas. The nature of the wetland material surrounding Selby Pond and local construction practices preclude subsurface excavation and/or development of Area F for residential purposes. In addition, groundwater in the area is not used or expected to be used in the future as a potable water supply because of brackish conditions.

6.9.3.2.1 Recreational Users

Area F, Selby Pond, is primarily used for boating by nearby residents. These frequent recreational users are evaluated for exposure to surficial wetland soil (0 to 2 feet bgs) and surface water under current and future land use. The boggy nature of the pond precludes wading and swimming in the pond. Therefore, direct contact with sediments within the pond is not anticipated. Recreational users are assumed to be exposed to area media frequently (90 days/year) due to the proximity of residential properties. These receptors are assumed to ingest an average of 200 mg/day for 6 years for the child and 100 mg/day for 24 years for the adult for the RME, and an average of 100 mg/day for 2 years for the child and 50 mg/day for 7 years for the adult for the CTE. Face, hands, forearms, and lower legs are expected to be available for dermal contact with soils. Hands, lower legs, and feet are expected to be available for dermal contact with surface waters.

6.9.3.2.2 Local Fishermen

Due to the presence of resident eel and perch populations in Selby Pond, local fishermen may visit Selby Pond. A current Health Advisory limiting consumption of American Eels from Selby Pond is in place. Local fishermen are evaluated for exposure to contaminants through consumption of American Eel or White Perch obtained from Selby Pond under future land use. These receptors are assumed to ingest an average of 9.5 g/day for 9 years for the CTE and 54 g/day 30 years for the RME.

6.9.3.3 Area F, Exposure Pathways

The primary routes of exposure for potential human receptors at Area F are incidental ingestion of and dermal contact with wetland soil, and dermal contact with surface water. Exposure routes associated with soil and surface water contact are evaluated for recreational users. Fish ingestion was considered for adult fishermen only. Children were not evaluated for this exposure route because the anticipated risks for children are expected to be similar to the risks for adult receptors (EPA, 1989a and 1989b). Although children are expected to eat less fish than adults, the lower body weight for children as compared to the adult body weight would compensate for the differences in ingestion rates. Therefore, an evaluation of the risks

for adult receptors is considered to adequately address potential risks associated with this exposure route for all receptors.

Other potential exposure routes such as groundwater uses, inhalation of fugitive dust and volatile emissions, and ingestion of surface water were not considered for the following reasons:

- The shallow aquifer at Selby Pond is not used as a potable water supply either at Area F or in the surrounding areas. Shallow groundwater in the area discharges to Selby Pond and Ferry Creek and its tributaries. Thus, domestic groundwater exposures by nearby residents are eliminated. In addition, as previously mentioned, groundwater in the area is not used or expected to be used in the future as a potable water supply because of brackish conditions and productivity constraints.

- Potential exposure to volatile emissions and fugitive dust from Area F is considered to be minimal, thereby eliminating the need for quantitative evaluation of this exposure pathway. As shown in Tables 6-30 and 6-31, all reported surface and subsurface soil concentrations are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a) with the exception of chromium. However, the SSL_{AIR} for chromium assumes that chromium (C_{MAX} = 505 mg/kg) is present in the hexavalent state. The assumption that chromium is in the hexavalent state is overly conservative. The average chromium concentration detected in the solid matrix samples (48 mg/kg) is less than the SSL_{AIR} (270 mg/kg). Additionally, the majority of the site is vegetated and/or wet, therefore the generation of fugitive dust via wind erosion is not expected to contribute significantly to exposures.

- Direct contact with sediment underlying Selby Pond and ingestion of surface water by potential human receptors was not evaluated because anticipated exposure is expected to be minimal. Because of the unattractive boggy nature of the pond, wading and swimming are unlikely to occur. Although boating and fishing activities may bring recreational users in contact with surface water, exposures would be limited primarily to dermal contact on the receptor's hands. Ingestion of surface water is not considered to be worthy of quantitative evaluation because of the anticipated limited contact.

6.9.3.4 Area F, Exposure Point Concentrations

Current EPA risk assessment guidance (EPA, 1992 and 1994c) was used to identify appropriate exposure point concentrations for CTE and RME conditions. Exposure point concentrations used in the risk assessment are presented in Table 6-36. For wetland soil, surface water, eel, and perch, 95 percent UCLs of the arithmetic mean were used as exposure point concentrations in estimating chemical intakes for the RME and CTE. In data sets with 10 samples or less and data sets in which the calculated 95 percent UCL exceeded the maximum detected concentration, the maximum detected concentration was used as the exposure point concentration for the RME and the average concentration was used for the CTE case. Listings of sample locations included in the evaluation of each receptor group are included in Appendix F-5. Support documentation for the calculation of dioxin TEQ concentrations, 95 percent UCLs, and distributions of data sets for COPCs are presented in Appendix F-6.

6.9.3.5 Area F, Estimates of Chemical Intake

Estimates of chemical intake were calculated using equations presented in Section 6.4. Tables 6-10, 6-11, and 6-12 contain the various assumptions used as input parameters to determine chemical intakes for each potential receptor and exposure route. Chemical intake estimates for Area F are provided in the area-specific risk assessment spreadsheets contained in Appendix F-11.

6.9.4 Risk Characterization

A summary of the quantitative risk assessment for Area F, Selby Pond, is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risk for the RME and CTE scenarios, are outlined in Table 6-37 for the frequent adult and child recreational user and the local fisherman. Sample calculations are provided in Appendix F-8. Appendix F-11 contains the chemical specific risk for Area F.

6.9.4.1 Noncarcinogenic Risks

Hazard indices developed for the frequent adult and child recreational user exposed to near shore surface wetland materials along the banks of Selby Pond and the surface waters of Selby Pond and for the local fisherman were as follows:

	RME Case	CTE Case
Frequent Recreational User Adult (Current/Future)(Surface Materials/Surface Waters)	1.3E-01	3.1E-02
Frequent Recreational User Child (Current/Future)(Surface Materials/Surface Waters)	7.5E-01	9.2E-02
Local Fisherman (Eels)	2.1E-02	2.4E-03
Local Fisherman (White Perch)	5.9E-03	5.2E-04

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

6.9.4.2 Carcinogenic Risks

Incremental cancer risk estimates developed for the frequent adult and child recreational user exposed to near shore surface wetland materials along the banks of Selby Pond and the surface waters of Selby Pond and for the local fisherman were as follows:

	RME Case	CTE Case
Frequent Recreational User Adult[(1)] (Current/Future)(Surface Materials/Surface Waters)	4.0E-05	1.4E-06
Frequent Recreational User Child[(1)] (Current/Future)(Surface Materials/Surface Waters)	8.6E-05	2.5E-06
Local Fisherman (Eels)	4.9E-07	1.6E-08
Local Fisherman (White Perch)	1.6E-07	2.8E-09

(1) Summation of total risk for frequent recreational user (adult plus child): 1.3E-04 (RME case) and 3.9E-06 (CTE case).

The EPA target risk range is 10^{-4} to 10^{-6}. The CT DEP target cancer risk level is 10^{-6} for any single contaminant and a total risk of 10^{-5} if there are more than 10 contaminants. The risk estimates for the RME adult and child recreational receptor exposed to COPCs in wetland material along the banks of Selby Pond and in surface waters of Selby Pond are within the

EPA target cancer risk range, but exceed 10^{-5}, the CT DEP target total cancer risk level. The combined risk estimates for adult and child recreational receptors for the RME case is 1.3E-04. As summarized in Table 6-70, the majority of the risk for the recreational users is attributable to exposures to COPCs in wetland material. Dioxin, PAH compounds (benzo(a)pyrene), and arsenic are the predominant risk drivers. Risks from these contaminants exceed the CT DEP target risk level of 10^{-6} for single contaminants for the RME case only. It should be noted that risk estimates for the dermal route of exposure to wetland materials exceed (adult receptor) or approach (child receptor) those calculated for the ingestion route of exposure. Risk estimates for exposures to COPCs in surface water and for fish ingestion do not exceed 10^{-6} in any case evaluated.

6.9.4.3 Exposure to Lead

Lead was identified as a COPC in soils/wetland soils/sediments at Selby Pond. Lead was detected at a maximum concentration of 775 mg/kg.

Exposure to lead in surface soil by the frequent child recreational user was evaluated using the EPA IEUBK Model, as discussed in Section 6.4.7. The IEUBK model was developed to evaluate exposures to lead by children in a residential setting. Consequently, using the IEUBK model for child recreational exposures should provide a very conservative evaluation of exposures to lead. A time-weighted exposure point concentration was calculated based on the average lead concentration of 256 mg/kg in Area F, an assumed lead concentration of 200 mg/kg at the home yard, and the assumption that the residential child will ingest 50 percent of their daily soil intake from Area F and 50 percent from home. The time-weighted exposure point concentration of 212 mg/kg as well as several default parameters were used to estimate blood-lead levels for children in a residential setting. IEUBK Model outputs and sample calculations are included in Appendix F-12. The estimated geometric mean blood-lead level for children exposed to lead in Area F soil was 3.8 µg/dL, which is less than the established level of concern of 10 µg/dL. The IEUBK model estimates that 1.76 percent of children are expected to have blood-lead levels greater than 10 µg/dL, which does not exceed the acceptable level of 5 percent.

Exposure to lead in surface soil by the frequent adult recreational user was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The exposure point concentration of 256 mg/kg for soil as well as several default parameters were used to estimate the probability that the fetal blood-lead levels of fetuses born to women in a recreational user setting will exceed a level of concern of 10 µg/dL. EPA's stated goal for lead is that individuals exposed would have no more than 5 percent probability of exceeding the level of concern of 10 µg/dL. Under the RME scenario assuming a soil ingestion rate of 100 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.18 to 2.23 percent. Under the CTE exposure scenario assuming a soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.11 to 1.82 percent. Using EPA's default values for baseline adult blood lead concentration and standard deviation in combination with the CTE soil ingestion rate of 50 mg/d, the probability that the fetal blood lead level exceeds 10 µg/dL is 0.89 percent.

6.9.4.4 Asbestos

Asbestos was detected in 6 of 38 solid matrix samples at a concentration range of 0.1 to 10 percent. The average concentration was 0.44. Although quantitative risk estimates (inhalation risk estimates) cannot be developed for this parameter, it should be noted that asbestos-containing material is material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61). 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. Since these samples were collected from sediment and wetland soils, it is unlikely that the asbestos will present an inhalation hazard.

6.9.5 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 6.6. Area-specific uncertainties for Area F are presented in the following narrative.

- Copper concentrations exceeded COPC screening criteria in Area F soils/sediments; however due to the lack of a verifiable toxicity value, no quantitative estimate of risks

can be performed. Copper is a significant contaminant in Raymark waste. It is reported in Area F soils/sediments (0 to 2 feet bgs) at concentrations ranging from 4.6 mg/kg to 1,240 mg/kg. The absence of a quantitative risk evaluation of copper may result in an underestimate of total non-cancer risks. However, since the maximum concentration is less than the EPA Region III residential and industrial soil ingestion risk-based concentrations of 3,100 mg/kg and 82,000 mg/kg, respectively; it is unlikely that risks due to copper exposure are significant in this area.

- Several PAHs selected as COPCs were detected at concentrations that are within an order of magnitude of the background concentrations determined for sediments. These include benzo(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene.

- Of the 12 inorganics that were selected as COPCs, only vanadium was detected at a concentration that was less than twice background concentrations. Vanadium, with a background concentration of 81.9 mg/kg, was detected between 1.2 and 97.2 mg/kg in surface soils/sediments.

6.9.6 Summary of Human Health Risk Assessment

This section and Table 6-38 present a summary of major risk assessment findings for Area F. Two potential receptor groups were evaluated: frequent recreational user and local fisherman.

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

- The risk estimates for the frequent adult and child recreational user are within the EPA target cancer risk range (10^{-4} to 10^{-6}) for the CTE case. For the RME case, risk estimates for the frequent adult and child recreational user are within the EPA target cancer risk range, but exceed 10^{-5}, the CTDEP target total cancer risk level. The combined adult and child risk estimates for the RME case is 1.3E-04. Dioxin/furans, PAH compounds (e.g., benzo(a)pyrene), and arsenic in wetland materials are the

predominant risk drivers. Risks from these contaminants exceed the CT DEP target risk level of 10^{-6} for single contaminants for the RME case only.

- Risk estimates for exposures to COPCs in surface water and for fish ingestion do not exceed 1E-6 in any case evaluated.

- Exposure to lead in surface soil by the frequent child recreational user was evaluated using the EPA IEUBK Model. The IEUBK Model results indicate the probability that blood lead levels of the frequent recreational child having direct contact with lead in soil at Area F will exceed the level of concern is within EPA's stated goal.

- Exposure to lead in soil by the frequent adult recreational user was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The results of the slope-factor approach indicate that the probability that blood lead levels of fetuses born to women exposed to lead in soil at Area F will exceed the level of concern is within EPA's stated goal.

- Asbestos was detected in 6 of 38 solid matrix samples at a concentration range of 0.1 to 10 percent. The average concentration was 0.44 percent. These samples were collected from wet sediment and moist (wetland) soils and are therefore unlikely to pose an inhalation hazard.

6.10 Summary of Human Health Risk Assessment for Areas B, C, and F

This section presents a summary of major risk assessment findings for Areas B, C and F.

6.10.1 Noncarcinogenic Risks

- Except for the potential future commercial worker in the western portion of the wetlands along Lockwood Avenue under the RME scenario, all HIs are less than unity in Area B, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment for trespassers, wetland/marsh receptors, current commercial workers, and local fishermen. Risks estimated for potential

future commercial workers are based on exposures to soils currently located at depths up to 15 feet bgs. Total Aroclors was the primary contributor to the hazard index for the potential future commercial worker in the western portion of the wetlands along Lockwood Avenue. The HQ for total Aroclors in soils exceeds unity when the potential future commercial worker in the western portion of the wetlands along Lockwood Avenue is evaluated for the RME case. A potential for adverse noncarcinogenic effects is anticipated for this receptor.

- In Area C, HIs were greater than unity for exposures to total Aroclor concentrations in surface water, indicating that adverse noncarcinogenic health effects are possible for wetland/marsh receptors.

- Hazard indices in Area F for frequent recreational users and fishermen are below unity.

6.10.2 Carcinogenic Risks

- Cancer risks for potential future commercial workers exposed to soils currently located at depths up to 15 feet bgs in area 2 (the western portion of the wetlands along Lockwood Avenue) of Area B exceed the EPA target cancer risk range for the RME case. Cancer risks for the current commercial worker, future commercial workers in area 1, local fishermen consuming mussels or oysters, trespassers, and adult and pre-adolescent wetland/marsh receptors are within the EPA target risk range of 10^{-4} to 10^{-6}, but exceed the CT DEP target risk level of 10^{-6} for single contaminants for the RME cases. The primary carcinogenic risk drivers are PAHs (benzo(a)pyrene), dioxins, arsenic, dieldrin, and total Aroclors (PCBs). CTE cancer risks for future commercial workers in area 2 are within the EPA target risk range, but exceed the CT DEP target risk level of 10^{-6} for benzo(a)pyrene, arsenic, and dioxins. CTE cancer risks for all other receptors are within or below the EPA target risk range and below the CT DEP target risk level.

- In Area C, the cancer risks for wetland/marsh receptors are within or below the EPA target cancer risk range (10^{-4} to 10^{-6}) and approximately equal to or below the CT DEP target total risk level of 10^{-5}. RME cancer risk estimates for dioxins, benzo(a)pyrene, and total Aroclors in soil and total Aroclors in surface water exceed the CT DEP target risk level of 10^{-6} for

single contaminants. CTE cancer risk estimates for total Arcolors in surface water exceed 10^{-6}.

- Carcinogenic risks are approximately equal to the upper bound of the EPA target cancer risk range (10^{-4} to 10^{-6}) and exceed the CT DEP target total risk level of 10^{-5} for the combined adult and child frequent recreational users in Area F from exposure to soils/wetland soils/sediments (RME case). The primary risk drivers are dioxins/furans, PAHs (benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene), and arsenic in soils/wetland soils/sediments. Risks from these contaminants exceed the CT DEP target risk level of 10^{-6} for single contaminants. Considered separately, risk estimates for adult and child frequent recreational users are within EPA risk range but exceed CT DEP target total and single contaminants risk levels for the RME cases. CTE cancer risk estimates are below CT DEP target total and single contaminant risk levels for adult or child frequent recreational users considered either separately or together. Risk estimates for exposures to COPCs in surface water and for fish ingestion do not exceed 10^{-6} in any case evaluated.

6.10.3 Exposure to Lead

Exposures to lead were evaluated using two models. Exposure to lead in soil by a child was evaluated with 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 acceptable level established by EPA is 5 percent. Exposures to lead in soil for a pregnant adult were evaluated by use of a slope-factor developed by the Technical Review Workgroup for Lead (EPA, December 1996d). The probability that fetal blood lead levels will exceed 10 µg/dL is estimated. EPA's stated goal for lead is that individuals exposed would have no more than 5 percent probability of exceeding the level of concern of 10 µg/dL.

- Lead was detected at a maximum concentration of 6,590 mg/kg in Area B. The exposure point concentrations of 582 mg/kg for surface soil under the trespasser scenarios, 745 mg/kg for surface soil under the current commercial worker, and 464 mg/kg and 474 mg/kg in all soil for the future commercial workers (area 1 and area 2) were used to estimate the probability that fetal blood lead levels will exceed 10 µg/dL. The model predicts that the probability that the fetal blood lead level exceeds 10 µg/dL is greater than the EPA's goal of 5 percent for all commercial worker RME scenarios. The model predicts that the

probability that the fetal blood lead level exceeds 10 µg/dL is less than the EPA's goal of 5 percent for trespasser scenarios.

- In Area C, lead was detected at a maximum concentration of 7,860 mg/kg. The average lead concentration was 387 mg/kg for surface soil. Exposures in this area are too infrequent for the accepted models to be reliable.

- In Area F, lead was detected at a maximum concentration of 775 mg/kg. The exposure point concentration of 256 mg/kg for surface soil was used to estimate blood-lead levels for the frequent adult recreational users. For child recreational users, a time-weighted exposure point concentration of 212 mg/kg was used in the IEUBK model. Under both the adult and child scenarios, the models predict that that the probability that the blood lead level exceeds 10 µg/dL is less than the EPA's goal of 5 percent.

6.10.4 Exposure to Asbestos

Although quantitative risk estimates (inhalation risk estimates) cannot be developed for asbestos, it should be noted that asbestos-containing material is material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61). 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.

- In Area B, asbestos was detected in 42 of 131 solid matrix samples collected in the 0- to 15-foot depth interval at a concentration range of 0.99 to 50 percent. The average concentration was 2 percent.

- In Area C, asbestos was detected in 13 of 90 solid matrix samples collected in the 0- to 2-foot interval at a concentration range of 0.99 to 60 percent. The average concentration was 1 percent.

- In Area F, asbestos was detected in 6 of 38 solid matrix samples at a concentration range of 0.1 to 10 percent. The average concentration was 0.44 percent.