REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

BASELINE RISK ASSESSMENT

Sutton Brook Disposal Area Superfund Site

Tewksbury, Massachusetts

May 2007

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SDMS DOC ID 273578

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EXECUTIVE SUMMARY

Risks assessments serve as the link between the Remedial Investigation and the Feasibility Study, since they provide quantitative information on the nature and magnitude of potential risks, which in turn form the basis for remedial goals for site media. The objective of the baseline human health and ecological risk assessment (HERA) is to characterize potential human health and ecological risks under baseline conditions (i.e., assuming no additional remediation is performed), and to help evaluate whether or not remedial response actions are warranted.

The Sutton Brook Disposal Area Superfund Site (Site) is located in Tewksbury, Massachusetts and is comprised of an inactive landfill primarily surrounded by open space, farming operations, a composting operation, and residential dwellings. Sutton Brook flows east to west through the Site, dividing the landfill into Northern and Southern lobes. Soil, groundwater, sediment, surface water, landfill gas and ambient air data have been collected at the Site as part of various site assessment activities conducted between 1989 and 2006. Sampling events and site data are described in sections of the previously submitted RI Report (February 2007). For the most part, the risk assessment considered the data set established for the RI, which excluded some historical data provided without laboratory reports, screening data, and data rejected via data validation methods.

Activities associated with the RI, risk assessment, and FS were developed and implemented with the presumption that the existing waste material in the two landfill lobes will be closed in-place using current landfill capping technology. Additional soil characterization sampling within the landfill lobes for risk characterization was not performed; samples for physical characteristics of the cover material and from adjacent groundwater, surface water, and sediments were collected and included in the RI and risk characterizations. The conclusions of the risk characterizations are thus predicated on this presumption with regard to the landfill lobes.

Each of the risk assessments completed for the Site is discussed in more detail below.

HUMAN HEALTH RISK ASSESSMENT

The Baseline Human Health Risk Assessment (HHRA) is presented in Section 3 of this report. The purpose of the HHRA is to understand the potential health risks associated with chemicals at/or migrating from the Site in order to evaluate the need for remedial actions.

The HHRA consists of four components:

- Hazard Identification, which describes the data used in the risk assessment, including reference data, evaluates the data with respect to its usability, and presents the selection of the Chemicals of Potential Concern (COPC);
- Exposure Assessment, which presents a detailed description of the Conceptual Site Model, including relevant receptors, exposure pathways and exposure scenarios;
- Dose-Response Assessment, in which toxicity information for the COPCs is identified; and
- Risk Characterization, in which cancer risk estimates and non-cancer hazard indices are quantified for each identified receptor and, as applicable, concentrations of COPCs are compared to applicable standards.

In addition, an Uncertainty Analysis is conducted as part of the HHRA. The Uncertainty Analysis identifies and, where possible, quantifies the uncertainties and biases associated with the risk assessment.

Due to different property uses, activities, ownership, and/or nature and extent of contamination, the Site was divided into the following seven Groups (areas):

- Groups 1 and 2 – former Northern and Southern Landfill lobes, respectively
- Group 3 - Former Drum Disposal Area and Adjacent Disturbed Area
- Group 4 - Former Residence, Garage and Storage Area
- Group 5 - Sutton Brook and Associated Tributary and Wetland Areas
- Group 6 - Area South of Southern Lobe, and
- Group 7 - Reference Locations

The following scenarios were evaluated in the human health risk assessment:

1. Current/Future Trespasser/Recreational User
2. Hypothetical Future Site Resident
3. Hypothetical Future Site Facility Worker
4. Hypothetical Future Site Construction Worker

In keeping with USEPA guidance, both the central tendency (CT) and "Reasonable Maximum Exposure" (RME) were evaluated for each of these receptor groups. The intent of evaluating a more typical (CT) as well as an upper bound (RME) intensity exposure is to better understand the range of these potential exposures and associated risks across the relevant population. Based on the types of activities and specific routes of exposure to various site media (i.e., soil, groundwater, sediment, surface water and/or air), these receptors were assumed to be exposed to COPCs in some or all of the site Groups described above.

Cumulative risk estimates for each receptor, for all relevant exposure pathways, were compared to USEPA risk limits. Specifically, the cumulative non-cancer risks, expressed as Hazard Indices (HI), were compared to the non-cancer target HI of 1 (one). Cumulative incremental lifetime cancer risks (ILCR) were compared to the USEPA cancer risk range of 10^{-6} to 10^{-4}. Risks quantified under both central tendency (CT) and reasonable maximum exposure (RME) scenarios were evaluated, primary risk drivers identified, and site-related risks discussed relative to risks attributable to reference sources.

In summary, the site-related human health risk estimates that were most significantly above the USEPA target risks or risk ranges were associated with exposure to groundwater, primarily through its assumed potable use in the future and through vapor intrusion into a future on-site building. The chemicals contributing most significantly to these groundwater risks included arsenic, phenols, aromatic VOCs, and tetrahydrofuran in Groups 1&2 groundwater, and arsenic, acrylonitrile, xylenes, ketones and phenolic compounds in Groups 3-6 groundwater. Exposure to upland soils in Group 3 generally resulted in risks below or within the target risk range, whereas residential exposures to upland soils in Group 4 were associated with risks above the risk range, primarily associated with exposure to carcinogenic PAHs (e.g., benzo(a)pyrene). Exposures to wetland soils and/or surface water in Groups 5&6 by trespassers/recreational users and/or future site residents were not associated with risks above the applicable risk limit or range; however, the cumulative non-cancer risks from arsenic in Group 5/6 sediments for trespassers/recreational users and/or hypothetical future site residents were above the target risk limit.

A further summary of the potential risk to each receptor is provided on the following tables. Three cumulative risks are presented in these risk tables: total risk, reference-related risk and site-related risk. The 'total' risk reflects risk posed by both site-related COPCs and COPCs that are attributed to reference (i.e., not site-related) conditions. The risk summaries below also show the primary risk "drivers" at each exposure point (in all cases, these include chemicals with concentrations resulting in a cumulative noncancer hazard index >1 or a cumulative ILCR > 1 x 10^{-6}).

Current and Future Youth Trespasser or Recreational User

It was assumed that a current youth (ages 8-18 years) trespasser or recreational user may encounter COPCs in upland soils in Groups 3 or 4, ambient air across the Site, and wetland soil, sediment and surface water in the Groups 5 and 6 (wetland) areas of the Site. The only difference between the Group 3 versus Group 4 trespasser risks is the exposure to upland soils in Group 3 or Group 4.

Current/future youth trespasser/recreational user, Group 3

Exposure Point	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3 (0-10' bgs)				
Total Risk	4 x 10^{-1}	3 x 10^{-5}	6 x 10^{-1}	4 x 10^{-5}
Reference-related risk	3 x 10^{-1}	2 x 10^{-5}	5 x 10^{-1}	3 x 10^{-5}
Site-related risk	8 x 10^{-2}	6 x 10^{-6}	1 x 10^{-1}	9 x 10^{-6}
Group 3 Primary Risk Drivers:	None	Benzo(a)pyrene; Arsenic	None	Benzo(a)pyrene; arsenic; phthalates

Current youth trespasser/recreational user, Group 4

Exposure Point	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4 (0-1' bgs)				
Total Risk	4 x 10^{-1}	3 x 10^{-5}	5 x 10^{-1}	4 x 10^{-5}
Reference-related risk	3 x 10^{-1}	2 x 10^{-5}	5 x 10^{-1}	3 x 10^{-5}
Site-related risk	5 x 10^{-2}	3 x 10^{-6}	7 x 10^{-2}	4 x 10^{-6}
Group 4 Primary Risk Drivers:	None	Benzo(a)pyrene; arsenic	None	Benzo(a)pyrene; arsenic

The future youth trespasser/recreational user scenario is identical to that of the current trespasser scenario, with the exception that this receptor is assumed to be exposed to both surface and subsurface upland soil (0-10'bgs) in Group 4. Cumulative risks for the Group 4 future youth trespasser/recreational user scenario are presented below.

Future youth trespasser/recreational user, Group 4

Exposure Point	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4 (0-10' bgs)				
Total Risk	4×10^{-1}	7×10^{-5}	6×10^{-1}	1×10^{-4}
Reference-related risk	3×10^{-1}	3×10^{-5}	5×10^{-1}	4×10^{-5}
Site-related risk	6×10^{-2}	4×10^{-5}	8×10^{-2}	6×10^{-5}
Group 4 Primary Risk Drivers:	None	PAHs; arsenic	None	PAHs; arsenic

In summary, neither the Group 3 or Group 4 current Trespasser/Recreational user scenarios had non-cancer risks above the cumulative limit of 1 or cancer risks above the upper end of the USEPA risk range (i.e., greater than 1×10^{-4}) .

Future Area or Site Resident

Under current conditions, local neighborhood residents are anticipated to have an exposure potential similar to that of the trespasser/recreational user. Media evaluated included ambient air, wetland soil, sediment and surface water. As required by USEPA guidance for baseline HHRAs, we also assumed that Groups 3 and 4 may be redeveloped as residences in the future, and that site groundwater (Groups 3-6) may be used as a potable water source.

Thus, in addition to impacted wetland media, future residents may be exposed to COPCs in upland soil, indoor air and drinking water. The table below summarizes the cumulative cancer and noncancer risks for a resident in Group 3 and Group 4. Note that risks for both Group 3 and Group 4 scenarios include risks for exposure to all wetland media (surface water, wetland soil and sediment), ambient air, and potable water from Groups 3-6.

Future Resident, Groups 3 & 4

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3				
Total Risk	1×10^{3}	2×10^{-2}	2×10^{3}	9×10^{-2}
Reference-related risk	6×10^{1}	6×10^{-5}	1×10^{2}	1×10^{-4}
Site-related risk	9×10^{2}	2×10^{-2}	2×10^{3}	9×10^{-2}
Primary Risk Drivers:	Tetrahydrofuran; methylphenols; acrylonitrile; toluene; phthalates; xylenes; metals	chlorinated VOCs; phthalates; arsenic; PAHs	Tetrahydrofuran; methylphenols; acrylonitrile, toluene, 2-butanone, xylenes, metals	bis-2-ethylhexyl phthalate chlorinated VOCs; arsenic
Group 4				
Total Risk	9×10^{2}	2×10^{-2}	2×10^{3}	9×10^{-2}
Reference-related risk	6×10^{1}	1×10^{-4}	1×10^{2}	2×10^{-4}
Site-related risk	9×10^{2}	2×10^{-2}	2×10^{3}	9×10^{-2}
Primary Risk Drivers:	Tetrahydrofuran; methylphenols; acrylonitrile, toluene, xylenes, metals	bis-2-ethylhexyl phthalate; chlorinated VOCs; PAHs; acrylonitrile arsenic	Tetrahydrofuran; methylphenols; acrylonitrile, toluene, ethylbenzene, xylenes, metals	chlorinated VOCs; benzene, bis-2-ethylhexyl phthalate, PAHs, arsenic

As indicated in this table, both cancer risks and non cancer HIs are well above EPA risk limits for both Group 3 and Group 4. Risks are primarily attributed to use of groundwater as a potable water supply. A variety of both chlorinated and non-chlorinated VOCs (including primarily vinyl chloride and xylenes, respectively) and metals (including arsenic, manganese, and beryllium) contribute to the majority of cancer and noncancer risks.

Childhood residential lead exposures for the RME scenario were evaluated separately for Groups 3 and 4 of the Site using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) model for lead. Model results indicate estimated probabilities well below the EPA probability limit indicating that lead in soil does not pose a significant risk to future residents.

A separate quantitative evaluation of future residential health risks associated with potable use of groundwater in Groups 1 and 2 was also conducted. As shown in the table below, noncancer hazard indices and ILCRs for both CT and RME scenarios exceed EPA risk limits. As with Groups 3-6 groundwater, risks are driven primarily by VOCs and metals, as well as SVOCs.

Future Resident, Groups 1 & 2

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 1 and 2				
Total Risk	5×10^{2}	2×10^{-2}	9×10^{2}	5×10^{-2}
Reference-related risk	4×10^{1}	--	7×10^{1}	--
Site-related risk	5×10^{2}	2×10^{-2}	9×10^{2}	5×10^{-2}
Primary Risk Drivers:	metals, methylphenols, toluene, naphthalene, tetrahydrofuran	Chlorinated VOCs, arsenic	metals, methylphenols, toluene, naphthalene, tetrahydrofuran	Chlorinated VOCs, arsenic

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

In addition to the quantitative risks presented above, groundwater EPCs (maximum detected concentrations) were compared to Federal Drinking Water Standards (MCLs). Numerous constituents had EPCs in excess of these standards.

Future Commercial or Industrial Facility Worker

It was assumed that Group 3 and 4 of the Site may be developed for commercial or industrial purposes under future conditions, and that, consequently, future facility workers may be exposed to COPCs in soil within each group and to indoor air, should VOCs in groundwater migrate into a future building. Furthermore, in keeping with USEPA guidance, it was assumed that groundwater from Groups 3-6 could be used as a potable water source for a future facility. Cumulative risks for each exposure point are presented below.

Future Facility Worker

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3				
Total Risk	1×10^{2}	2×10^{-3}	2×10^{2}	2×10^{-2}
Reference-related risk	7×10^{0}	3×10^{-7}	9×10^{0}	2×10^{-6}
Site-related risk	9×10^{1}	2×10^{-3}	2×10^{2}	2×10^{-2}

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4				
Total Risk	$9x\ 10^{1}$	2×10^{-3}	2×10^{2}	2×10^{-2}
Reference-related risk	$7x\ 10^{0}$	3×10^{-6}	1×10^{1}	1×10^{-5}
Site-related risk	8×10^{1}	2×10^{-3}	2×10^{2}	2×10^{-2}
Primary Risk Drivers:	Acrylonitrile, 4-methyl-2-pentanone,toluene, xylenes, arsenic,	Arsenic, acrylonitrile, chlorinated VOCs; PAHs	Acrylonitrile, toluene, xylenes, arsenic	Arsenic, acrylonitrile, chlorinated VOCs; PAHs

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

As indicated above, cumulative hazard indices for both areas of the Site and for both CT and RME scenarios are over the EPA threshold of one. Cancer risks for the RME scenarios are above the upper limit of the EPA cancer risk range of 1×10^{-4}. Noncancer risks are primarily associated with ingestion of and dermal contact with VOCs, SVOCs and metals in drinking water; to a lesser extent, volatile COPCs (notably xylenes) in indoor air contribute to non-cancer risks. Risks from soil exposures are substantially lower than those from groundwater exposures. Cancer risks are driven primarily by chlorinated VOCs and arsenic in drinking water and acrylonitrile in both indoor air and drinking water. Primary non-cancer risk drivers in drinking water include heavy metals (arsenic), 4-methyl-2-pentanone, 2-butanone and toluene. Although some of the heavy metals (antimony, beryllium, zinc and silver) present in groundwater are at levels consistent with reference concentrations, site-related risks, exclusive of reference-related risks, exceed EPA risk limits. For lead exposures, model results indicate estimated probabilities well below the EPA probability limit indicating that lead in soil does not pose a significant risk to future facility workers.

Future Construction Worker

During future site redevelopment, construction workers may be exposed to COPCs in soil and shallow groundwater within Groups 3 and 4. Additionally, as VOCs are present in shallow groundwater within each of these areas, it was assumed that construction workers may inhale volatiles that have emanated from standing water or saturated soils in an excavation trench. Cumulative risk estimates for the construction worker scenario are provided in the table below.

Future Construction Worker

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3				
Total Risk	8×10^{-1}	9×10^{-7}	2×10^{0}	2×10^{-6}
Reference-related risk	1×10^{-1}	8×10^{-8}	1×10^{-1}	2×10^{-7}
Site-related risk	7×10^{-1}	9×10^{-7}	1×10^{0}	2×10^{-6}
Primary Risk Drivers:	Toluene, xylenes	Tetrachloroethene, bis-2-ethyl hexyl phthalate	Toluene, xylenes, bis-2-ethylhexyl phthalate	Tetrachloroethene, benzo(a)pyrene, bis-2-ethyl hexyl phthalate
Group 4				
Total Risk	6×10^{-2}	4×10^{-6}	1×10^{-1}	8×10^{-6}
Reference-related risk	3×10^{-2}	5×10^{-7}	6×10^{-2}	1×10^{-6}
Site-related risk	3×10^{-2}	3×10^{-6}	6×10^{-2}	7×10^{-6}
Primary Risk Drivers:	None	PAHs	None	PAHs

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

As indicated in the table above, cumulative noncancer risks for a construction worker in the former drum disposal area (Group 3) do not exceed EPA risk limits for the RME scenario. Cancer risks are also below the EPA upper-bound ILCR limit of 1×10^{-4}, and are driven by PCE and bis-2-ethylhexyl phthalate (BEHP) and, to a lesser extent, benzo(a)pyrene and arsenic in soil. Cumulative cancer risks, however, are within the EPA risk limits.

For construction workers exposed to media in the former residence, garage, and storage area (Group 4), both cumulative cancer and noncancer risks were within or below EPA acceptable risk limits. Benzo(a)pyrene and other PAHs in Group 4 soils contribute most to cumulative cancer risk.

For lead exposures, model results indicate estimated probabilities well below the EPA probability limit indicating that lead in soil does not pose a significant risk to future construction workers.

ECOLOGICAL RISK ASSESSMENT

Section 4 presents the methods and results of a Baseline Ecological Risk Assessment (BERA). The first component of the BERA, the Screening-Level Ecological Risk Assessment (SLERA) was prepared and submitted to the EPA in 2006. The SLERA evaluated five distinct habitat areas through the use of generic benchmarks and toxicity values. The SLERA was completed in accord with EPA, 1997 *Ecological Risk Assessment for Superfund*, and had as the primary objective the identification of exposure pathways and compounds that present a potential risk of adverse effects to ecological receptors. In accord with EPA guidance, the evaluation compared maximum concentrations of identified COPCs to generic no-effect or threshold-effect benchmarks to identify compounds that have a potential for adverse effect.

The results of the SLERA identified compounds exceeding benchmarks in each of the five habitat areas, indicating that further evaluation of these COPCs was warranted.

The BERA consists of the further evaluation of the pathways and COPCs identified in the SLERA. The conservative assumptions used in the SLERA were reviewed and, where appropriate, replaced by site-specific values to obtain a more accurate understanding of the ecological risks at the site. In addition, the results of additional sampling and site-specific toxicity tests are included to more accurately assess the potential for exposure and effect in selected portions of the Site. The goal of this assessment is to identify COPCs that present a potential risk to ecological receptors, and, for each of these COPCs, to describe the upper bounds of the threshold of effects.

In the BERA, concentrations of COPCs in surface water, sediment and soils were used to estimate the potential for effects on aquatic and semi-aquatic receptors, waterfowl, and terrestrial wildlife at the Site. Potential risks to aquatic and semi-aquatic receptors were evaluated by a comparison of media concentrations to ecological benchmarks, while risks to waterfowl and wildlife were evaluated by the estimation of an exposure dose and comparison to established Toxicity Reference Values (TRVs). Risks were evaluated separately for the following Habitat Areas and assessment endpoints at the Site:

- Upper Sutton Brook - consists of an Eastern Reach, extending from the access road to the bridge/crossing; the Southern Tributary, which enters Sutton Brook from the south; and the Site Channel, which extends from the bridge/crossing downstream to and including sample location SD/SW-34.
  - Assessment endpoints: benthic and pelagic macroinvertebrates and fish
- Aquatic Wetlands - consists primarily of emergent, shrub-scrub and forested wetlands that exist at various locations at the Site.
  - Assessment endpoints: benthic and pelagic macroinvertebrates, amphibian, wildlife herbivore (black duck), omnivores (mallard), and carnivores (heron)
- Pond - shallow man-made pond south of the Southern Lobe.
  - Assessment endpoints: benthic and pelagic macroinvertebrates, amphibian, and in conjunction with the Aquatic Wetland, wildlife herbivore, omnivores, and carnivores
- Wetland Soils - consists of saturated, but not inundated, soils that exist adjacent to the Aquatic Wetland areas.
  - Assessment endpoints: terrestrial plants and soil invertebrates, wildlife herbivores (rabbit) and carnivores (shrew)
- Uplands - consists of open packed dirt and fields on the northern portion of the Site (e.g., Former Drum Disposal Area, former residence and garage).
  - Assessment endpoints: terrestrial plants and soil invertebrates, wildlife herbivores (meadow vole) and carnivores (robin)

A review of rare, threatened and endangered species databases and information sources indicated that the New Jersey Tea Inchworm (*Apodrepanulatrix liberaria*) (an Endangered moth) and frosted elfin (*Callophrys irus*) (a Special Concern butterfly) have been documented in the vicinity of the site. The search also indicated that the project area is located within a priority habitat, *Priority Habitat 380* (PH X380). Both of these species are upland species that are dependent on one or two specific host plants for reproduction and/or feeding, a characteristic that limits the suitability of many apparently appropriate habitats. Based on an assessment conducted as part of this BERA, neither of these species is considered likely to occur at the Site because of the lack of available populations of critical host plants; however, an

evaluation of the potential effects of contaminants on these species was considered in the BERA.

Risks in the Upper Sutton Brook Site Channel and the Former Drum Disposal Area portion of the Upland Soils habitat were not evaluated in the BERA. The potential for risk in these areas was based on the conclusions of the SLERA.

Risk calculations are represented by the use of Hazard Quotients (HQs), which quantifies the comparison between the exposure experienced by a receptor to the exposures associated with toxicological effects (published in the literature). For receptors other than wildlife, the exposure concentration is the concentration of COPC detected at each location in surface water or sediment. The waterfowl or wildlife receptors were evaluated based on average, 95% UCL, and maximum contaminant concentrations, to allow for three levels of conservatism in risk estimates. An exception is the shrew, which, because of a small home range, was evaluated by use of maximum values.

Measured or estimated exposures are refined and compared to concentrations associated with the lowest or probable level of effect. These values, categorically referred to in this document as lowest observed adverse effect (LOAEL)-based benchmarks or TRVs, are used as a representative of an upper bound of the potential for effect. These values typically consisted of generic probable effect level benchmarks or the lowest of the range of applicable effects values identified in the scientific literature.

Risk was evaluated by several methods. First, for each compound, the number, magnitude, and location of no-observed-adverse-effect level (NOAEL)-based HQs >1.0 were evaluated. Because of the conservatism of NOAEL-based benchmarks, small and infrequent exceedances are typically not associated with a likelihood of adverse effect. Compounds exceeding NOAEL-based benchmarks by a large number or in more than three samples were compared to LOAEL-based benchmarks. The resulting LOAEL-based HQs were evaluated in conjunction with the number and location of LOAEL exceedances and the scientific representativeness of the LOAEL value itself. These considerations were combined to arrive at an assessment of potential risk. As an additional measure, a comparison of detected concentrations of inorganics to reference concentrations was conducted in some instances.

Based on the results of the BERA, potential risks were identified as follows:

Upper Sutton Brook:

Reach:	Eastern Reach
Media:	Surface water
Assessment Endpoints:	Fish and pelagic invertebrates
COPCs:	Iron (exceedance of chronic WQC)

Reach:	Site Channel
Media:	Surface water
Assessment Endpoints:	Fish and Pelagic invertebrates
COPCs:	DDT, ethylbenzene, toluene, xylenes, barium, and manganese (from NOAEL exceedances in SLERA)

Reach:	Site Channel
Media:	Sediment
Assessment Endpoints:	Benthic invertebrates
COPCs:	1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methyl-2-pentanone, acetone, carbon disulfide, chloroethane, ethylbenzene, xylenes, toluene, arsenic, and manganese (from NOAEL exceedances in SLERA)

Aquatic Wetland

Media: Surface water
Assessment Endpoint: Aquatic life
COPCs: Iron (exceedance of chronic WQC)

Media: Surface Water
Assessment Endpoint: Amphibians
COPCs: Aluminum

Former Drum Disposal Area Soils (from SLERA):

Assessment Endpoint: Plants
COPCs: Bis(2-Ethylhexyl)phthalate, ethylbenzene, naphthalene, xylenes

Assessment Endpoint: Soil invertebrates
COPCs: 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, ethylbenzene, toluene, xylenes

Assessment Endpoint: Carnivores (robin)
COPCs: 1,2,4-Trimethylbenzene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, xylenes

Upland Soils (excluding Former Drum Disposal Area):

Assessment Endpoint: Soil Invertebrates
COPCs: Zinc

Assessment Endpoint: Carnivores
COPCs: di-n-octylphthalate and lead

1. INTRODUCTION

The Sutton Brook Potentially Responsible Party (PRP) Group (the Group) has entered into an Administrative Order by Consent (the Order) with the U.S. Environmental Protection Agency (EPA) to perform a Remedial Investigation (RI) and Feasibility Study (FS) at the Sutton Brook Disposal Area Superfund Site (the Site) (U.S. EPA Region 1 Docket No. CERCLA-01-2004-0002). The Sutton Brook Disposal Area, also referred to as Rocco's Landfill, is located off South Street on the eastern boundary of the Town of Tewksbury, Middlesex County, Massachusetts. A small portion of the Site also extends into the Town of Wilmington. The general location of the Site is presented as Figure 1-1.

Consistent with the Order, a Draft RI/FS Workplan was prepared and submitted to EPA and the Massachusetts Department of Environmental Protection (MassDEP) on June 23, 2004. On July 21, 2004, EPA approved, with conditions, the Draft Workplan. During July and August, comments were reviewed and addressed and a Revised RI/FS Workplan was prepared and submitted to EPA and MassDEP on September 10, 2004.

As indicated in the Workplan, activities associated with the RI, risk assessment, and FS were developed and implemented with the presumption that the existing waste material in the two landfill lobes will be closed in-place using current landfill capping technology. This allowed the RI/FS to focus on areas of potential impact outside of the landfill footprint. Additional soil characterization sampling within the landfill lobes for risk characterization was not performed; samples for physical characteristics of the cover material and from adjacent groundwater, surface water, and sediments were collected and included in the RI and risk characterizations. The conclusions of the risk characterizations are thus predicated on this presumption with regard to the landfill lobes.

Field activities associated with the RI (Phase 1A) were initiated in September 2004. Consistent with the Order and schedule of deliverables, following the Phase 1A RI activities, a Draft Phase 1A RI Deliverable was prepared and submitted to EPA and the MassDEP on March 4, 2005. The Phase 1A RI Deliverable was comprised of: an updated Conceptual Site Model; the First Interim Deliverable for the Risk Assessment; a proposed scope for the Phase 1B RI Field Investigation; a Pre-Record of Decision (ROD) Monitoring and Sampling Plan; and an updated RI/FS Schedule.

On August 18, 2005, EPA provided formal comments on the Phase 1A RI Deliverable. On September 16, 2005, a revised Phase 1B RI Workplan was submitted to EPA and field activities associated with the Phase 1B RI were initiated. A response to comments submittal on the Phase 1A RI Deliverable was prepared and submitted to EPA on September 22, 2005. Additional comments on the Phase 1A RI Deliverable, predominantly on the risk assessment, were provided by EPA on January 13, 2006.

The data collected during the Phase 1A and 1B RI was used to develop a Draft Screening Level Ecological Risk Assessment (SLERA), which was submitted to EPA and MassDEP on May 4, 2006, and a Draft RI Report, including a draft human health risk characterization, which was submitted to EPA and MassDEP on April 28, 2006. EPA provided comments on the Draft RI report on July 3, 2006 and responses to these comments were submitted on August 11, 2006 with a comment discussion meeting conducted on September 6, 2006. Responses to issues identified in the September 2006 meeting were submitted to EPA on November 13, 2006 with comments to these responses provided by EPA on November 29, 2006.

EPA provided comments on the Draft SLERA on June 6, 2006 and based on responses to comments and follow-up comments and discussions, a Preliminary Data Refinement (initial steps in the Baseline Ecological Risk Assessment refinement) was submitted on September 19, 2006. Following review of this

interim deliverable by EPA, additional sediment samples were collected in two distinct areas of the site to aid in the ecological risk characterization of the Site. These samples were collected in November 2006. The results and evaluation from these sediment samples were submitted to EPA in December 2006 and January 2007.

On March 8, 2007, a draft Baseline Risk Assessment consisting of the human health risk assessment (HHRA) and the baseline ecological risk assessment (BERA) was submitted to the EPA and MassDEP. This document reflected the comments on the previous interim deliverables and incorporated the results of all sampling conducted as part of the RI. Following submittal of this document, comments and discussions on the submittal were conducted with EPA in April and May 2007.

This document comprises the revised Baseline Risk Assessment prepared for the site and includes the HHRA and BERA. It reflects the comments made by EPA and other reviewers on the previous deliverables.

1.1 RISK ASSESSMENT OBJECTIVES

Risks assessments serve as the link between the Remedial Investigation and the Feasibility Study, since they provide quantitative information on the nature and magnitude of potential risks, which in turn form the basis for remedial goals for site media. Human health and ecological assessments differ in approach and methodology but share in general a consistent set of objectives, as follows:

- To identify populations which, through behavior, proximity, or other life history characteristics, are likely to be exposed to site contaminants;
- To identify the type and magnitude of potential risk that populations may experience as the result of that exposure.

The evaluation of risks to human and ecological receptors proceeds through different means, and are described in the following sections.

1.2 REPORT ORGANIZATION

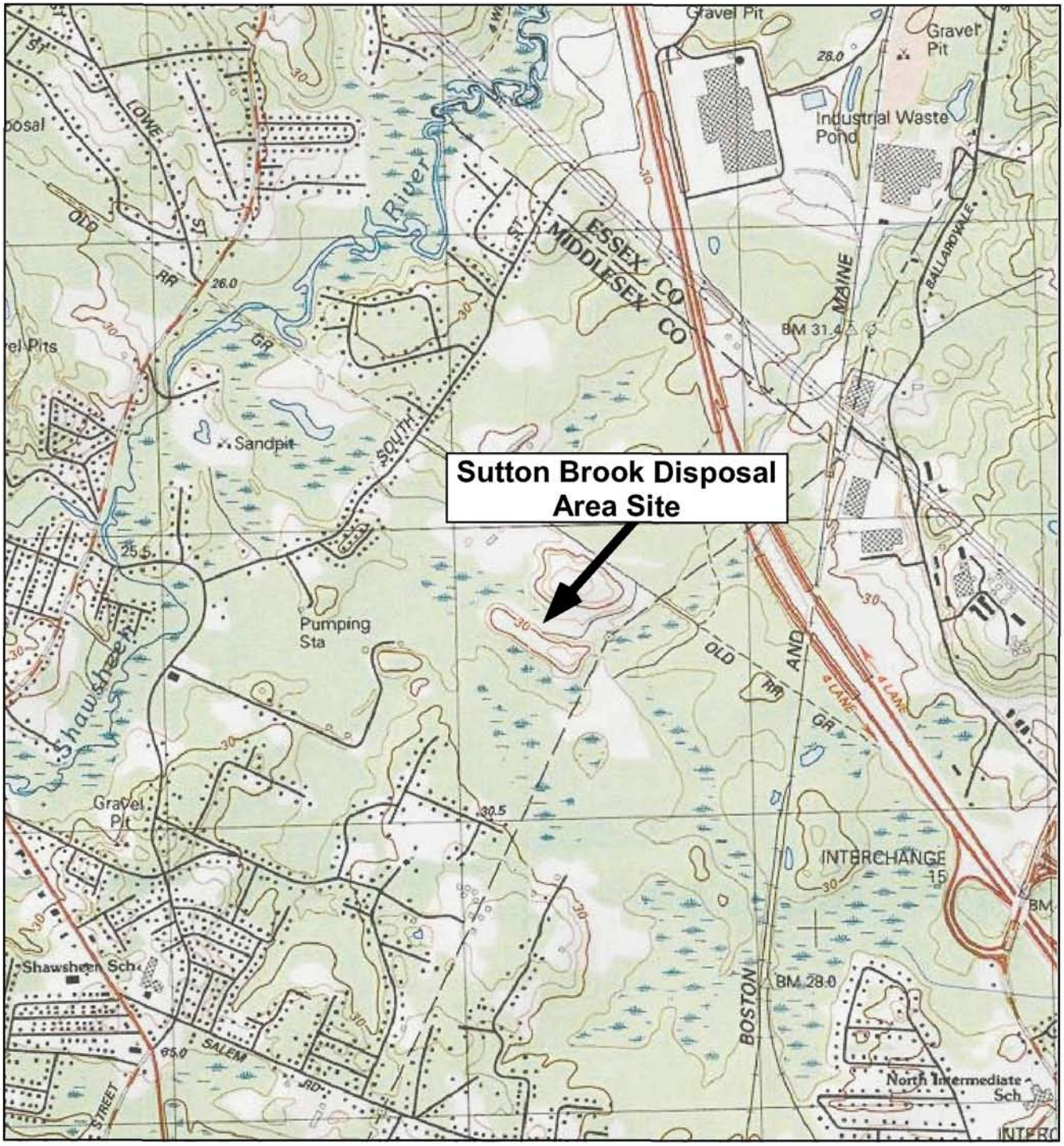
This report is organized into this introduction and the following sections:

Section 2 – Summary of Remedial Investigation Results– A summary of the findings of the RI is provided in this section. This provides an overall understanding of the site features and the source, nature and distribution of contaminants on the property. This understanding forms the basis of the exposure assumptions in both the human and ecological risk assessments.

Section 3 – Human Health Risk Assessment - This section presents the methodology and results of the human health risk assessment for the site. Components of the Hazard Identification, Exposure Assessment, Risk Characterization, and Uncertainty Assessment are presented and discussed. A listing of applicable references is provided.

Section 4 – Baseline Ecological Risk Assessment - This section presents the methodology and results of the baseline ecological risk assessment for the site. A Problem Formulation, Analysis, and Risk Estimation and Description are presented for each of five different habitat areas at the site. A listing of applicable references is provided.

Section 5 – HERA Conclusions – A summary of the conclusions is presented for each of the respective risk assessments.



0 .5 1 MILE

0 1000 FEET 0 500 1000 METERS

Base Map Source:
TOPO!™ © 2000
Wildflower Productions

MN 15½° TN

DES.BY:	DR.BY: EVR	CK.BY:

FIGURE 1-1

SITE LOCUS MAP

SUTTON BROOK DISPOSAL AREA

SCALE: AS SHOWN	JOB NO.: 210517
DATE: MARCH 2007	FILE NAME: Site Locus 1-1.cnv

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2. SUMMARY OF REMEDIAL INVESTIGATION RESULTS

Tewksbury is a semi-rural community located in northeastern Massachusetts, approximately 20 miles north of Boston and occupies approximately 20 square miles of land. For purposes of presentation and discussion, the Site has been divided into two major source areas (Landfill Lobes [Northern and Southern lobes] and Former Drum Disposal Area). The solid waste source areas on the Site are referred to as the Northern Lobe and Southern Lobe. These Solid Waste Areas comprise about 40 acres of the Site. In 2000, between 300 to 400 buried drums were removed from an area located northwest of the Northern Lobe (referred to as the Former Drum Disposal Area).

Sutton Brook (and associated wetlands) flows east to west through the property, dividing the landfill into Northern and Southern lobes. Additional wetland areas are located south of the landfill and along the eastern and western portions of the property. Potentially sensitive areas and/or human or ecological receptors located in the vicinity of the Site include Sutton Brook, mapped medium and high yield potentially productive aquifers, freshwater wetlands, areas of protected open space, and approved Zone 2 water supply areas. In addition, several private residential wells are located in the neighborhoods in the vicinity and the Town of Tewksbury has five inactive public water supply wells located southwest of the Site. According to the Town of Tewksbury, all of their former wells on Poplar Street were abandoned in place around the mid 1990's. Tewksbury is relying on the Merrimack River as its (main and) only source of drinking water.

Figure 2-1 depicts the site features and ground surface contours, including the locations of the inactive former town wells and those private wells (most inactive) proximate to the site.

2.1 DATA COLLECTION AND DATA QUALITY ASSESSMENT

The data collected at the Site and surrounding areas and to be used in the Remedial Investigation and Risk Assessment is comprised of both previous site investigations and the recently completed Phase 1A and Phase 1B Remedial Investigations. These data encompass sampling and investigation activities performed from 1989 to 2006 (together referred to as the RI).

The recent RI field activities (i.e., 2004 and 2006) consisted of activities related to the following tasks:

- Site Survey (elevation and location surveys of investigation points)
- Soils and Sources of Contaminants Investigation (soil borings, surficial soil sampling, and test pit excavations)
- Subsurface and Hydrogeological Investigation (installing temporary and permanent monitoring wells; groundwater sampling; stream piezometer installation; water level measurements; stream gauging; in situ hydraulic conductivity testing; and groundwater modeling)
- Air Quality Assessment (landfill gas sampling)
- Surface Water and Sediment Investigation (surface water, wetland soil/sediment, and sediment sampling)
- Ecological Assessment (wetland delineation; floodplain delineation; habitat characterization, and fish survey of Upper Sutton Brook)

Samples were analyzed by the off-site laboratory for VOCs, SVOCs, metals, PCBs, pesticides, and general chemistry parameters. A summary of the combined data set developed as part of this RI, which

includes previous data deemed "usable" through the data review process and the recently collected data, is provided in the table below.

Table 2-1 Summary of RI Data Collection Locations

Sample Media	Total Number of Locations - Previous Investigations	Total Number of Locations - Phase 1A RI, 1B RI, and pre-ROD (2004 – 2006)	Total Number of Locations
Test Pit Explorations	10	38	48
Soil Samples (Surface, Wetland, and Sub-Surface)	55	41	96
Monitoring Wells, including Temporary Wells and Piezometers	64	46	110
Groundwater Sampling Events[1]	4	8	13
Landfill Gas	3	8	11
Sediment	27	45	72
Surface Water	16	28	44
Ambient Air	7	0	7
Leachate	0	2	2

Notes: [1] Not all monitoring wells were sampled during each sampling event.

Following analyses, the data's usability was assessed by reviewing laboratory data for each medium and assessing whether it meets the prescribed PQOs developed in the QAPP. These data have been reviewed in terms of their precision, accuracy, representativeness, completeness, and comparability (PARCC). The historic data deemed "usable" (see above) was determined to be generally consistent with QAPP requirements and suitable for use in the RI.

Based on the results of the data quality assessment, the data collected during the RI are considered to be 'suitable' for its intended use in satisfying the RI objectives. These objectives (or end uses) include evaluating the contaminant sources; determining the nature, extent, and distribution of contaminants; and assessing the current and future potential risks to human health and the environment.

2.2 ENVIRONMENTAL SETTING

The majority of the Site is unpaved and relatively flat, aside from the steeply sloped landfill lobes. Outside the landfill lobes, the Site primarily consists of wetlands including several individual wetland areas (red maple swamp/floodplain associated with Sutton Brook [greater than 50 acres]; small isolated man-made pond [approximately 2 acres]; isolated man-made areas subject to flooding [small forested wetland area and a borrow pit]; and an isolated emergent wetland area). Refer to Figure 2-1 for a depiction of these wetland locations.

The overburden geology of the area is characterized by glacial features (e.g., outwash and till deposits). The site-specific unconsolidated materials underlying these surficial deposits consist primarily of sand layers (stratified drift) underlain by a till laid down on top of bedrock. Depth to rock at the Site ranges from 20 to 60 feet below ground surface (ft bgs). The mapped rock along with the rock cores obtained during the RI, indicate that two types of rock were encountered beneath the Site. A granite or granodiorite, referred to as the Andover Granite, is classified as a light to medium-gray, foliated, medium to coarse grained muscovite-biotite granite. The other rock type, gneiss, is classified as a thinly bedded to massive amphibolite; minor biotite gneiss. A weathered zone was observed at the top of the rock followed by more competent rock with moderate fracturing.

Unlike the ground surface topography (aside from the landfills), the bedrock surface topography varies considerably across the site. A bedrock outcrop was observed on the western portion of the area adjacent to Sutton Brook. The bedrock surface generally slopes in a southerly to southwesterly direction across the site. A valley on the southwestern portion of the site was filled with glacial drift deposits creating a higher transmissive water zone (e.g., the Town's former Poplar Street wellfield).

The ground surface across the Site consists of landfill lobes or fill areas, wetland soils, or an upper sand layer. The upper sand layer (10 to 45 feet in thickness) is comprised of a brown to gray medium to fine sand with a little silt and exists across the entire site. The units underlying this layer are controlled by the depth to bedrock and the presence and thickness of a till layer. In areas of deeper bedrock, coarser sand with some gravel was encountered beneath this upper sand, as seen on the western portion of the Site.

The main hydrologic feature at the Site is Sutton Brook and associated tributaries and wetlands. Sutton Brook is a medium gradient stream that includes both moderately moving water through established banks and slower moving water through much wider and less-established channels. The stream bed is comprised of sand and gravel with some areas of muck and peat. Sutton Brook originates in an upland area north of the Site in Andover and flows southerly, turning westerly to northerly through the Site with discharge to the Shawsheen River approximately 2,500 feet northwest of South Street. As Sutton Brook traverses the Site, the character of the brook is affected by the channel width, the channel depth, the composition of the soils underlying the brook, and tributaries that contribute to the brook.

Based on the majority of the water table elevations, surface water elevations, and the stream gauging measurements, overall, groundwater was found to be discharging to the brook, whereas the wetlands area and smaller tributaries experienced variable elevations suggesting periods of groundwater discharge and recharge throughout the season.

To characterize groundwater flow across the Site, potentiometric surveys were conducted between October 2004 and October 2006 during which water level measurements were made at the monitoring wells and surface water staff gauges installed at the site at the time of each survey. Of these events, September 2005 and October 2006 represent low water conditions at the Site, while April 2005 and May 2006 represent high water conditions. The data collected after December 2005 are the most complete potentiometric surveys due to the inclusion of the monitoring wells and well points installed during the Phase 1B RI field activities.

Depth to groundwater at the site ranges from approximately near/at ground surface to 12 feet below ground surface. In general, the water table surface (i.e., top of the groundwater surface) mimics the natural land surface topography of the area and is influenced by the streams and wetland areas. To aid in understanding regional groundwater flow conditions, a 3-dimensional groundwater flow model (MODFLOW) was developed for the area. Simulated groundwater flow north of the Site is southerly towards Sutton Brook or westerly towards the Shawsheen River. Groundwater to the east flows westerly

or southerly towards Sutton Brook and an un-named tributary. Groundwater to the south flows northerly towards Sutton Brook or the Shawsheen River. Groundwater west of the site flows either northerly toward the Shawsheen River or easterly towards Sutton Brook.

Groundwater flow patterns specific to the Site are similar to regional patterns with the brook acting as the main hydrologic feature controlling shallow groundwater flow directions. During low water conditions, the hydraulic gradient decreases; however, groundwater continues to flow southwesterly towards Sutton Brook on the northern portion of the Site and northerly towards the brook on the southern portion. As indicated on the potentiometric surface maps, the brook is the main hydrologic feature controlling groundwater flow directions regardless of season. A similar groundwater flow pattern was observed in the intermediate overburden groundwater.

Based on a review of the hydraulic gradients, groundwater flow is in a predominantly horizontal direction (horizontal gradients greater than vertical gradients) with an upward flow component, where the brook and wetland areas act as discharge zones for site groundwater. The horizontal hydraulic gradient increased slightly under higher groundwater conditions. The hydraulic gradients observed at the upgradient Perkins property and residential neighborhood were steeper than those observed on the northwestern and southwestern portions of the Site. The flattest hydraulic gradient, regardless of season, was observed in the intermediate overburden aquifer (e.g., course sand) on the northwest portion of the Site, in the area of the Former Drum Disposal Area.

A comparison of the average hydraulic conductivity values for each of the hydrogeologic units indicates the estimated hydraulic conductivity generally decreases with depth in the overburden with the exception of the deeper coarser sand layer, where encountered. Estimated groundwater seepage velocities under water table conditions ranged from 130 to 400 feet per year and 4 to 14 feet per year in the intermediate overburden. The calculated groundwater velocities represent estimated flow rates between various monitoring wells located on the site and specific geologic units, and not the entire aquifer. In addition, the estimated groundwater flow velocities are not necessarily indicative of the rate of contaminant transport.

2.3 NATURE AND EXTENT OF CONTAMINANTS

For discussion purposes, the nature and extent of contaminants at the Site have been divided into the following areas:

- Landfill Lobes
- Former Drum Disposal Area and Adjacent Disturbed Area
- Former Residence, Garage, and Storage Area
- Sutton Brook and Associated Tributaries and Wetland Areas
- Area-Wide Groundwater

A summary of the principal RI findings for each of these areas is presented in the following sections.

2.3.1 Landfill Lobes

Of the two landfill lobes, the Northern Lobe is the largest at approximately 30 acres (1.9 million cubic yards of material), whereas the Southern Lobe comprises approximately 10 acres (0.3 million cubic yards of material). Small debris/waste piles have also been identified in five distinct areas proximate to the landfill lobes. The landfill lobes constitute the primary source areas at the Site.

The primary migration pathways for contaminants from the landfill lobes are:

- infiltration/leaching of contaminants with subsequent transport via groundwater flow;
- soil erosion and wind blown transport of contaminants that are exposed at the surface, and includes both dust and surface water runoff; and
- volatile air emissions and transport.

Landfill gases generated from the two lobes ranged from 14 to 70 % methane; 15 to 34% carbon dioxide; and 0.7 to 540 ppm total VOCs. These levels are generally consistent with other New England municipal solid waste landfills of this size. The VOCs detected at the greatest frequency in the samples were toluene, xylene, ethyl benzene, n-hexane, and dichlorofluoromethane. Potential air emissions from the uncapped landfill were evaluated by ambient air samples. Results indicated low parts per billion concentrations of several VOCs were detected in only two of the seven samples.

Based on the RI data (visual observations of the slopes; groundwater samples proximate to the lobes; surface water and sediment samples; and landfill gas and ambient air samples), groundwater migration is the primary contaminant migration pathway associated with the lobes given: 1) the uncapped/uncontained nature of the landfill does not limit infiltration and subsequent leaching; 2) wastes are most likely located at or near the water table surface; 3) the proximity of Sutton Brook to the landfill lobes; 4) typical landfill gas levels in the subsurface and low to non-detect concentrations of VOCs in ambient air indicating minimal mass transport; and 5) the majority of the material in the lobes is covered on the ground surface with soil and/or vegetation, thereby reducing transport by runoff.

The primary constituents detected in groundwater samples were VOCs and metals. The highest concentrations of VOCs were detected in the groundwater collected from monitoring wells located adjacent to the northern sides of the Southern Lobe. Total VOC concentrations in these wells ranged from 3,450 to 57,210 ug/l. The VOC generally detected at the highest concentration in the wells was toluene. Groundwater data from the wells along the perimeter of the Northern Lobe were much lower in concentration (total VOCs ranged from 53 to 842 ug/l). Unlike the Southern Lobe, the VOC generally detected at the highest concentration in the wells was either 1,4-dioxane or tetrahydrofuran.

The overall distribution of the total VOCs in groundwater supports groundwater flow directions with flow in the direction of Sutton Brook. Similar constituents to those detected in groundwater were also detected in leachate samples and in surface water and sediment samples. The samples with the highest concentrations were detected in the stretch of Sutton Brook between the two lobes.

2.3.2 Former Drum Disposal Area

A removal action was conducted in this area by EPA in 2000, in which approximately 300 to 400 crushed drums were excavated and 13,786 tons of soil was transported off-site for disposal. Post-excavation data indicates that residual levels of VOCs (TCE, toluene, PCE, ethyl benzene, trimethylbenzenes, and xylenes) are present in soils with toluene, ethyl benzene, and xylenes exhibiting the highest concentrations and greatest frequency of detection. The highest total VOC concentration was detected in samples located on the southeast portion of the area. This area (southeast portion) also corresponds to an area of elevated SVOCs, specifically bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and naphthalene and the area where more of the drums were formerly located.

The primary migration pathways for these residual contaminants are infiltration/leaching with subsequent transport via groundwater flow. In addition, soil erosion and volatile air emissions are potential migration

pathways for contaminants that may be exposed or migrate to the surface. However, the highest concentrations of contaminants are not located at the ground surface.

As described above, groundwater and surface water runoff from this source area is toward Sutton Brook and the downgradient wetlands. Migration of volatiles in soil vapor is limited because the groundwater is at the land surface across most of this area, thereby eliminating soil pore spaces.

Similar to soils, VOCs were the primary constituents detected in the groundwater samples with benzene, toluene, ethyl benzene and xylenes (BTEX) and lower concentrations of 1,1,1-TCA, TCE, and 1,1-DCA being detected at the greatest frequency. Elevated concentrations of 4-methyl-2 pentanone, 2-butanone, and phenols were also detected in groundwater proximate to the area of the former drum disposal.

The dissolved VOC concentrations in groundwater were found to be decreasing with distance from this source area. The highest concentrations of VOCs are migrating at an intermediate depth within the overburden aquifer and within a low hydraulic conductivity medium to fine sand layer. The groundwater data also indicates that impact is limited to the overburden and has not migrated into the bedrock aquifer.

As the groundwater plume approaches Sutton Brook, a portion of the plume discharges into the brook/wetlands area. This is evident from the potentiometric heads of the wells; the results of the USGS PVD Study, similar contaminant concentrations detected in shallow groundwater (wetland piezometers), sediments, and surface water; and the lower concentrations and type(s) of VOCs in hydraulically downgradient wells.

The groundwater flow patterns and the presence of conditions amenable to natural degradation appear to be the controlling factors to the nature and extent of the groundwater contamination in this area. Groundwater on either sides of the brook and wetland areas flows east or west, respectively towards the brook and wetlands. There is also a northerly component flow that parallels the flow of the brook. This flow regime results in a net northerly groundwater flow pattern in this area. The horizontal hydraulic gradients are relatively flat, especially in the intermediate overburden (area of higher groundwater contamination) as groundwater approaches the wetlands/brook. These low gradients and low hydraulic conductivity result in a reduced groundwater velocity and subsequent contaminant migration rates.

Based on the investigation activities conducted in the “disturbed” area adjacent to the Former Drum Disposal Area, there is not a significant source of contaminants within this area. Low concentrations of some VOCs consistently detected across the site have been detected in groundwater in this area. This area is almost totally comprised of a wetland area that was most likely created as a result of topsoil removal and equipment compaction (as evidenced by the exposed soil cuts on the limits of the area and presence of sand and gravel on the surface).

2.3.3 Former Residence, Garage, and Storage Area

This area is located on the northern portion of the Site and consists of the former residence, garage, and storage areas. The majority of the area contains surficial debris from past storage activities. Impacted soils (petroleum hydrocarbons and PAHs) are present on the south central portion of the area and most likely were caused by former storage or operation activities in this area. A subsurface fill area, comprised of wood, metal, and concrete, is present on the southern portion of the area. Groundwater is not impacted from operations within this area.

2.3.4 Sutton Brook and Associated Wetlands Areas

The main hydrologic feature at the Site is Sutton Brook and its associated tributaries and wetlands. Sutton Brook is a medium gradient stream that includes both moderately moving water through established banks and slower moving water through much wider and less-established channels. The stream bed is comprised of sand and gravel with some areas of muck and peat. Sutton Brook originates in an upland area north of the Site and flows southerly, turning westerly to northerly through the site with discharge to the Shawsheen River approximately 2,500 feet northwest of South Street.

As Sutton Brook traverses the Site, the character of the brook is affected by the channel width, the channel depth, the composition of the soils underlying the brook, and tributaries that contribute to the brook. Along its path, additional flow is discharged to Sutton Brook via three separate tributaries. One tributary flows northerly, draining a wetland area southeast of the site and discharging into the brook on the southeast side of the site. Another tributary flows northerly, draining an area south of the Site and discharging into the brook on the western portion of the Site. The third tributary flows southerly, draining a wetland area north of the site and discharging into the brook on the northwest portion of the site.

Water table and surface water elevations across the entire site were measured during the RI. Stream gauging was also performed on multiple occasions. These events aid in understanding the site groundwater-surface water flow interactions as well as any contributions from tributaries to Sutton Brook, incorporating seasonal variation. The measurements indicate that, overall, groundwater discharges to the brook; whereas, the wetlands area and smaller tributaries experienced variable elevations suggesting periods of discharge and recharge throughout the seasons. At times of low water (late summer and early fall), the smaller tributaries (southeast of the site and north of the site) have areas that dry up or form smaller, trickling channels through the muck or peat.

Outside the landfill lobes, the Site primarily consists of wetlands including several individual wetland areas (red maple swamp/floodplain associated with Sutton Brook [greater than 50 acres]; small isolated man-made pond [approximately 2 acres]; isolated man-made areas subject to flooding [small forested wetland area and a borrow pit]; and an isolated emergent wetland area). These wetland areas are shown on Figure 2-1.

The area south of the Southern Lobe is located on the southern portion of the Site and is mainly comprised of a shallow pond and dirt trails routinely used by recreational vehicles. The pond appears man-made given the presence of a berm along the pond's edge and exposed sand substrates, which suggest past excavation activities. Based on the surface water and sediment sample results, there does not appear to be an impact to the pond from site operations.

Another feature within this area is an isolated forested wetland located northeast of the pond and adjacent to the Southern Lobe. Portions of this area also appear to be man-made as a result of past excavation activities. Samples collected within this area indicate that the area has been impacted by VOCs, SVOCs, and metals.

The highest concentrations of constituents (primarily VOCs and metals) were detected in surface water and sediment samples from the brook in the reach that traverses closest to the landfill lobes. The RI data indicates that there are two primary contaminant plumes in groundwater beneath the Site. The sources of these plumes are the Former Drum Disposal Area and the Southern Lobe. As contaminants within these plumes migrate away from the source area, these plumes discharge into the wetland area and the brook. The results of the surface water and sediment sampling (PVD and laboratory analytical) within the brook and wetland areas correlate well with groundwater contamination and groundwater plume discharge

areas. Contaminants (VOCs, SVOCs, and metals) were also detected in surface water, sediment, and shallow groundwater in the wetland area/marsh located adjacent to the southern side of the Southern Lobe.

2.3.5 Area-Wide Groundwater

As discussed above, the primary impacted media and migration pathway from the source areas is groundwater. Other affected media include sediment and wetland soils; however, these affected areas are localized.

Based on a review of the analytical data collected from groundwater, the primary constituents detected in site groundwater are VOCs, metals, and SVOCs. The most frequently detected VOCs and those detected at the higher concentrations in groundwater were: xylenes, toluene, ethylbenzene, 1,4-dioxane, and tetrahydrofuran. Other more frequently detected VOCs were generally detected at lower concentrations (1,1-dichloroethane and benzene) and some of the VOCs detected at higher concentrations (4-methyl-2-pentanone and 2-butanone) were not widely distributed in groundwater across the Site.

The detected inorganic constituents in area wide groundwater were arsenic, nickel, aluminum, zinc, cobalt, vanadium, beryllium, chromium, cadmium, copper, lead, silver, cyanide, thallium, antimony and mercury (in descending order of frequency detected). For relative comparison purposes, metals concentrations were compared to maximum contaminant levels (MCLs). This comparison indicated that total arsenic was the most predominant metal detected in excess of the applicable MCL.

The predominant SVOCs detected in groundwater were phenols (2,4-dimethylphenol, 2-methylphenol, 3-methylphenol/4-methtylphenol, 4-methylphenol, and phenol) and phthalates (primarily diethyl phthalate).

The predominant factors that will ultimately control the migration pathways of the contaminant plumes are the hydrogeologic environment, the location and characteristics of the source areas, and the partitioning/migration characteristics of the specific contaminants comprising the plume. Based on the characteristics of the source areas, fate and transport characteristics of the predominant contaminants, and the site-specific hydrogeologic environment, advection, dispersion, and natural degradation/attenuation are the primary characteristics controlling the migration of the dissolved VOC plumes away from the source areas in groundwater.

Plume configurations depict the Southern Lobe and the Former Drum Disposal Area as the primary source areas for these contaminant plumes at the Site. The purgeable aromatic hydrocarbons and tetrahydrofuran plumes are similar in configuration; whereas the 1,4-dioxane plume is more widespread, detected at lower concentrations, and suggests contribution from both landfill lobes. This may be attributable to 1,4-dioxane being more soluble and less degradable than the aromatic hydrocarbons. The plume configurations also show that the plumes are generally contained within the immediate boundaries of the Site (i.e., plume configurations are controlled by groundwater flow, discharge to the brook and associated wetlands, along with degradation/attenuation mechanisms).

Similar to the VOC contaminant plumes, the highest concentrations of total arsenic are present in the areas immediately adjacent to the source areas. However, unlike the VOC plumes, arsenic concentrations in groundwater in excess of MCLs are also detected in upgradient wells; indicating that, arsenic concentrations may be naturally occurring at “elevated” levels (e.g., concentrations that exceed the drinking water standards).

As groundwater flows through the source areas, the constituents partition into the groundwater and migrate with groundwater flow away from the source areas forming a dissolved plume. The predominant

mechanism for migration of the plume away from the source area is through advection. In the area of the Southern Lobe, it appears that groundwater (based on potentiometric head data) and the dissolved VOCs (based on concentrations detected in monitoring wells) initially migrates away from the source area in a predominantly northeasterly to northerly direction. In the area of the Former Drum Disposal Area, the dissolved VOCs initially migrate in a southwesterly to westerly direction towards Sutton Brook and the associated wetlands.

Once both plumes reach the general vicinity of the brook/wetlands, the plumes merge with regional groundwater flow and travel in a predominantly northerly flow direction. Based on hydraulic gradients, the dissolved VOC plume predominantly migrates in the horizontal direction with a slight upward component of flow as the plume approaches the brook/wetlands.

Simulated regional groundwater flow patterns within the area (based on the site-specific groundwater flow model) in relation to these plumes indicates groundwater flow patterns correlate well with the contaminant plume configurations. These flow directions also suggest that groundwater flow further downgradient of the Site would be predominantly along the reaches of Sutton Brook and that due to the configuration of surface water bodies (Sutton Brook, Shawsheen River, and associated tributaries) the majority of the surrounding areas, including the residential neighborhoods, are located hydraulically upgradient of the Site and therefore, in general, the groundwater plumes migrate toward and discharge to Sutton Brook and associated wetlands along the brook.

The higher VOC concentrations are detected in the intermediate overburden. Hydraulic gradients in this zone of the aquifer are relatively flat (0.001 ft/ft range) and combined with low hydraulic conductivities result in a reduced groundwater velocity and subsequent reduced contamination migration rates.

No significant increasing trends in concentrations of dissolved VOCs or SVOCs or significant changes in the shape of the dissolved VOC plumes have been detected at the site throughout the sampling events. Although a significant amount of new groundwater data has been recently collected, the extent and concentration distribution of the plume on the site appears to be generally consistent throughout the past ten years of sampling (dating back to 1995). Additionally, decreasing contaminants trends in VOCs are apparent especially for the VOC contaminant mass across the site.

The analytical and geochemical data indicate that natural attenuation processes are degrading and reducing the mass of site contaminants. These natural attenuation processes, including biodegradation, dispersion, dilution, sorption, volatilization and chemical or biological stabilization, transformation, or destruction, have stabilized and/or decreased the size of the contaminant plume. In addition, chemical footprint indicators, including the absence of electron acceptors oxygen, nitrate and sulfate and the presence (and subsequent increase spatially on-site) of metabolic byproducts methane and ferrous iron have been measured within and immediately downgradient of source areas on-site, indicating that biodegradation processes are interacting with contaminants in groundwater.

A review of the results of the RI indicate that sufficient information has been collected to evaluate the source(s), nature, extent, and distribution of contaminants and to assess the current and future potential risks to human health and to the environment.

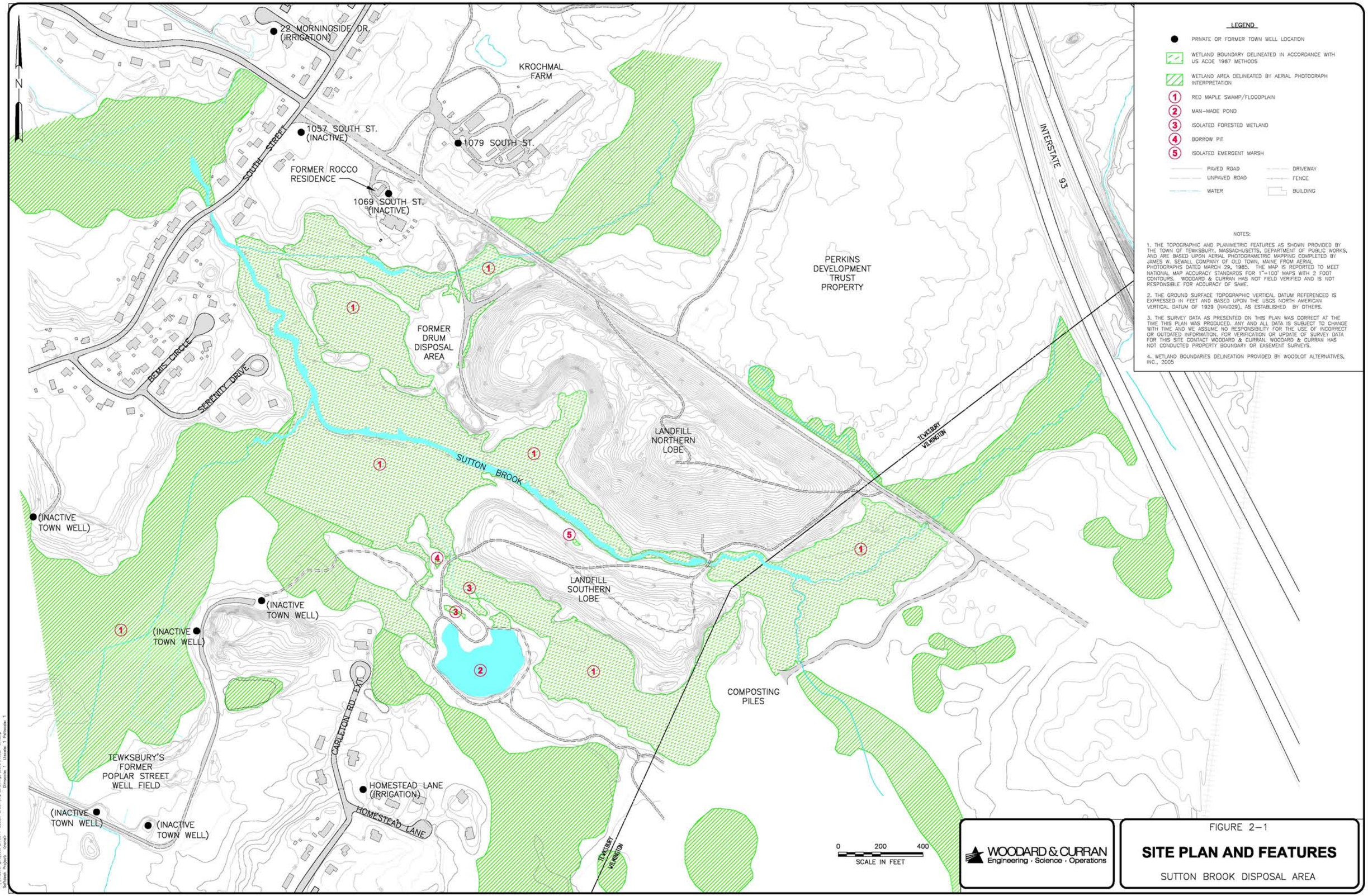

FIGURE 2–1

SITE PLAN AND FEATURES

SUTTON BROOK DISPOSAL AREA

3. HUMAN HEALTH RISK ASSESSMENT

The purpose of the Baseline Human Health Risk Assessment (HHRA) is to understand potential risks associated with chemicals at/or migrating from the Site in order to evaluate the need for remedial actions. This baseline HHRA was conducted for the Site based on USEPA risk assessment guidance and policy, and the Site-specific risk assessment scope of work, the RI/FS Workplan, first and second interim deliverables for the HHRA, comment-responses on these deliverables, and discussions with EPA.

The HHRA consists of four components:

- Hazard Identification, which describes the available data to be used in the risk assessment, including reference data, evaluates the data with respect to its usability, and presents the selection of the Chemicals of Potential Concern (COPC);
- Exposure Assessment, which presents a detailed description of the Conceptual Site Model, including relevant receptors, exposure pathways and exposure scenarios;
- Risk Characterization, in which cancer risk estimates and non-cancer hazard indices are quantified for each identified receptor and, as applicable, concentrations of COPCs are compared to applicable standards; and
- Uncertainty Analysis, which identifies and, where possible, quantifies the uncertainties associated with the risk assessment.

This HHRA incorporates several rounds of comments provided by and discussions with EPA in response to the Phase IA Deliverable (September 22, 2005 and January 13, 2006) and draft HHRA submitted in April 2006 (July 3, 2006; September 6, 2006; November 29, 2006; and January 2007) and revised draft HHRA submitted in March 2007 (April 2007).

As noted previously, activities associated with the RI, risk assessment, and FS were developed and implemented with the presumption that the existing waste material in the two landfill lobes will be closed in-place using current landfill capping technology. Additional soil characterization sampling within the landfill lobes for risk characterization was not performed; samples for physical characteristics of the cover material and from adjacent groundwater, surface water, and sediments were collected and included in the RI and risk characterizations. The conclusions of the risk characterizations are thus predicated on this presumption with regard to the landfill lobes.

3.1 HAZARD IDENTIFICATION

3.1.1 Site Description and History

Please refer to Section 2 of this report for a description and history of the Site. Briefly, the Site is an inactive landfill primarily surrounded by open space, farming operations, a composting operation, and residential dwellings. Sutton Brook flows east to west through the Site, dividing the landfill into Northern and Southern lobes. For presentation and nomenclature purposes, specific areas of the Site have been grouped into Data Groups. For example, the Northern and Southern Lobes are referred to as Groups 1 and 2, respectively. The Former Drum Disposal Area (Group 3) is located northwest of the Northern Lobe. Group 4, located in the northern portion of the Site, includes the former Rocco residence (currently vacant), the landfill entrance, a garage and a storage area. Wetland areas associated with Sutton Brook and minor tributaries (Group 5) are located throughout the area. Forested uplands and a small man-made pond (Group 6) are located south of the Southern lobe and abut a residential neighborhood; this area is

used for recreation, as indicated by the numerous trails and bike jumps that run through the woods and around the pond.

3.1.2 Nature and Extent of Contamination and Selection of Chemicals of Potential Concern

The objective of the Hazard Identification is to present the relevant sampling data, evaluate its usability, and select the COPCs for each medium. Soil, groundwater, sediment, surface water, landfill gas and ambient air data have been collected at the Site as part of various site assessment activities conducted between 1989 and 2006. Sampling events and site data are described in sections of the previously submitted RI Report (February 2007).

3.1.2.1 Data Usability in the HHRA

Data usability was extensively discussed in Section 3 of the previously referenced RI report. The risk assessment considered the data set established for the RI, which excluded some historical data provided without laboratory reports, screening data, data rejected via data validation methods, and tentatively identified compounds (TICs) that were screened out in accordance with the project-specific TIC Data Assessment process. This evaluation includes one exception to the general exclusion of data qualified as rejected ('R'-flagged); R-flagged data for non-detected compounds from select sediment samples with low percent moisture were retained in this evaluation as described in Section 3.1.2.5. TICs are discussed further in Section 3.1.3.4 and the uncertainty analysis (refer to Section 3.5).

With the limited exceptions noted below, this same RI data set was used in the risk assessment. Analytical results for the environmental media at the Site, including reference locations, are provided in Appendix A. These tables were created and are provided as electronic filtered "look-up" Excel tables to review specific data at the Site, due to the large amount of data available.

We have included as Appendix B analytical testing summary (ATS) tables, which identify the samples collected from the Site by group and the analyses performed on each sample.

As indicated on the ATS tables in Appendix B, samples not included in the risk assessment are highlighted. Generally, we considered most available data for use in the risk assessment; however, some reasons for data exclusion from the risk assessment included: 1) the age of data set, i.e., the data were collected 10 or more years ago, or represent pre-remediation conditions, and more recent data have since been collected that are more representative of current and future conditions; and 2) historic data where no laboratory sheet or detection limit was provided.

We conducted a separate evaluation of groundwater data usability in this risk assessment. As multiple rounds of groundwater data from 1995 to 2006 have been collected at the Site, we evaluated the available data for each well relative to number of sampling rounds, concentration trends and project action limits, and retained or eliminated groundwater data based on these criteria. Appendix C describes the dataset evaluated for each wellhead location. Groundwater data from both monitoring wells and temporary wells were considered in the risk assessment. Groundwater and surface water samples were analyzed in some instances for both total and dissolved metals. In general, a higher number of total metals were detected than dissolved metals, more samples were analyzed for total metals, and total metals concentrations were higher than dissolved concentrations. Based on these statistics, total metals data (instead of dissolved metals data) for both groundwater and surface water were conservatively used in the risk assessment.

For each monitoring well or surface water location in which more than one sampling event was conducted, we treated each sampling event as a discrete sampling point; thus, statistical summaries are based on this approach. As described above, for groundwater a well-by-well analysis was performed to select the appropriate number of sampling rounds to be considered in this assessment (Appendix C).

These individual sampling events were then used as the basis for the statistical frequencies of detection, minimum, and maximum detected values.

In some instances, samples (groundwater, surface water, soil and sediment) were analyzed via more than one analytical method resulting in two (or more) results for a given compound (e.g., naphthalene may be reported in analyses for VOC, SVOC, EPH and VPH analyses). When multiple results for a compound were present, the maximum result among the various methods was selected. For constituent results reported by isomer (e.g., o-xylenes and p/m-xylenes), we summed the results from the separate isomers reported for a particular sample and reported one 'total' compound result (e.g., total xylenes).

In calculating the average concentration and 95% upper confidence limits (UCL) of the mean concentration for soil, sediment and surface water[1], we included one-half of the laboratory reporting limit (LRL) as the concentration for non-detect results, with one exception. For non-detect results where the LRL exceeded twice the maximum detected concentration of a given dataset, we excluded that LRL from calculation of the mean and 95% UCL, in accordance with EPA risk assessment guidance (EPA 1989). The appropriateness of this exclusionary criterion is discussed further in Section 3.2.1.5 (Methods for Estimating Exposure Point Concentrations). As described in Section 3.2.1.5, however, this resulted in the exclusion of only a very small number of non-detects from the calculation of these statistics.

Figure 3-1 presents the aforementioned data groups and those specific RI sampling locations for all sampling points used in the human health risk assessment. A discussion of the specific data sets for each area of the Site is presented in the following sections.

3.1.2.2 Landfill Lobes (Group 1 and 2)

Soil, groundwater, landfill gas and ambient air samples have been collected from the landfill lobes. The Northern and Southern Landfill Lobes are collectively grouped together as "Groups 1 and 2" in the risk assessment, since it is presumes that both lobes will be capped; hence, similar (limited) exposure exists.

Soil: Given that it has been assumed that the landfill lobes will be capped, the risk assessment, consistent with the RI/FS, has focused on areas of potential impact adjacent to/outside the landfill footprint, because it is presumed that the existing waste material (identified through test pits, borings and well installation) will be closed in-place using current landfill capping technology. Accordingly, this risk assessment is based on the assumption that the landfill contents (i.e., waste materials and associated soils) will be capped and landfill gas properly managed. We also assumed an approximate 50 foot perimeter around the extent of waste limit and other adjacent areas of debris, which represents an area that may potentially be included/disturbed during the remedy implementation. The risk assessment assumes that direct exposure to constituents within the landfill soils will be eliminated; therefore, soil from this area of the Site was not considered further in the risk assessment.

Groundwater: In contrast to soil, we have included an evaluation of risks associated with groundwater from the two landfill lobes, since groundwater is a mobile medium and as the Site is located in a potential drinking water source area. Summary statistics for groundwater collected from wells located in these two areas (collectively known as Groups 1 and 2) are presented in Table 3-1; complete data sets are provided in Appendix A. We relied on all available groundwater monitoring well data for this area, with the exception of 1995 data from wells MW-3B, MW-4S and MW-4B. Up to nine additional rounds have been collected in these wells between 1999 and 2006; thus, these more recent data provide a better representation of current (and potential future) groundwater quality in these wells.

[1] As requested by the USEPA, groundwater was evaluated through use of maximum detected concentrations.

The results indicated that numerous VOCs, SVOCs, and metals were detected in groundwater from this area. Many of the highest levels of constituents were detected in wells MW-4S, MW-4B, GP-12 and GP-13, located adjacent to the Southern Lobe. Benzene, tetrahydrofuran, 1,4-dioxane, toluene, and metals were generally detected with the greatest frequency.

Ambient Air: An ambient survey completed on the landfill lobes in August 1992 was evaluated within this risk assessment. During this survey, EPA collected seven ambient air samples (STA-1 through STA-7) in August 1992 from the landfill and analyzed the samples for VOCs (EPA TO-14 analysis). Summary statistics for ambient air data are based on data collected from locations STA-1 through STA- 6 (STA-7 reflects a reference location). This summary is provided in Table 3-2; the dataset is presented in Appendix A.

As indicated in Section 3.1.3.5 of this report, the maximum detected ambient air concentration of each detected constituent from 1992 data (consisting of six site samples) was compared to Region 9 Preliminary Remediation Goals (PRGs) for Ambient Air when selecting the chemicals of potential concern (COPCs) for this medium. As detection limits were obtained for this dataset, we utilized these data in our evaluation. Constituents were detected in only two of the six samples collected from across the landfill and both of these samples were from the northern lobe of the landfill. No constituents were detected in samples collected beyond the lobe limits. Maximum concentrations of benzene, xylenes, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene exceeded Region 9 PRGs and were therefore carried through the quantitative risk assessment as COPCs in ambient air.

As indicated on Table 3-2, constituents were detected only in samples STA-2 and STA-3, collected from the Northern Lobe of the landfill; as previously stated, no constituents were detected in samples collected beyond the lobes or along South Street. Although these data were collected in 1992, these data have been assumed to reflect existing site conditions (or are conservative in nature). Given site conditions, the existing ambient air data likely reflect similar or even historically elevated ambient air conditions at the Site. Furthermore, release of vapors into ambient air will be mitigated as part of lobe capping and a gas venting system to be installed as part of the remedy. There is some uncertainty associated with use of these historical data; however, the concentrations of constituents in the landfill are anticipated to be either in steady state or decreasing and therefore, the benefit of including these data outweighs these uncertainties.

3.1.2.3 Former Drum Disposal Area and Adjacent Disturbed Area – Group 3

As described in Section 5 of the RI report, EPA conducted a removal action in the former drum disposal area (Group 3) in 2000, in which approximately 300 to 400 crushed drums and 13,786 tons of soil were transported off-site for disposal. The adjacent "disturbed" area is almost totally comprised of a wetland area. This wetland was most likely created as a result of topsoil removal and equipment compaction.

Upland (i.e., non-wetland/non-hydric) soil data from Group 3 were evaluated in the human health risk assessment, as the former drum disposal area represents an area with known sources of contamination and could potentially be developed under future conditions. In this risk assessment, all wetland soil, surface water and sediment data initially collected from this area of the Site (and initially categorized under Group 3) have been regrouped with Group 5-6 wetland media, due to the similarities in potential for human exposure between the "disturbed" area and Sutton Brook and wetlands (see Figure 3-1). Thus, the only media considered from Group 3 include upland soil and groundwater.

Soil: As discussed, a large volume of contaminated soil and debris was removed from the former drum disposal area in 2000. As presented in Section 2 and 3 of the RI report, laboratory analytical data sheets

from the post-excavation data collected from this area in 2000 were not provided. Only summary tables of select compounds were available. As such these data were not evaluated in the risk assessment.

The post-remediation soil samples (collected in 2004) have been retained for use in the risk assessment, since they represent current soil conditions. A review of the data indicates that the general areas of more elevated contamination correlate well with the 2000 post-excavation data set. With the exception of one soil sample, all soil data from this Group were collected from subsurface (i.e., >1' bgs) depths.

As further described in Section 3.2.1.5, we generally used surface soil data to evaluate current exposures, if it was representative of the area under evaluation. The surface soil data in Group 3 included post-excavation soil samples collected by EPA following the removal action; however, the depths of these samples were not provided in the report and it was not evident that backfilling had occurred over these sample locations. The follow-up sampling conducted during the RI focused on collecting samples from the most contaminated depth intervals, based on soil jar headspace testing.

Based on this information and visual inspection of the area, there appears to have been some backfilling of portions of the excavated area. Low points still remain in this area relative to the surrounding ground surface. The analytical results from the shallow soil sample (0 to 2 feet below grade) collected in 2004 indicate the presence of contaminants at this depth interval; however, the more elevated concentrations of contaminants were detected from depths around 4 to 6 feet below grade.

For the purposes of the risk assessment specific to this area of the Site, the 0-10' interval was conservatively used to evaluate both current (which typically are only exposed to surface soil) and future (all depths to 10' bgs) scenarios. This is considered a conservative estimate of current exposures, as surficial concentrations are likely to be lower than those found in deeper samples.

A summary of the risk assessment soil data for this area is provided on Table 3-3; soil analytical results are presented in Appendix A. As indicated in this table, VOCs (in particular, BTEX and several chlorinated solvents) were the most prevalent constituents detected in Group 3 soils, with highest concentrations primarily occurring in samples SB-1(04), SB-5(04) and SB-6(04). Phthalates and other SVOCs were also present in Group 3 soils.

Groundwater: As a removal action was conducted in 2000 in Group 3, we excluded all groundwater data collected from Group 3 from 1999 and previous sampling rounds in the risk assessment, in order to represent current groundwater quality in this area of the Site. A summary of the Group 3 groundwater data is provided on Table 3-4; complete data sets are provided in Appendix A. Results indicated that chlorinated and non-chlorinated VOCs, SVOCs (primarily phenolic compounds), and inorganics were detected in groundwater from this area, with VOCs and inorganics detected at the greatest frequency. Highest concentrations of most VOCs were detected primarily in wells MW-9 and MW-7M.

3.1.2.4 Former Residence, Garage and Storage Area – Group 4

This area, characterized by Group 4 samples, encompasses the former Rocco residence, the landfill entrance, a garage, and a storage area. Currently, the residence is not inhabited; however, storage and related activities occur in this portion of the Site.

Soil and groundwater data have been collected from this upland Site area. Data collected from all soil sampling locations were considered in the human health risk assessment, with the exception of sample WED-07(99), collected at 15-17 feet below ground surface. This depth interval is assumed to be greater than that to which typical receptors would be exposed and thus was excluded as not representative of Site soil exposures. A summary of the soil sampling data from Group 4 is provided on Table 3-5. The results indicated that VOCs, SVOCs, pesticides, PCBs, petroleum constituents and metals were detected at least

once in soil in this area with PAHs and metals detected at the greatest frequency. Concentrations of constituents in Group 4 soils are generally lower than those detected in Group 3.

All groundwater data collected from this area were retained for evaluation, with the exception of 1995 data from well MW-1S. Since 1995, five additional rounds of data have been collected from this well; therefore, inclusion of the more recent data (1999-2005) provides a more accurate reflection of groundwater quality in this well. A summary of the risk assessment groundwater data for Group 4 is provided on Table 3-6; complete data sets are provided in Appendix A. The results indicated that several VOCs and SVOCs were sporadically detected in this area, and typically only in wells MW-1S or MW-1R; numerous metals were detected at a higher prevalence in these and other wells of this Group.

3.1.2.5 Sutton Brook and Associated Tributary and Wetland Areas – Group 5

Group 5 is comprised of a portion of the Site not located within the limits of the landfill lobes, former drum disposal area, or former residence, garage and storage area. Group 5 is comprised primarily of wetland areas associated with Sutton Brook and its tributaries. As Sutton Brook traverses the Site, additional flow is discharged to the brook via three separate tributaries. A very large red maple swamp (greater than 50 acres) associated with the brook is a significant feature across the entire Site. It includes floodplain and wetland basins associated with Sutton Brook and the tributary streams. Wetland soil, groundwater, sediment and surface water have been collected from this area between 1999 and 2006.

As discussed in Section 4.2 of the RI Report, the water level in Sutton Brook and associated tributaries is highly variable throughout the year, ranging from several inches to several feet. In the summer and fall, when human exposures are most likely, some of the smaller tributaries were observed to become relatively shallow or dry up entirely. Sutton Brook, although, maintained surface water flow throughout these time periods. However, as described in more detail in the BERA (Section 4 of this report), the water depths in Sutton Brook remained fairly shallow throughout these time periods, ranging from approximately one to four feet in depth. Thus, it is believed that all sediment data considered in the HHRA are representative of potentially accessible sediments.

Wetland soil samples (defined as surface soil that may be covered by water a portion of the year and exhibits hydric characteristics) were evaluated as a distinct medium in this risk assessment. As discussed, three wetland soil samples originally classified as Group 3 (GP-23(04), SS-13(04) and SS-14(04)) have been considered as part of the Group 5 wetland area for this risk assessment.

A summary of the wetland soil data is provided on Table 3-7; analytical results are provided in Appendix A. Metals were detected with the highest frequency in these soils. VOCs were typically detected at low to moderate frequencies of detection; however, chemical concentrations were typically within a factor of 10 of method detection limits. SVOCs and several chlorinated pesticides were detected at relatively low concentrations in only one sample, SD-12(99), which is located at the eastern (and upgradient) portion of Group 5, near the dirt access road to the composting facility.

Groundwater data from all available sampling rounds (1999-2006) in Group 5 wells have been included in this risk assessment. Groundwater data are summarized on Table 3-8; analytical results are provided in Appendix A. The results indicated that VOCs, SVOCs, inorganics and alpha-BHC were detected in various Group 5 wells, with the highest concentrations reported in wells MW-8M, located adjacent to Group 3 (former drum disposal area) and MW-22M, located west of the Southern landfill lobe. Both wells are immediately downgradient of these two source areas.

Sediment samples (defined as solids covered by surface water throughout the year) were collected from Sutton Brook and its tributaries. Data collected from 1999 through 2006 were retained for evaluation in the risk assessment; earlier data from 1989 and 1995 were not included since additional, more recent

samples have been collected in similar or comparable areas. As discussed earlier, we have incorporated sediment and surface water data (samples SS-12(04) and SW-111(05)) formerly considered as Group 3 into Group 5.

With respect to sediment data, EPA Region I Functional Guidelines (1996) governing data validation defines sediment by the same criteria used to define soils, which is containing greater than 30% solids. As part of an aquatic system, many shallow sediments from quiescent water bodies do not meet this soils-based definition. As a result, and in accordance with the EPA 1996 guideline, all detected compound results are flagged as estimated (J) and non-detected compound results (e.g., reporting limits) are flagged as rejected (R). Samples typically contained about 15% solid material, which is typical for wetlands and slow-moving streams. In consequence, the sediment samples contain a high percentage of moisture, which cannot be removed in the field by conventional techniques. It was agreed to stay with the current sampling methods of extensive decanting in the field and collecting extra volume to compensate for the low percent solids.

With the addition of six samples collected in 2006, the Deep Marsh, southwest of the southern landfill lobe, is represented by 13 samples, which provides adequate coverage of the sample variability. Based on the total solids results detected in these sediment samples over the three separate sampling events and the use of decanting the free liquids along with collecting extra volume, the non-detected R-flagged data are considered to be representative of non-detected compounds at the reporting limits, with the understanding that these values are estimates. This is the same approach used for J-flagged data, which is used throughout the risk assessment. The non-detected values that were included in the risk assessment calculations at ½ their reported values typically had elevated detection limits. This approach, which supplies qualified information, was considered preferable to eliminating the non-detected results entirely.

Unless rejected for reasons other than moisture content (as described above) data from all locations and from sampling dates 1999 to present were considered as usable in the risk assessment.

The resulting sediment data set for Group 5 is summarized on Table 3-9; analytical results are provided in Appendix A. The results indicated that VOCs, SVOCs, pesticides and metals were detected in sediments. Highest concentrations of contaminants were predominantly detected in samples collected in Sutton Brook between or near the two landfill lobes.

Surface water samples were also collected from Sutton Brook and its tributaries. Surface water data from 1999 through 2006 were evaluated in this risk assessment. The 1995 data were considered as not representative of current and future site conditions. Some surface water sample locations were monitored over successive sampling events; in such cases, we treated each sampling event as a discrete data point; this approach was used as the basis for calculating summary statistics. Surface water summary results for Group 5 are presented on Table 3-10; analytical results are provided in Appendix A. The results indicated that SVOCs and pesticides were detected infrequently (<5%), typically at locations SW-02(99), SW-05(99) and SW-33(05), while VOCs, volatile petroleum hydrocarbons (VPH) and metals were detected at frequencies ranging from 3% to 100%. As with sediment, highest concentrations of contaminants were typically present in samples collected in between the landfill lobes.

3.1.2.6 Area South of Southern Lobe – Group 6

This area is located on the southern portion of the Site and is mainly comprised of a shallow, man-made pond and dirt trails currently used by recreational vehicles. Another feature within this area is a small isolated forested wetland located northeast of the pond and adjacent to the Southern lobe of the landfill. A portion of this area also appears to be man-made as a result of past excavation activities. This wetland area drains across the trail from the Southern Lobe into the larger wetland area located north of this area.

Groundwater, sediment and surface water samples have been collected from the Group 6 area between 1999 and 2006. Additionally, sample SD-02(99), formerly assigned to Group 2, was included in Group 6 sediments.

Table 3-11 presents the sediment results for this area and indicates that VOCs and SVOCs were detected in the several of the samples collected from Group 6; most metals were detected in the sediment samples collected from this area of the Site. Eight surface water samples were collected in 2004 and 2005; these data are summarized on Table 3-12. Both chlorinated and non-chlorinated VOCs and metals were detected in surface water samples, with highest concentrations occurring in samples SW-102(05), SW-103(05) and SW-105(05), located immediately south/downgradient of the landfill's Southern lobe.

Groundwater has been collected in Group 6 from monitoring wells and temporary wells from 1999 to 2006. VOCs, phenols and inorganics were detected, as summarized on Table 3-13. The highest concentrations of constituents were detected in wells located closest to the Southern landfill lobe.

3.1.2.7 Reference Locations – Group 7

To establish a reference data set (herein referred to as "reference" locations, or Group 7) for this RI/FS, both previous Site investigation data and data collected during the RI have been considered. Note that data from Group 7 have <u>not</u> been used to eliminate site COPCs but are instead used to identify constituents at the Site that are present at levels consistent with reference conditions.

Samples used in defining reference areas included samples collected from areas that have similar physical, chemical, geological, and biological characteristics as the Site, but have not been affected by site activities or releases. Reference data may be representative of naturally-occurring geochemical conditions, or may represent areas of low-level contamination that have not been impacted from *Site* use or disposal, but where impacts may be present due to off-site anthropogenic sources, such as automotive emissions or storm-water runoff, which may contain measurable levels of contaminants. As per RAGs (USEPA, OERR, December 1989), both of these types of background reference constituents and levels can be considered to distinguish between site-related and "reference" area risk, such that one can ultimately make informed decisions regarding the need for and extent of remedial response measures at a site. As described in Section 5.6 of the RI report and in Section 3.1.4 of this report, the data and statistics support that these data sets are representative of the variation in reference levels reflective of this geographic and geological setting.

To establish a reference data set for this RI/FS, both previous site investigation data and newly collected data during the RI have been considered. Samples used in defining reference areas included samples collected from areas that have similar physical, chemical, geological, and biological characteristics as the site, but have not been affected by site activities or releases. These areas may be impacted from other "sources" not related to the site. For example, areas include the adjacent Krochmal farm, the adjacent composting facility, all-terrain vehicle use of dirt roads in the area, or vehicular traffic impacts.

The reference areas have been divided into three categories, as described below and in the following paragraphs.

- Sutton Brook and Associated Tributaries
- Undeveloped Areas Located Hydraulically Upgradient of the Site
- Off-Site Residential Areas

These areas are collectively referred to as Group 7 areas, and represent areas where no specific sources of constituents, other than those naturally-occurring or from incidental anthropogenic non-point sources

(e.g., atmospheric deposition of vehicle emissions, roadway run-off etc.), would be expected as well as areas which have not been impacted from Site use or disposal. A detailed description of the Reference sample locations is provided in Section 5.6 and on Figure 5-6a of the RI report. Data for reference samples for all media are presented in Appendix A.

With regard to Sutton Brook, reference samples were collected immediately upstream of the Site and further downstream at the confluence with the Shawsheen River, respectively. In addition, surface water and sediment samples were collected from the upstream portion of the southern tributary, which flows northerly past the composting facility and discharges into the brook on the southeastern portion of the Site.

As described in Section 4 of the RI report, Sutton Brook is the primary hydrologic feature on the site and its location controls groundwater flow directions in this vicinity, and thus areas considered hydraulically upgradient of the site. There are two areas that are considered both undeveloped and hydraulically upgradient to the site: the first is located to the east of the landfill on property generally referred to as the Perkins Development Trust property and the second is located to the south of the landfill lobes. These areas, therefore provide good site reference locations.

As part of the RI, reference soil and groundwater samples have been collected from both of these areas. A summary of the specific sampling locations collected from this area is presented in Section 5.6 of the RI report.

Since the early 1990's, numerous investigations and sampling activities have been conducted by the MassDEP and EPA within the residential neighborhood located to the northwest of the Site. Based on a review of historical information and aerial photographs, no site-related landfill operations appear to have occurred in these residential areas prior to development as residences (most of these properties pre-date the landfill). As presented in Section 4 of the RI report, this residential neighborhood is hydraulically upgradient of or crossgradient to the groundwater contaminant plumes associated with the Former Drum Disposal Area and landfill lobes. This was confirmed further upon installation, monitoring and sampling of the new monitoring wells installed at Bemis Circle (MW-25/25M) and Serenity Drive (MW-24/24M). Additional discussion on the installation of these wells and the determinations made based on the hydrogeologic features encountered are provided in Sections 2 and 4 of the RI report.

The groundwater data set collected from this area (MW-24 and MW-25 well couplets) was not quantitatively considered in this risk assessment. However, the numerous soil samples collected within the neighborhood were used as part of the reference data set, based on their general consistency with soil reference data collected from undeveloped areas, as described below. As indicated in Section 3.1.4 of this report, comparison of soil samples from the neighborhood area had lower levels of PAHs typically associated with combustion by-products/anthropogenic activities (e.g., 4-6 ring, high molecular weight PAHs) relative to reference samples collected from undeveloped areas. With respect to naturally-occurring metals, the neighborhood samples typically had higher concentrations relative to the samples from undeveloped reference areas. Furthermore, as part of the exposure assessment, the residential area is discussed and qualitatively evaluated.

Soil, groundwater, sediment and surface water samples have been collected from reference locations throughout the investigation activities at the site (1989 through 2006). For the purpose of the risk assessment, the only sample identified in the RI data set that was excluded from the reference data set is sediment sample SD-02, collected in 1989 from Sutton Brook adjacent to the dirt access roadway on the Perkins property, since more recent data have been collected in this area.

Soil data were collected from various reference locations, as shown on Figure 3-1. Site soil and reference soil data are provided Appendix A. VOCs, SVOCs, pesticides, PCBs and inorganics were detected at various frequencies among site samples. Only the data potentially related to either naturally-occurring constituents (e.g., metals) and/or constituents associated with non-release related anthropogenic activities (e.g., PAHs from automobile/truck emissions or fires) were considered in the subsequent reference to site comparisons.

Group 7 groundwater data represent sampling rounds conducted from 1999 through 2006. Metals were detected at a range of frequencies, depending on the metal; VOCs and SVOCs were only sporadically detected. Surface water and sediment samples were collected from Reference areas between 1999 and 2006. Inorganics were detected at a high frequency in Group 7 samples; SVOCs, VOCs and several pesticides were also detected in some samples.

With respect to comments previously received from USEPA regarding the presence of low levels of organic constituents found in Reference samples (e.g., Comment 21, Response to Comments, August 11, 2006), some of the constituents detected in the reference samples were not detected at either frequencies or concentrations high enough to be selected as COPCs in site media or were not COPCs in site media that could likely be transported via a migration pathway to the reference medium (e.g., COPC only detected in groundwater and was found in Reference surface soils from upgradient locations). Furthermore, although toluene is a key COPC at the site, the detected concentrations in the reference samples used as examples by the USEPA (Comment 21), were all lower than 0.002 mg/kg, and were estimated values below the laboratory's MDL. There are numerous sources of such low levels (close to the detection limit and within the "noise" of the analytical method) of toluene in soils, such as a small spill of gasoline/emissions from lawn mowers, vehicles, paints, etc. Lastly, it should be noted that the HERA did not identify any VOCs in site media as being "consistent with reference" and hence did not remove them from calculation of site-related risks.

A statistical evaluation of site conditions relative to reference concentrations is presented in Section 3.1.4 and Appendix D.

3.1.3 Selection of Chemicals of Potential Concern

The objective of the Hazard Identification is to present the relevant sampling data and select the Chemicals of Potential Concern (COPCs) for each medium. Soil, groundwater, ambient air, surface water, and sediment data have been collected at the Site as part of various site assessment activities conducted between 1989 and 2006. As described in previous sections of the HHRA, the vast majority of the data that were collected during assessment activities was retained for use in the risk assessment.

COPCs were selected for each of the HHRA Groups 1 through 6, identified above. As previously discussed, we did not identify COPCs for Groups 1 and 2 soil, as this area of the Site has been assumed to be capped as part of the remedy for the landfill lobes and therefore be rendered inaccessible to potential receptors. We identified COPCs for groundwater in Groups 1 and 2 (combined) and in Groups 3 through 6. As discussed, COPCs were not identified for Group 7 media, as these data were used only to distinguish the risk contribution of site-related COPCs relative to reference risks, as described in Section 3.1.4.

The selection process used to determine site COPCs conforms to EPA guidance. Criteria used in this selection process are described below.

3.1.3.1 Frequency of Detection

Per EPA guidance, chemicals that were not detected at least once in a medium per group were not retained as a COPC. However, since several of the datasets used in this HHRA were comprised of fewer than twenty samples, we did not exclude any compounds as COPCs based on a low frequency of detection (typically considered as a prevalence of less than or equal to 5%).

3.1.3.2 Elimination of Essential Nutrients

The following several inorganics are common elements and nutritionally essential minerals and are not considered human health COPCs: calcium, iron, magnesium, potassium and sodium.

3.1.3.3 Elimination of Laboratory Contaminants

Chemicals considered to be common laboratory contaminants (e.g., acetone and methylene chloride) were not selected as COPCs if they were present in samples at levels less than ten times those reported in associated blank samples (EPA, 1989). However, blank contamination was rarely reported in site samples, and so this criterion ultimately was not used in the selection of COPCs for this HHRA.

3.1.3.4 Tentatively-Identified Compounds (TICs)

As previously discussed in Section 3.1.2, TICs were not retained as COPCs in the quantitative risk assessment if the constituent was characterized as "unknown", was present as an analyte in another laboratory method, was present at a low frequency (<5%) or if no health-based screening criteria were available for that constituent. Based on this preliminary screening presented in Section 3 of the RI Report, two TICs, chlorodifluoromethane and n,n-dimethylformamide, were identified as potential COPCs.

Chlorodifluoromethane was detected via TIC analysis in groundwater from four wells (MW-3S, MW-11, PMW-2 and PMW-3). As the highest detected concentration of 23 ug/L is well below the Region 9 tapwater PRG of 85,000 ug/L; this TIC was excluded as a COPC in groundwater. Thus, this compound has been screened out from further quantification in the risk characterization.

N,N-dimethylformamide was detected in groundwater from six wells (MW-4B, MW-5, MW-7M, MW-8M, MW-9 and WP-7) during various sampling rounds. Concentrations in only well MW-9 (9,400 ug/L to 19,000 ug/L) exceed the Region 9 tapwater PRG of 3,600 ug/L. Results from MW-9 indicated the highest concentration of organic compounds were detected in site groundwater from this well. Given that n,n-dimethylformamide was detected at concentrations elevated above the tapwater PRG in only one of 56 wells sampled (2%), this compound was excluded from quantification in the risk characterization.

The uncertainty and bias associated with exclusion of TICs in the quantitative risk assessment is further discussed in Section 3.5.

3.1.3.5 Screening Criteria

COPCs were further identified by comparing maximum detected concentrations to EPA-recommended toxicity-based screening criteria and applicable standards. Chemicals with maximum detected concentrations exceeding the screening criteria or standards were identified as COPCs and carried through the HHRA. When possible, we used screening criteria from structurally similar compounds for chemicals that did not have toxicological information. The following screening criteria were used for comparison:

Soil –USEPA Region 9 Preliminary Remediation Goals (PRGs) for residential soil. If a PRG was not available for a particular detected constituent (for example, petroleum hydrocarbon fractions); the maximum detected concentration of this constituent was compared to the risk-based Massachusetts Contingency Plan (MCP; *310 CMR 40.0000*) Method 1 soil standard for S-1/GW-1 soils. These S-1/GW-1 soil standards are protective of residential land use, assuming the underlying aquifer may be used for potable water. PRGs and Method 1 cancer-based standards correspond to an incremental lifetime cancer risk (ILCR) of one in one million (1×10^{-6}), whereas noncancer-based screening levels are adjusted to reflect a hazard quotient (HQ) of 0.1. Soil screening levels are presented in Table 3-3 (Group 3), Table 3-5 (Group 4) and Table 3-7 (Group 5).

Sediment – No sediment-specific screening criteria were identified for the HHRA. However, in order to address the potential human exposure to sediment, the USEPA requested that the maximum sediment concentration be compared to the Region 9 PRGs for residential soils. These criteria are conservative since the potential for exposure to soil, even under non-residential scenarios, is substantially greater than the potential for exposure to sediment beneath surface water bodies. Because PRGs were not available for all of the detected constituents, concentrations without Federal criteria were compared to MCP (MCP; *310 CMR 40.0000*) Method 1 soil standards for S-1/GW-1 (residential) soils, as described above. Sediment screening levels are presented in Table 3-9 (Group 5) and Table 3-11 (Group 6).

Groundwater – Groundwater at the Site is classified by the MassDEP as a GW-1 (potable) aquifer. Therefore, Region 9 tap water PRGs were used as comparison criteria for groundwater. For constituents for which PRGs were not available, maximum concentrations were compared to MCP Method 1 GW-1 groundwater standards, which are protective of exposures associated with potable water use. As with soil screening levels, PRGs and Method 1 groundwater standards are based on an ILCR of 1×10^{-6} and HQ of 0.1. Maximum groundwater concentrations were also compared to Federal drinking water standards (Federal Maximum Contaminant Levels, or MCLs). Using these criteria, we selected COPCs for Groups 1 and 2 (combined) groundwater and Groups 3-6 groundwater, as shown on Tables 3-1 and 3-14, respectively. These two groundwater groupings reflect the evaluation of potable water use described in Section 3.2.1.5. In addition, groundwater COPCs were separately selected for all of the Group 3, 4, 5 and 6, and quantitatively assessed for Groups 3 and 4 (see Tables 3-4 and 3-6) to evaluate potential dermal contact and/or inhalation exposures that may occur in these individual site areas.

Surface Water – Per EPA's response to the Phase IA RI deliverable, maximum detected concentrations of constituents in surface water were compared to Federal MCLs. For compounds without MCLs, concentrations were compared to Region 9 PRGs for tap water and/or MCP GW-1 standards. Surface water screening levels are presented in Table 3-10 (Group 5) and Table 3-12 (Group 6).

Ambient Air – Ambient air concentrations were compared to Region 9 Preliminary Remediation Goals for ambient air. As with other screening levels, PRGs are based on an ILCR of 1×10^{-6} and HQ of 0.1. Ambient air screening levels are presented in Table 3-2.

For constituents with no the relevant screening criteria, we used screening criteria from structurally similar compounds as surrogate values. Where no appropriate surrogates were identified, we eliminated those compounds as COPCs, as there are no readily available toxicological information with which to quantify risks for these compounds.

Tables 3-1 through 3-14 present statistical summaries of the analytical data for each Site group, by medium, and a comparison of maximum detected concentrations to the relevant screening levels identified above. Table 3-15 presents a summary of the COPCs by group medium.

In general, groundwater COPCs in Groups 1/2, 3 and 5 included the largest number of VOCs relative to other Groups and media. Groundwater COPCs in all groups contained several metals and select SVOCs and petroleum associated VOCs. Wetland and upland soils COPCs consisted primarily of PAHs and metals; COPCs in sediment and surface water in Groups 5 and 6 were largely limited to metals. Ambient air COPCs consisted of aromatic VOCs.

3.1.4 Preliminary Evaluation of Reference Locations

Local reference concentrations were not considered in the identification of COPCs. However, these conditions were assessed to evaluate whether concentrations of inorganic or PAH COPCs or possible laboratory contaminants identified in each medium at the site may be consistent with reference concentrations. Reference samples were collected from off-site locations where no overt sources of constituents were present, other than those naturally-occurring or related to anthropogenic non-point sources (such as roadway run-off). The locations identified as reference are provided in Table D-1. A list of COPC for each medium is presented in Table D-2.

The comparison of site inorganic and PAH COPC concentrations to reference COPC concentrations is pertinent to all media evaluated (upland soils, wetland soils, groundwater, surface water, sediment), due to both naturally-occurring constituents present in the region, as well as anthropogenic sources of constituents, which may be present. As inorganics are naturally-occurring and are also constituents that often may exert elevated toxicity, inorganic COPC concentrations that, based on the statistics described below, were not significantly different from the reference concentrations are identified as a "Reference" throughout the risk assessment. This approach was also used for PAHs which are ubiquitous in the environment. This identification was performed to understand how potential site risks compare to reference-related risks.

3.1.4.1 Method of Comparison

The comparison of Site to Reference concentrations was performed in accordance with EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA, 2002). Statistical methods that are used to compare site to reference locations generally include either parametric or non-parametric tests. Parametric statistical tests assume the data follow a known distribution, while non-parametric tests do not assume a specific underlying distribution. As described in EPA's guidance (USEPA, 2002), for data sets less than 20, non-parametric tests should be used to avoid incorrectly assuming the data are normally distributed when there may not be enough information.

Data distributions were evaluated for pertinent SVOCs and inorganics within the groundwater, surface water, soil, and sediment datasets. The majority of the distributions were highly right-skewed. Few of the data sets approximated a normal distribution and, in the majority of cases, standard log transformations failed to normalize the data. Due to this condition, and because fewer than 20 Reference samples were generally analyzed from each medium or area, the non-parametric Wilcoxon Rank Sum test, which compares medians of the data sets, was utilized. The Wilcoxon Rank Sum test, a non-parametric test that evaluates whether measurements from one data set are different from another set, ranks data from both sets together and compares the relative ranks of the two underlying data sets. The assumption is that the difference between Reference and Site data is due to a shift in the site concentrations to higher values, due to site contamination. Distributions of the COPC data for each medium, for both Reference and Site locations, are provided in Appendix D.

The Wilcoxon Rank Sum test has been described by EPA as having three advantages for background comparisons:

1. The data sets are not required to be from a known type of distribution;

2. It allows for non-detect measurements to be present in both data sets; and,
3. It is robust with respect to outliers.

The Wilcoxon Rank Sum test was performed to test the null hypothesis (H_0) that the median of the inorganic or PAH Site data is equal to the median of Off-Site data. The alternative hypothesis (H_A) is that the median of on-site data does not equal the median of Reference data. EPA recommends an 80 – 95% confidence value be used. According, a p-value (alpha) of 0.05 (i.e., 95% confidence) was used as the cut-off value for rejection of the null hypothesis in all analyses.

EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA, 2002) recommends that the Wilcoxon Rank Sum test not be used in cases where greater than 40% of the data are non-detects. In such cases, significant differences may be the result of detection limits being elevated in one group, rather than the result of an actual difference in concentrations between the sites. For all of the analyses, comparisons for which the data sets contain greater than 40% non-detects are noted, and the results from these tests should be interpreted with caution. However, in all of these cases, the inorganic or PAH constituent was determined to be site-related (i.e., higher in site data than in reference data.

3.1.4.2 Outliers

The determination of outliers was made based upon qualitative evaluation of histograms of the data for each COPC. Outlier analysis techniques that are typically used for normally distributed data cannot be applied to highly skewed data sets, as data that fall in the extreme right-tail of the distributions may be incorrectly removed from the analysis. A data point was only tentatively considered an outlier if the value was several orders of magnitude greater than other data points, and if it was the only data point in the set exhibiting such a high value. Table D-3 lists potential outliers.

Analyses were conducted both by including and excluding these outliers. The results of the analyses, for all comparisons made, were very similar. These outliers were therefore conservatively included in all analyses to prevent inadvertent removal of a data point that represents important site or reference data.

3.1.4.3 Comparisons

Northwest "Neighborhood" compared to undeveloped locations

Numerous soil samples were collected in the residential neighborhood located northwest or north of the Site. These "neighborhood" reference points were compared to the other reference points in undeveloped areas to determine if a significant difference exists for any COPCs between the two reference groups. Table D-4 lists the locations included as "neighborhood" sites. These comparisons were made for soil and groundwater, the two media for which "neighborhood" sampling data exist. Table D-5 details the results of these comparisons.

For several of the metals and PAHs evaluated, it was determined that there was a significant difference between "neighborhood" sampling locations and undeveloped reference locations. However, there was no consistent trend for these constituents to be consistently higher in either of the reference group – some were higher in the "neighborhood" locations while some were higher in the undeveloped locations. Many of the PAHs, which would be expected to be higher in developed locations due to the possible presence of fill material or other sources, were significantly lower in the "neighborhood" locations relative to the undeveloped locations. The inorganic compounds show no pattern of being greater at one type of reference location versus another. These results suggest that there are not significant anthropogenically-driven impacts on the "neighborhood" locations that differentiate these locations substantially from the

undeveloped locations. The differences most likely reflect variation in background levels of these constituents. Additionally, many of the significant comparisons result from using data sets with greater than 40% non-detect values. The significant differences in these cases may be due to the laboratory detection limits rather than actual differences between the "neighborhood" and undeveloped sampling locations.

In conclusion, it is reasonable to use both neighborhood and undeveloped locations collectively as a reference data set, and the remaining comparisons utilize both "neighborhood" and undeveloped sampling locations collectively as the soil reference data set.

Site compared to Reference locations

For each medium and COPC, concentrations at the Site were compared to the reference locations using non-parametric Wilcoxon tests. Table D-6 provides details of the tests and the summary table below lists the results of these comparisons. Statistical outputs for the Wilcoxon Rank Sum test for each COPC are provided in Appendix D. Each COPC that was identified as being consistent with or significantly lower than the Reference concentration is identified as "Reference" in the table below. Blank cells mean that the chemical was not identified as a COPC for that medium.

Constituent	Groundwater	Sediment	Soil	Surface Water
Aluminum, Total	Reference		Reference	
Antimony, Total	Reference			
Arsenic, Total	**Site-related**	Reference	Reference	**Site-related**
Barium, Total	**Site-related**		Site-related	
Benzo(a)anthracene		Reference	Site-related	
Benzo(a)pyrene		Reference	Site-related	
Benzo(b)fluoranthene		Reference	Site-related	
Benzo(e)Pyrene		Reference	Reference	
Benzo(ghi)perylene		Reference	Site-related	
Benzo(k)fluoranthene		Reference	Site-related	
Beryllium, Total	Reference		Reference	
Cadmium, Total	Reference		Site-related	Reference
Chromium, Total	Reference		**Site-related**	
Cobalt	Site-related			
Copper	Reference			
Dibenzo (a,h) anthracene			Reference	
Fluoranthene			Site-related	
Indeno(1,2,3-cd)Pyrene			Site-related	
Lead, Total	Reference	Reference	Site-related	
Manganese, Total	**Site-related**	Reference	**Site-related**	Reference
Naphthalene	Site-related		Reference	Reference
Nickel, Total	Reference		**Site-related**	
Phenanthrene			Site-related	
Pyrene			Site-related	
Selenium, Total	Reference		Reference	

Constituent	Groundwater	Sediment	Soil	Surface Water
Silver, Total	Reference		Reference	
Thallium, Total	Reference			
Vanadium, Total	Reference	Reference	**Site-related**	Reference
Zinc, Total	Reference		**Site-related**	Reference

Reference = Constituent determined to be present at concentrations consistent with or lower than Reference concentrations.
Site-Related = Constituent determined to be present at concentrations elevated above Reference.
Bold = data set has fewer than 40% non-detects.
Blank cell = Constituent is not a COPC in the medium.

Concentrations of numerous COPCs were found to be significantly higher in the Site ("Site-related") than in the Reference locations. However, in many of these cases, greater than 40% of the data values were non-detects. Those COPCs for which the Site was significantly higher than the reference values, and for which fewer than 40% of the values are non-detects, are listed in bold above. These COPCs are, for groundwater - arsenic, barium and manganese, for soil - chromium, manganese, nickel, vanadium, and zinc, and for surface water - arsenic. A more in-depth evaluation may be necessary for setting cleanup levels based on reference concentrations.

3.2 EXPOSURE ASSESSMENT

The objective of the Exposure Assessment is to estimate the type and magnitude of potential exposure to site-related COPCs present at or migrating from the Site. Exposure is quantified for the populations potentially exposed to contaminated media via specific exposure pathways, based on current and future potential land use. The exposure estimates are first calculated using chemical-specific exposure point concentrations (EPCs) and receptor-specific exposure parameters and then combined with dose-response information to characterize the potential risk to human receptors.

As previously discussed, exposures were evaluated assuming that no direct contact exposures to materials and soils within the landfill lobes (Groups 1 or 2) will occur, due to a landfill cap. Exposures to COPCs in environmental media in areas proximate to and outside the waste boundaries were evaluated by "data group". Each group represents a distinct area (exposure point) of the Site that is characterized by a particular type of contamination (e.g., metals in Group 4), a particular historic use (i.e., drum disposal in Group 3), and/or particular characteristics that may limit future use (i.e., future development is not assumed in Sutton Brook or associated wetland areas [Groups 5-6]). These data groups are depicted on Figure 3-1.

3.2.1 Exposure Scenarios / Conceptual Site Model

Complete and potentially complete exposure pathways are identified and quantitatively evaluated as part of the human health risk characterization. A complete exposure pathway, which links COPCs in an environmental medium to a human receptor, consists of the following elements:

- a source and mechanism of chemical release;
- a retention or transport medium;
- a point of potential human contact (exposure point); and
- an exposure route (e.g., dermal contact, ingestion, or inhalation).

Human exposure may be direct (i.e., the receptor contacts the COPC in the affected medium such as air, water or soil) or may be indirect, involving exposure to chemicals from the Site through the food chain (for example, one may ingest COPCs via consumption of vegetables grown at the Site that have absorbed COPCs from soil).

The exposure assessment has been conducted in a manner consistent with USEPA risk assessment guidance. For each identified receptor at each exposure point, complete or potentially complete exposure pathways were identified based on current or potential site activities and uses and the presence of COPCs in environmental media. Age groups that represent the longest or most intense exposure periods were selected to be adequately protective of all stages of the receptor's life. For all receptors, we evaluated both Central Tendency (CT) and Reasonable Maximum Exposures (RME) to provide both central and upper-bound estimate of health risks. The USEPA requires evaluation of the CT and RME scenarios to provide information on the possible range of potential risks to each receptor; however, the need for remedial action is based on the risks estimated under the RME scenario.

Figure 3-2 presents a Conceptual Site Model (CSM) summary of potential human receptors, exposure points and potentially complete exposure pathways identified for the various Site areas. The CSM is based on a review of historical information, analytical data collected to-date, and observations made during the field activities.

Exposure profiles for each identified receptor are provided in the following sections. Exposure scenarios reflect current and potential future conditions for the trespasser and local resident receptors, and hypothetical future conditions for the Site resident, construction and facility worker receptors.

Youth Trespasser/Recreational User

Given the accessibility of the Site and its proximity to residential areas, we have assumed that trespassers or recreational users may occasionally be present on the Site. This assumption is verified through visual observation of dirt-bike paths and trails, which indicate that portions of the Site are used at least occasionally for recreational purposes.

Risks were quantified separately for a Group 3 and Group 4 trespasser. Although under current conditions, surface soils in Groups 1 and 2 (Northern and Southern Lobes) are accessible to trespassers, we did not quantify risks for these areas of the Site, as it is presumed that the cap to be installed as part of the remedy will eliminate this exposure pathway. Since the decision to cap the former landfill waste areas (to both contain the waste materials and eliminate potential exposures) has been presumed, it is not necessary to quantify exposures.

Thus, trespassers/recreational users of Groups 3 and 4 may have dermal contact with or incidentally ingest COPCs in impacted, exposed surface[2] soils (defined as 0-1 foot below grade) under current conditions and with surficial and subsurface soils (0-10 feet below grade) under future conditions, assuming site redevelopment occurs. Although the trespasser may also potentially inhale volatiles emanating from surface soils or COPCs entrained in particulate dust, risks from this exposure pathway are assumed to be negligible relative to direct contact risks and therefore were not quantified for this receptor (EPA Region 1, January 2006. *Review by EPA of Response to Comments on the March 2005 Draft Phase IA RI Deliverable, Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts [Dated September 22, 2005]*). We did assume, however, that this receptor may inhale VOCs in ambient air across the landfill.

Trespassers may also encounter COPCs in surface water, sediment and wetland soil in the numerous streams and wetland areas of the Site, primarily in the areas defined as Group 5 and Group 6. As the streams/wetlands are relatively shallow and heavily vegetated, it is hypothetically possible that trespassers may occasionally walk/wade through these areas; however, swimming or boating would not likely occur.

[2] Note that only one surface soil sample is available for Group 3 soils. We have therefore used Group 3 soil data from samples collected 0-10' to evaluate both current and future trespasser exposure scenarios for this area of the Site.

FIGURE 3-2
EXPOSURE ASSESSMENT SUMMARY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Surface Soil (0-1' bgs)	Groups 3 & 4; Group 5	Trespasser/Recreational User/Local Resident	Pre-Adolescents / Adolescents	Dermal Contact, Incidental Ingestion	Quantitative	Because soils in Groups 1 & 2 will be capped, they are not included in this evaluation. Trespassers and recreational users could be exposed to surface soils in Groups 3 & 4, and to surficial wetland soil in Group 5.
	Wetland Soil	Wetland Soil (0-1' bgs)	Group 5	Trespasser/Recreational User/Local Resident	Pre-Adolescents / Adolescents	Dermal Contact, Incidental Ingestion	Quantitative	Because the site is accessible to the public, trespassers and recreational users could be exposed to wetland soil when wading or walking in the wetland areas comprised by Groups 5.
	Sediment	Sediment	Groups 5 & 6	Trespasser/Recreational User/Local Resident	Pre-Adolescents / Adolescents	Dermal Contact, Incidental Ingestion	Quantitative	Because the site is accessible to the public, trespassers and recreational users could be exposed to sediment when wading or walking in the wetland areas comprised by Groups 5 & 6.
	Surface Water	Surface Water	Groups 5 & 6	Trespasser / Recreational User/Local Resident	Pre-Adolescents / Adolescents	Dermal Contact	Quantitative	Because the site is accessible to the public, trespassers and recreational users could be exposed to surface water when wading or walking in the wetland areas comprised by Groups 5 & 6.
	Air	Ambient Air	Site	Trespasser / Recreational User/Local Resident	Pre-Adolescents Child / Adult	Inhalation	Quantitative	These receptors may be exposed to landfill gas that emanates into ambient air.

FIGURE 3-2
EXPOSURE ASSESSMENT SUMMARY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Surface and Subsurface Soil (0-10' bgs)	Groups 3 & 4	Trespasser/Recreational User, Site Resident, Construction Worker, Commercial Facility Worker	Child/Adult Adult	Dermal Contact, Incidental Ingestion	Quantitative	Future trespassers, residents, construction workers and commercial workers may be exposed to surface and subsurface soils in Groups 3 & 4 through construction activities, or following re-development of these areas for either residential or commercial purposes.
		Particulates, Volatiles	Groups 3 & 4	Construction Worker Commercial Worker	Adult	Inhalation	Quantitative	Future construction workers and commercial workers may be exposed to the particulates and volatiles emitted from soils through construction activities or following re-development of Groups 3 & 4.
	Wetland Soil	Wetland Soil (0-1' bgs)	Group 5	Trespasser/Recreational User/Local Resident	Pre-Adolescents / Adolescents	Dermal Contact, Incidental Ingestion	Quantitative	Because the site is accessible to the public, trespassers and recreational users could be exposed to wetland soil when wading or walking in the wetland areas comprised by Groups 5.
	Groundwater	Groundwater	Groups 1 & 2 Groups 3, 4, 5 & 6	Site Resident, Commercial Worker	Child / Adult	Dermal Contact, Ingestion and Inhalation	Quantitative	The Site is a potential source of potable water. Potential exposures to groundwater via potable water use are evaluated distinctly for Groups 1 and 2 (combined) since these areas will be capped and Groups 3, 4, 5 & 6 (combined). Commercial workers are anticipated to have only dermal contact with and ingestion of potable water. Inhalation exposures relevant to showering are applicable to only the resident.
		Groundwater	Groups 3 & 4	Construction Worker	Adult	Dermal Contact	Quantitative	Construction workers may be exposed to groundwater in Groups 3 & 4 during construction activities involving excavation in areas where groundwater is shallow.
		Indoor Air	Groups 3 & 4	Site Resident Commerical Worker	Child / Adult Adult	Inhalation	Quantitative	Potential exposures to volatiles released into indoor air may occur, assuming redevelopment of Groups 3 & 4 for residential or commercial purposes.
		Trench Air	Groups 3 & 4	Construction Worker	Adult	Inhalation	Quantitative	Potential exposures to volatiles released into ambient air of an excavation pit or trench may occur during redevelopment of Groups 3 & 4 for residential or commercial purposes.
	Air	Ambient Air	Site	Trespasser/Recreational User, Site Resident	Child / Adult	Inhalation	Quantitative	While playing or working outside, future trespassers and Site residents may be exposed to landfill gas that emanates into ambient air.
	Sediment	Sediment	Groups 5 & 6	Trespasser/Recreational User, Site Resident	Child / Adult	Dermal Contact and Ingestion	Quantitative	While Groups 5 & 6 do not contain developable land, trespassers or residents could be exposed to sediment when walking or wading in these areas.
	Surface Water	Surface Water	Groups 5 & 6	Trespasser/Recreational User, Site Resident	Child / Adult	Dermal Contact	Quantitative	While Groups 5 & 6 do not contain developable land, trespassers or residents could be exposed to surface water when wading or walking in the area comprised of Groups 5 & 6.

At times of low water (late summer and early fall), the smaller tributaries (southeast of the site and north of the site) have areas that dry up or form smaller, trickling channels through the muck and peat found in those areas. We assumed that exposure to surface water would occur primarily through dermal contact, and that incidental ingestion of surface water was unlikely.

It was also assumed that trespassers would not catch and ingest fish from Sutton Brook and its associated tributaries and wetlands. While a trespasser could potentially fish in site surface water, due to the shallow nature of the Brook and difficulty walking through the wetlands, it is expected that the frequency of fishing would be low. Furthermore, many of the site water bodies are intermittent in nature and would not likely support a fish population, especially during dry periods of the year (i.e., summer, fall) when human receptors are most likely to be present at the Site. This condition appears to be supported by the unsuccessful fish collection efforts conducted at the Site as part of the ecological risk assessment. As described in the BERA (Section 4), numerous tadpoles were also present in the site pond, indicating the lack of fish since they typically consume these organisms. Thus, we did not quantify risks for the fish ingestion exposure pathway.

Local Resident/Future Site Resident

The Site is bordered to the south and west by residential neighborhoods, primarily consisting of single-family homes. South Street runs southwest to northeast of the Site, crossing over Sutton Brook (see Figure 3-1) approximately 800 feet west of Group 3 (the former drum disposal area). Two cul-de-sacs (Serenity Drive and Bemis Circle, known as the "northwest" neighborhood), abut the wetlands appurtenant to Sutton Brook and are located approximately 800 feet from the northern landfill lobe's northwestern limits. The neighborhood to the south of the Site is also comprised of two cul-de-sacs (Homestead Lane and Carleton Road Extension), while the neighborhood north of the Site contains the residences along South Street.

As discussed in Section 5.5 and presented on Figure 5-5e of the RI report, several private wells (water supply and irrigation) are located in the vicinity of the Site within the residential neighborhoods located to the north and south of the Site. As this figure depicts, all of these wells are located in areas hydraulically upgradient of the landfill and former drum disposal area. As such, impacts to these wells from Site operations are expected to be minimal. As presented in Section 5.6 of the RI report, EPA collected groundwater samples from several of these wells for VOC, SVOC, pesticides/PCBs, and metals analysis. No concentrations of site-related VOCs were detected in any of these wells. As part of the RI, four monitoring wells (two well couplet locations) were installed in the neighborhood to the west of the Site (Bemis Circle and Serenity Drive). All of these residences are supplied with public water. No site-related VOCs were detected in groundwater from any of these monitoring wells. Given this information, adequate data has been considered collected to support the CSM, indicating that the site groundwater plume does not extend into these areas.

As these off-site wells are located either cross-gradient or upgradient of the site groundwater plume and as the detected concentrations are relatively consistent with those found in groundwater samples from reference areas, it is postulated that the presence of these constituents is, for metals, likely a result of naturally-occurring conditions (i.e., local geochemistry) or, for organics, associated with other non-site plume conditions; therefore, the RI concluded that the constituents detected in off-site wells are unrelated to the landfill's presence. For this HHRA, we have thus assumed that local residents could be potentially exposed to COPCs only in impacted media present at the Site.

Given the proximity to the Site, we have assumed that a local resident/future site resident may be exposed to COPCs in soil, surface water, sediment, and wetland soil at the Site in a manner similar to that of the trespasser/recreational user scenario. It has also been assumed that residents of these areas may also

potentially inhale volatile emissions from the landfill. Vapor intrusion of VOCs from the subsurface into indoor air of these current residences is not considered to be a complete exposure pathway, as the majority of the residential properties proximate to the Site (e.g., Bemis Circle, Serenity Drive, Carleton Road extension, etc.) are hydraulically upgradient or cross-gradient with respect to groundwater flow patterns. Given the assumed dates of releases, groundwater flow rates, and natural attenuation mechanisms, it is not expected that the current plume configuration would significantly change in the future. In addition, the mapped extent of the dissolved VOC plume in groundwater associated with the Site does not extend to the areas of these residences. Therefore, since site-related VOCs are not present in groundwater located within 100 feet of these residences[3] and the plume has stabilized, no additional assessment of the potential for vapor intrusion in this area was conducted. Refer to Section 5.5 and 5.6 of the RI report for additional details supporting the conceptual site model (CSM), groundwater flow and hydrogeological conditions in the vicinity of the neighborhood monitoring and private drinking water wells. Since the supportive information indicates that groundwater in these areas is not impacted by site-related VOCs, groundwater is not a potential source of VOCs to indoor air in these areas; we therefore did not quantify vapor intrusion risks for these off-site residential areas.

Under future conditions, we have assumed that upland portions of the Site may be redeveloped for residential use. Under this hypothetical scenario, residents may be exposed to COPCs in upland soil in HHRA Group 3 and Group 4 areas. Since this is a hypothetical future scenario, and redevelopment will displace, excavate and potentially move currently subsurface soils to the surface, exposure point concentrations for this future receptor are based on the 0-10 feet below ground surface (fbgs) soil interval. Due to the presence of VOCs in groundwater, future residents may also inhale volatile COPCs that have migrated from the subsurface into indoor air of a future site residence (vapor intrusion), or ingest, contact or inhale COPCs in potable water, assuming site groundwater is used for this purpose. Groundwater from beneath the landfill lobes may potentially be drawn upon if site groundwater is used as a potable water source.

Although it is possible that VOCs in soils from Groups 3 or 4 may also contribute to vapor intrusion, their contribution to the indoor air pathway was determined to be insignificant relative to groundwater for the following reasons:

- Shallow vadose zone soil concentrations of VOCs in Group 3 were orders of magnitude lower than in deeper samples. The highest levels of VOCs in soils from this area were generally present at depths at or near the water table (4-6 fbgs). As such, these samples represent either capillary fringe soils or saturated conditions. Similar chemicals with similar or higher concentrations, and higher frequencies of detection were identified in groundwater from this area. Therefore, although unsaturated soil could potentially contribute VOCs to indoor air, the contribution from shallow, highly contaminated groundwater would dominate, due to the prevalence of elevated concentrations.

- The levels of VOCs in unsaturated zone soils in Group 4 were lower than even the conservative screening levels used to select COPCs. Thus, no VOCs were selected as COPCs for soil in this area and thus, these soils do not significantly contribute to potential indoor air risks.

This condition is further discussed in the uncertainty section.

[3] This 100 foot criteria reflects "Question #2" in the Primary Screening performed when evaluating the potential for vapor intrusion in accordance with draft EPA Vapor Intrusion Guidance (EPA, November 2002).

As part of the risk characterization, we quantified risks for only one residential receptor, which reflects both current and future potential site uses. This scenario evaluates residential exposure to COPCs in upland soil, groundwater, indoor air, ambient air, surface water, sediment, and wetland soil. As previously described, it is assumed that under current conditions a local off-site resident may be exposed to COPCs in ambient air across the Site, and to surface water, sediment, and wetland soil in Groups 5 & 6. Although the local resident may also be exposed under current conditions to upland soils in Groups 3 & 4, the evaluation of higher intensity exposures by future site residents is adequately protective of those shorter duration/lower intensity (current) exposures. Furthermore, current/future soil exposures to trespassers are also evaluated, as previously described. In the future use scenario, it was assumed that upland site areas outside of the cap (i.e., Groups 3 & 4), would be redeveloped for residential use. Thus, it was assumed that that this receptor would be exposed to soil in Groups 3 and 4, groundwater underlying all site areas (Groups 1/2 and Groups 3-6) as well as the surface soil, sediment and surface water and ambient air risks quantified for the "current" resident described above. By summing both the current and future risks for this receptor together, the scenario captures the highest intensity/fullest use of all site areas. Risks were quantified separately for a Group 3 and Group 4 hypothetical on-site resident, assuming that a future (on-site) resident would be exposed to COPCs in soil in either Group 3 or Group 4 following their (hypothetical) redevelopment.

Construction/Utility Worker

If the Site is redeveloped in the future, construction or utility workers may be exposed to COPCs in soil, shallow groundwater or ambient air. Routes of exposure may include dermal contact with COPCs in soil and shallow groundwater, and incidental ingestion of COPCs in soil. Construction or utility workers may also inhale volatile COPCs that have migrated from the subsurface into the ambient air of an excavation trench or inhale COPCs bound to air-borne particulates (fugitive dust). Risks were quantified separately for a Group 3 and Group 4 construction/utility worker.

Future Site Industrial or Commercial Worker

Future facility workers may be exposed to COPCs in soil via direct contact (i.e., dermal contact and incidental ingestion) and fugitive dust via inhalation, as well as to VOCs that have migrated from the subsurface into indoor air of a future building. The facility worker exposure assumptions conservatively assume an 8-hour exposure to volatile constituents in indoor air, *in addition to* an 8-hour exposure to fugitive dust in outdoor air. These receptors also assumed to receive the full daily dose of soil contact and ingestion exposures during this 8 hour work day. Since on-site groundwater may hypothetically be used as a potential future source of potable water, we have also assumed that a facility worker may dermally contact or ingest COPCs in tap water during the work day. Risks were quantified separately for a Group 3 and Group 4 industrial/commercial worker.

Exposures to COPCs in sediment, wetland soil or surface water were assumed to be unlikely exposure pathways for these workers and were not evaluated under the industrial/commercial scenarios.

3.2.1.1 Quantification of Exposure

The quantitative exposure assessment describes a conservative estimate of exposure to a representative individual within the subpopulation (receptor group) based on the defined exposure profiles. The exposure dose therefore, represents the amount of a COPC to which an individual receptor may come into contact. It is a function of receptor-specific exposure assumptions and chemical-specific exposure parameters. The material that reaches the receptor's absorption barrier (such as the skin, lung, or gastrointestinal tract) is referred to as the applied dose (for ingestion and inhalation exposures), while the

absorbed (or internal) dose is defined as the amount of material that actually crosses the receptor's exchange boundary (as in dermal exposures).

Exposure doses are calculated as the daily amount of constituent taken into the body per unit body weight per unit time (mg/kg-day). Average daily doses (ADDs) are based on conservative exposure assumptions and factors developed in accordance with EPA risk assessment guidelines.

The general equation used to estimate Average Daily Doses (ADD), Lifetime Average Daily Dose (LADD), Average Daily Exposure (ADE) and Lifetime Average Daily Exposure (LADE) is:

$$\text{ADD (or LADD)} = \frac{\text{Total amount of COPC contacted/ingested * Absorption Adjustment Factor}}{\text{Body weight * Averaging Period}}$$

For inhalation exposures, ADEs or LADEs are calculated, instead of ADDs or LADDs, to make them compatible with the inhalation dose-response values presented as reference concentrations or unit risks (expressed in units of mg/m^3 and $(mg/m^3)^{-1}$, respectively). Exposures are then estimated by normalizing fugitive dust or vapor exposure point concentrations (EPCs) with averaging times:

$$\text{ADE or LADE} = \frac{\text{Time-weighted exposure concentration for airborne chemicals}}{\text{Averaging Period}}$$

Exposure doses are calculated using receptor-specific exposure variables and chemical-specific exposure parameters, (e.g., the appropriate exposure point concentration, absorption adjustment factors, skin permeability coefficients, etc.) unique to each receptor and exposure pathway.

Subchronic ADDs and ADEs are calculated for evaluation of non-carcinogenic effects associated with short-term exposures (i.e., less than 10% of a lifetime, or 7 years), such as for the construction worker. Chronic ADDs and ADEs are calculated for the evaluation of noncarcinogenic effects that occur over a time period greater than 7 years, such as for the (hypothetical) future site residents or facility workers. LADDs or LADEs are estimated for evaluation of carcinogenic effects.

The equations specific to each exposure pathway and the assumptions used to estimate exposure doses are presented on Tables 3-16 through 3-21. These tables and assumptions reflect both central tendency (CT) and reasonable maximum exposure (RME) scenarios so that the potential range of risk may be evaluated. We generally used EPA default exposure parameters for residential and commercial/industrial scenarios for soil, indoor air and groundwater exposures. Where appropriate and available, central tendency assumptions reflect 50th percentile of the variables distribution (e.g., tap water ingestion rate for the resident) and an upper bound percentile (typically 90-95%) for the RME scenarios. For exposure to wetlands media, we used both EPA-recommended exposure parameters as well as professional judgment in estimating exposures for the recreational and residential scenarios.

For simplicity in calculating ADDs, ADEs, LADEs and LADDs, we first calculated an intermediate term called a "receptor-specific exposure factor." This exposure factor is a value that represents the combination of all applicable receptor-specific exposure variables and conversion factors in the dose equations presented above, excluding the chemical concentration in the relevant environmental medium (i.e., the exposure point concentration, described in Section 3.2.1.5). This factor is then multiplied by the chemical-specific exposure parameters, e.g., the appropriate exposure point concentration, absorption adjustment factors, and skin permeability coefficients, to calculate the chemical-specific doses or exposures for each receptor and pathway.

Exposure assumptions and receptor-specific exposure factors for each receptor are documented in Tables 3-16 through 3-21.

3.2.1.2 Dermal Soil Absorption Fractions

The routes of exposure and the exposure matrices upon which toxicological studies and resultant toxicity values are based are often different from the route of exposure and exposure matrix of a chemical at a particular site. This may result in different absorption rates and efficiencies. The dermal absorption fraction (ABS_d) is used to account for these differences in the absorption of a chemical. This assessment relied on chemical-specific dermal ABS_d provided in Exhibit 3-4 of USEPA 2004. For semi-volatile organic constituents without published ABS_d, we assumed a value of 0.1 (10%), in accordance with USEPA 2004 guidance (Page 6-1, USEPA 2004). For VOCs and inorganic constituents lacking ABS_d, we did not quantify risks from the dermal exposure pathway but instead qualitatively addressed potential risks from these constituents in the Uncertainty Analysis (Section 3.5).

We conservatively assumed an absorption fraction of 100% for oral and inhalation exposure pathways. Dermal absorption fractions are summarized in Table 3-22a.

3.2.1.3 Dermal Absorption from Water

For groundwater and surface water exposures, we used the EPA-recommended equations (EPA 2004) to estimate dermal absorption of COPCs for each exposure scenario. Dermal absorption is a function of the concentration of the COPC, the chemical/physical properties of a COPC, as well as the receptor's exposure time. The skin permeability coefficient (Kp) is a key parameter in estimating dermal absorption of chemicals in water. Kp (cm/hour) represents the permeability of a chemical from an unspecified (aqueous) vehicle (such as groundwater) through the skin. Published literature on experimentally-measured or estimated values of Kp were used for constituents in groundwater (USEPA, 2004). For those chemicals without published values or default Kp values, values were obtained from the U.S. Department of Energy's Risk Assessment Information System (RAIS) on-line database.

Some constituents, such as PCBs, PAHs and other lipophilic organics, have Kp values outside the effective predictive domain (EPC) of the model used to estimate Kp. In such instances, EPA guidance suggests applying a Fraction Absorbed (FA) value to the Kp (USEPA 2004). Where a published FA value existed, we used this value to quantify aqueous dermal exposures. In instances where no published FA value existed, we assumed an FA of 1. Permeability coefficients, lag-time (tau) and FA values used to estimate the average daily doses for the COPCs are summarized in Table 3-22b.

As an intermediate step in the calculation of health risks associated with dermal groundwater exposures, we first calculated a "dermal absorbed dose factor" (DA-factor), which employs the EPA dermal absorption equations for aqueous exposures, taking into account Kp, FA and tau, as well as the exposure time specific to each exposure scenario. Calculation of this DA-factor for each receptor is presented in Table 3-22c. This factor is then used in conjunction with the receptor-specific exposure factor (described in Section 3.2.1.2) and exposure point concentration (described in Section 3.2.1.5) to quantify noncancer hazards and cancer risks.

3.2.1.4 Lead Exposures

The dose equations presented above do not apply to lead exposures. Different procedures were used to evaluate a child's and adult's exposure to lead, in accordance with USEPA guidance (USEPA 1994, with updates). For children (under a residential scenario), a model developed by the USEPA, the Integrated Exposure Uptake Biokinetic (IEUBK win Model V.1.0 build 263, December 2005), estimates blood lead levels (BLL) from multiple environmental exposures such as soil, diet, water, and air. The IEUBK model

calculates the likelihood that the BLL in the child exposed to lead in site soil will exceed the action BLL of 10 µg/dL. USEPA model default values were used in the model, with the exception of the relevant site exposure point concentrations in soil and groundwater.

USEPA has also published an adult lead exposure model (the Adult Lead Methodology, or ALM) to evaluate lead risks for non-residential, adult exposure scenarios (USEPA 1996 with updates). This model is similar to the IEUBK, but instead estimates the BLL in the fetus of a pregnant adult worker, assuming that the adult female body burden of lead is available for transfer to the developing fetus. As a fetus is a more sensitive receptor than an adult, then lead risks calculated for the fetus will also be protective of a worker. The ALM calculates the likelihood that the BLL in the fetus of the exposed worker will exceed the action BLL of 10 µg/dL. The ALM was utilized to evaluate risks to both the facility worker and construction worker scenarios, modifying the model default exposure parameters to reflect the exposure assumptions used for these scenarios, as described previously.

No lead uptake model currently is available for older children (8-18 years)[4]. We qualitatively evaluated risks for this scenario based on results from the IEUBK model, which is assumed to be protective of exposures to older children.

Supporting documentation for both lead models is provided in Appendix E.

3.2.1.5 Methods for Estimating Exposure Point Concentrations

The identification of exposure points and the derivation of exposure point concentrations (EPCs) for receptors evaluated in the HHRA are presented in this section. Exposure point concentrations are estimates of the chemical concentrations to which a potential receptor is likely to be exposed under current and reasonable foreseeable future site activities and uses and are dependent upon the exposure period and pathway.

As discussed with the EPA on September 6, 2006, for groundwater CT and RME exposure point concentrations (EPCs), we used the maximum concentration for each COPC detected at each well during any of the sampling events.

To clarify the approach with regard to the other site media, as discussed in more detail below, EPCs for most media were based on the minimum value between the 95% Upper Confidence Limit (UCL) of the mean concentration and the maximum detected concentration. For non-detect results, we generally used one-half the laboratory reporting limit (LRL) in calculating the 95% UCL; however, in instances where one-half the LRL exceeded the maximum detected concentration within a dataset (i.e., the LRL was greater than 2 times the maximum concentration), we excluded that data point from the EPC.

This approach is consistent with EPA risk assessment guidance (USEPA 1989), which instructs the risk assessor to exclude elevated SQLs from the quantitative risk assessment "if they cause the calculated exposure point concentration to exceed the maximum detected concentration for a particular sample set" (p. 5-10). Where a detection limit exceeded more than twice the maximum detected value, use of one-half the SQL for the non-detect value would result in inclusion of a value greater than the maximum detected concentration, thereby artificially inflating the EPC above the maximum positive result.

We evaluated the soil, sediment, and surface water datasets used in each exposure point for instances in which the elevated non-detect results were removed from the dataset, such as not to artificially inflate the EPC above the maximum detected concentration for a particular COPC. As the maximum individual

[4] Although EPA has released a draft All-Ages Lead Model, this model is not currently available for use in conducting risk assessments.

detection was used for the groundwater EPC for the RME scenarios, we did not conduct this evaluation for groundwater.

The table below summarizes, by medium and exposure point, the non-detect data we removed from EPC calculations using the rationale provided above:

Exposure Point	Group 3	Group 4	Group 5	Groups 5 & 6	
Exposure Medium	Soil	Soil	Wetland Soil	Surface Water	Sediment
COPCs affected	Benzo(a)anthracene Benzo(a)pyrene Benzo(e)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Indeno(1,2,3-cd)pyrene	Bis(2-Chloroethoxy) methane	Perylene	None	None
Samples removed	SB-6(04)	SB-8 (04)	SS-5(04) GP-8(04) GP-7(04)		

Results of this evaluation indicate that only a limited number of data points were removed from the EPC dataset and that the approach used in the HHRA is unlikely to underestimate exposures at the site. As indicated in the table above, the only media affected by this approach include: upland soil in Group 3, where results for six polycyclic aromatic hydrocarbons (PAHs) in only one sample (SB-6(04)) were excluded; upland Soil in Group 4, where one result for one COPC (bis(2-chloroethoxy)methane) was excluded; and wetland soil in Group 5, where results from one sample was excluded for only one COPC, perylene.

With respect to the six PAHs in Group 3 soil referenced above, since only one location in this area was excluded and the ratios of ½ SQL to the maximum detected for all those PAHs were less than or equal to 5, the potential for actual underestimation of the EPCs for those compounds is very low. For the Group 4 soil, only one COPC result was excluded from the EPC calculations, for a compound that was detected infrequently in that area (only twice out of 13 samples analyzed), and again, with a ratio of ½ SQL: maximum concentration less than 5. With respect to perylene in wetland soils, this compound is not a significant risk driver for any relevant receptor and no toxicity information is available for perylene. No data for COPCs from other media at the Site were removed as a result of applying this approach.

We summarized the data points excluded for each COPC detected in each medium in our response to EPA comments dated November 13, 2006.

Soil

As previously discussed, we have divided the Site into five separate areas based on the potential for exposure (Groups 1 and 2 combined, and Groups 3, 4, 5 and 6). It is assumed that none of the evaluated receptors will be exposed to upland soils within Groups 1 and 2 (the northern/southern lobes), since this former landfill area will be capped. Upland soil data are available in Groups 3 and 4, whereas wetland soil data are available for Group 5. Upland soil exposures were evaluated separately for Group 3 and Group 4 areas, as each of these areas may be (separately) redeveloped in the future. Furthermore, since Group 3 and Group 4 are located in noncontiguous areas of the Site, each area was evaluated as a distinct exposure point. We evaluated wetland soil exposures in Group 5 separately from upland soil exposures in Groups 3 or 4, to address the differences in exposure potential between these two types of media/areas at

the Site. In addition, due to differences in physical characteristics and exposure settings, sediments were separately assessed, as described later in this section.

Different receptors may have a different potential for exposure based on the nature of the activities that they may undertake at the Site. Current receptors such as a trespasser/recreational user are anticipated to encounter COPCs only in surface soils, whereas future receptors are assumed to be exposed to a greater depth interval (0-10 feet bgs), since currently-located subsurface soils may become exposed if the area is redeveloped.

For Group 4 soils, we utilized surficial soil data from 0-1 foot bgs to derive EPCs for the current trespasser scenario. As only one upland soil sample was collected from 0-1 foot in Group 3, however, we used all Group 3 soil data (0-10 feet bgs) to evaluate the trespasser scenario under both current/future conditions. The follow-up sampling conducted during the RI focused on collecting samples from the most contaminated depth intervals based on soil jar headspace testing. In other words, the RI sampling was biased toward the most highly-contaminated areas/depths. Based on this information and visual inspection of this area, there appears to have been some backfilling of portions of the excavated area. Low points still remain in this area relative to the surrounding ground surface. The analytical results from the shallow soil sample (0 to 2 feet below grade) collected in 2004 indicate the presence of contaminants at this depth interval; however, the more elevated concentrations of contaminants were detected from depths around 4 to 6 feet below grade.

For the purposes of the risk characterization specific to this area of the Site, the 0-10 foot interval was conservatively used to evaluate both current (which typically are only exposed to surface soil) and future (all depths to 10 feet) scenarios for Group 3. This is considered a conservative estimate of current exposures, as surficial concentrations are likely to be lower than those found in deeper samples. To evaluate trespasser exposure to soils under future conditions, the 0-10 foot interval was used to estimate the EPCs for both Groups 3 and 4.

Under future land use scenarios, we have assumed that future receptors such as construction workers, facility workers or hypothetical residents may encounter both surface and subsurface soils, up to depths of 10 feet bgs, which is the depth interval recommended by EPA Region 1 (1995). This depth interval is based on the assumption that currently subsurface soils may be brought to the surface as part of excavation/re-development activities.

Within each soil or wetland soil exposure point, we used the lesser value between the maximum detected concentration and the 95% Upper Confidence Level (UCL) of the arithmetic mean soil concentration as the Exposure Point Concentration (EPC). In accordance with USEPA guidance, this value was used as the EPC for both CT and RME scenarios. Upper confidence limits were calculated using USEPA's ProUCL software (Version 3.00.02); UCLs used in the EPC were the appropriate statistic recommended in the model output. ProUCL output for each COPC in each exposure point are provided in Appendix F. For results reported as non-detect, we assumed a concentration of one-half the laboratory reporting limit (LRL) in the estimation of the UCL. In instances where the detection limit for a non-detect result was more than two times greater than the maximum detected concentration in a data group, we excluded the LRL from the dataset.

Upland soil EPCs are summarized in Table 3-23a for Group 3 soils and Table 3-23b and 3-23c for Group 4 soils. Wetland soil EPCs are summarized in Table 3-24.

Emissions from Soil (Fugitive Dust and Volatiles)

Soil particles may be suspended in ambient air and inhaled as dust by receptors. Additionally, VOCs in soil may volatilize into ambient air and be inhaled by receptors. We estimated concentrations of COPCs

in air resulting from fugitive dust emissions for each upland soil exposure point using the USEPA default particulate emission factor (PEF) of 1.36 x 10^9 m^3/kg (USEPA 2002) in conjunction with chemical-specific volatilization factors, based on equations presented in USEPA 1996. Fugitive dust emission calculations are presented in Appendix G; fugitive dust EPCs are summarized in Tables 3-25a and 3-25b for Groups 3 and 4, respectively.

Groundwater: Ingestion/dermal exposures

As described in the HHRA workplan, we divided site groundwater data into two separate exposure points for the evaluation of potable water use. Groundwater from Groups 1 and 2 was treated as one exposure point representing aquifer conditions beneath the landfill lobes. Groundwater from the remainder of the Site, which includes Groups 3-6, was considered as a second exposure point for evaluation of potable water use. Although site groundwater is not currently used as a potable water source, we assumed that this use may occur in the future, and that receptors may draw from groundwater from any point within each of these two areas.

At EPA's direction (September 2006 meeting), we used the maximum detected concentration of each COPC in groundwater, within each exposure point, as the EPC for both CT and RME scenarios involving groundwater exposures. These EPCs are based on select monitoring well data from each wellhead. We first evaluated all available data for each groundwater monitoring well and selected data to be used in calculating EPCs, based on number of available sampling rounds, trends in concentrations and relevance to project action limits. This evaluation is presented in Appendix C. Of this dataset, we then chose the maximum detected concentration of each COPC as the EPC for each Group. Groundwater EPCs for Groups 1 and 2 and Groups 3-6 are provided in Tables 3-26a and 3-26b, respectively.

We assumed that a future construction/utility worker may be dermally exposed to COPCs in groundwater in either Group 3 or Group 4. Accordingly, we derived EPCs for each of these two groups to address the dermal exposure pathway for the construction worker scenario. For both the CT and RME scenarios, we used the maximum concentration among the wells located in either Group 3 or Group 4 as the EPC for each exposure point. Groundwater EPCs for Groups 3 and Groups 4 are provided in Tables 3-26c and 3-26d, respectively.

Ambient Air

For ambient air EPCs, we conservatively used the maximum detected concentration of each COPC as the EPC to evaluate ambient air exposures for the trespasser/recreational user and the future site resident. Ambient air EPCs are provided in Table 3-27a.

To evaluate a construction worker's exposure to trench air, ambient air concentrations of volatile COPCs were estimated from shallow groundwater analytical results using a USEPA air emissions model (USEPA, 1990). This model conservatively assumes that volatile compounds in soil gas or groundwater vaporize from the subsurface into the ambient air of a trench throughout the workday. A combination of two exposure models was used to estimate EPCs of volatile constituents in groundwater that may accumulate and volatilize into an excavation trench. A conservative screening-level model (RTI Model; USEPA, 1990) describing simple mass transfer of volatile constituents from liquid surfaces to air was used to predict mass emission rates (mass/time) based on an individual constituent's overall mass transfer coefficient, the area of the liquid surface, and the concentration of the constituent in the liquid phase. The compound-specific flux rate is then entered into a simple one-box mass balance model which integrates the effects of air movement through the trench. This model estimates the concentration of contaminant in air, which is then used as the ambient air EPC for construction workers who may conduct subsurface work at the Site.

The groundwater EPCs for Groups 3 and 4 were used to estimate trench air EPCs for the construction worker scenario. A discussion of the models used to estimate trench air EPCs (and supporting calculations) is provided in Appendix H. Trench air EPCs are summarized in Tables 3-27b and 3-27c for Groups 3 and 4, respectively.

Emissions from Groundwater: Vapor Intrusion into Indoor Air

Based on the shallow depth to groundwater at the Site, the presence of volatile constituents in groundwater, and the possibility that buildings could be constructed in Groups 3 and 4 of the Site, vapor intrusion risks were evaluated for the hypothetical future resident and facility worker receptors. As discussed in Section 3.2.1, we did not evaluate vapor intrusion risks for neighborhood areas adjacent to the Site, based on the Site Conceptual Model and the negligible potential for vapor migration into these buildings.

Indoor air concentrations were estimated from groundwater EPCs using the USEPA Johnson & Ettinger (J&E) vapor intrusion model (USEPA, 2004). When possible, site-specific geochemical characteristics were incorporated into the model; otherwise, USEPA default parameters were used where site-specific information was not available.

A description of the model used to estimate indoor air concentrations is included in Appendix H. Indoor air EPCs are summarized in Tables 3-28a for Group 3 and Table 3-28b for Group 4.

Emissions from Soil

Although VOCs in soil may potentially contribute toward vapor intrusion into indoor air, we did not estimate indoor air concentrations based on soil data from Groups 3 or 4. Due to the shallow groundwater table within each of these two areas (approximately 4-5 feet on average), many of the soil samples collected from these areas were saturated with groundwater. Furthermore, shallow unsaturated soils would likely be removed/graded when clearing an area for development. In this section, we have evaluated Group 3 and 4 soil data with respect to the potential for vapor intrusion.

Group 3 Soils: Concentrations of VOCs in Group 3 soils are relatively elevated. During the Remedial Investigation (RI), the samples for laboratory analyses were selected from the soil depth intervals that exhibited the highest relative responses on the field screening instrumentation. This screening step resulted in most samples being collected from depths at or near the water table (4-6 feet bgs). As such, these samples represent either capillary fringe soils or saturated conditions. The one surficial soil sample from Group 3 (SB-3[04]), collected from 0-2 feet bgs, indicates VOC concentrations orders of magnitude lower than in deeper samples. Additional unsaturated zone soils collected from soils directly above the water table (approximately 4-5 feet bgs) did contain elevated concentrations of chlorinated VOCs similar to the suite of COPCs evaluated in the groundwater vapor intrusion analysis (soils from SB-5[04] and SB-6[04]). That is, since the majority of soil samples collected from this area represents saturated conditions, groundwater is more appropriate for evaluating the potential for vapor intrusion. Although unsaturated soil could potentially contribute VOCs to indoor air, the contribution from shallow, highly contaminated groundwater is likely more significant due to the prevalence of elevated concentrations.

Group 4 Soils: An evaluation of the soil dataset from Group 4 indicates that only residual low levels of VOCs are present in unsaturated-zone soil within this area. The maximum detected concentrations of VOCs in Group 4 soils were below the conservative levels used to select COPCs. Thus, no VOCs are COPCs for Group 4 soils. Accordingly, due to the low levels of VOCs present in this area of the Site, it is considered that VOCs in Group 4 soils do not significantly contribute to potential indoor air risks.

Based on this evaluation, we did not quantitatively evaluate vapor intrusion related to surface soil contamination in Groups 3 and 4. Inclusion of soil data in predicting indoor air concentrations would likely over-estimate indoor air concentrations by essentially "double-counting" the contribution from groundwater. As further detailed in our response to EPA comments dated November 13, 2006, the majority of soil VOC contamination in these areas is at the capillary fringe or below the water table (Group 3) or not at concentrations elevated above conservative COPC selection criteria (Group 4). Thus, we have assumed that volatile COPCs in groundwater will primarily contribute to vapor intrusion, whereas the VOCs present in unsaturated soils will contribute only a negligible amount.

Emissions from Groundwater: Volatilization from Potable Water

As VOCs are present in groundwater, which may be used as a potable water supply, there is the potential for these constituents to volatilize into indoor air while a future resident is bathing or showering. We estimated an inhalation concentration for each volatile COPC using the Foster and Chrostowski inhalation model (Foster and Chrostowski, 1987). Potable groundwater EPCs for Groups 1 and 2 and Groups 3-6, as described above, were used to derive shower air exposure concentrations. A discussion of the model used to estimate shower air EPCs (and supporting calculations) is provided in Appendix I.

Sediment

Groups 5 and 6 comprise Sutton Brook and associated wetland areas at the Site. For the purposes of this evaluation, we considered sediment in Groups 5 and 6 collectively as one exposure point for both trespasser/recreational users and residents, as it is assumed that these receptors would likely have similar exposures to these areas of the Site. As previously stated, all sediment samples were collected from locations that are beneath surface water year-round. As discussed in Section 4.2 of the RI Report, the water level in Sutton Brook and associated tributaries is highly variable throughout the year, ranging from several inches to several feet. In the summer and fall, when human exposures are most likely, some of the smaller tributaries were observed to become relatively shallow or dry up entirely. Sutton Brook, although, maintained surface water flow throughout these time periods. We have conservatively assumed that all site sediment may be potentially accessible to receptors who may be exposed to wetland media.

We first calculated 95% UCLs for sediment data in these two groups; the lesser value between the maximum detected concentration and the 95% UCL was then used as the EPC for both CT and RME exposures. As with other media, one-half the method detection limit was included in the derivation of the UCL for results reported as non-detect. ProUCL output for each COPC in sediment are provided in Appendix F. Sediment EPCs are summarized in Table 3-29.

Surface Water

Surface water samples have been collected from Sutton Brook, its northern and western tributaries, aquatic wetlands, and from the on-site (man-made) pond. For the purposes of this assessment, we have grouped together surface water data from Sutton Brook, its tributaries, the aquatic wetlands, and the pond (Groups 5 and 6) to provide a more robust dataset that represents a conservative estimate of overall average exposure to surface water at the Site. To estimate surface water exposures, the lesser value between the maximum detected concentration and the 95% UCL (calculated using ProUCL) in surface water samples from Group 5 and Group 6 (collectively) was used as the EPC. As with other media, one-half the method detection limit was included in the derivation of the UCL for results reported as non-detect. ProUCL outputs for each COPC in surface water are provided in Appendix F. Surface water EPCs are summarized in Table 3-30.

3.3 DOSE-RESPONSE EVALUATION

The dose-response evaluation describes the relationship between the level of exposure to a particular chemical and the likelihood and/or severity of an adverse effect. The dose-response assessment quantifies the toxicity of each chemical of concern using information obtained from published literature describing epidemiologic or toxicological studies. The products of the dose-response assessment are the toxicity values used to predict the likelihood of adverse health effects in identified receptors at site-specific exposure levels.

For each of the COPCs, toxicity values for the relevant exposure periods (i.e., chronic and/or lifetime) were selected according to the following hierarchy, as recommended by USEPA (USEPA, December 2003):

- Tier 1: USEPA IRIS database (USEPA, 2007)
- Tier 2: USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs), as provided by the Superfund Technical Support Center (STSC)
- Tier 3: Other sources, including the Health Effects Assessment Summary Tables (HEAST; USEPA, 1997), California Environmental Protection Agency (CalEPA), Agency for Toxic Substance Disease Registry (ATSDR), and state hazardous waste site programs (e.g., Massachusetts Department Environmental Protection).

Sources of toxicological information for each COPC have been documented in the relevant toxicity tables. If no toxicity information was available for a particular COPC, a structurally-similar compound was identified as a surrogate for that COPC, and its toxicity values used to quantify risks. Where appropriate surrogate compounds were not identified, we did not quantify risks for that particular compound but rather qualitatively discussed the impacts of these constituents as part of the uncertainty analysis (refer to Section 3.5).

Dose-response information is divided into three major categories: (1) toxicity data associated with threshold (non-carcinogenic) effects; (2) toxicity data concerning carcinogenicity; and (3) the absorption adjustment factors used to relate toxicity information identified from the literature to the exposure pathways evaluated for the Site.

3.3.1 Dose-Response Criteria for Non-Carcinogenic Effects

Non-carcinogenic effects, such as organ damage or reproductive effects, are evaluated by reference doses (RfDs) or Reference Concentrations (RfCs). RfDs and RfCs are developed based upon the assumption that there exists a threshold dose or concentration below which there will be minimal risk, if any, for adverse health effects. These values provide a benchmark for the daily dose to which humans may be subjected without an appreciable risk of deleterious effects during a given period of exposure. These values incorporate modifying and/or uncertainty factors to ensure they are protective even for sensitive subpopulations. RfDs for oral and dermal exposure are presented in milligrams per kilogram body weight-day (mg/kg-day) and RfCs for inhalation exposure are typically presented in milligrams per cubic meter (mg/m^3). The chronic RfD and RfCs are conservative estimates of concentrations below which no adverse non-cancer effects are expected to occur over long periods of exposure. Subchronic RfDs and RfCs are designed to be protective of shorter duration exposures days to less than or equal to seven years. For this evaluation, we only used chronic RfDs/RfCs for each receptor, regardless of the exposure period; use of the chronic value is a conservative approach for receptors with shorter-term exposures, such as the construction worker.

Table 3-31a provides a summary of the noncancer ingestion and dermal toxicity values for each COPC at the Site. Dermal toxicity values were derived from oral RfDs using the gastrointestinal ABS values (ABS_{gi}) recommended in USEPA 2004. Where no ABS_{gi} was recommended for a particular COPC, we assumed an ABS_{gi} of 100%. Noncancer inhalation toxicity values are provided in Table 3-31b.

Lead Endpoint

As previously mentioned, residential childhood exposures to lead were evaluated using the IEUBK model, and adult non-residential lead exposures (i.e., construction and facility workers) were evaluated using the ALM. Each model estimates a blood lead level (BLL) from environmental exposures (including off-Site sources, such as air, water and food), and compares the estimated BLL to a target BLL of 10 μg/dL. This target value is defined by the USEPA as the lower limit of the range of known possible adverse neurobehavioral effects in young children (USEPA 1994)[5].

Both models calculate the likelihood that the BLL in a child or fetus in the subject population will exceed the target BLL of 10 μg/dL. The EPA threshold level for this risk is 5%; in other words, there is a 95% likelihood that a child or fetus would not have a blood lead level exceeding 10 μg/dL as a result of lead exposures.

3.3.2 Dose-Response Criteria for Carcinogenic Effects

Previously, the USEPA had developed a classification system for compounds based upon the strength of evidence that a compound is a human carcinogen. The classification system was defined as follows:

- Group A - Human Carcinogen
- Group B - Probable Human Carcinogen
- B1 - Limited human data are available
- B2 - Sufficient evidence in animals and inadequate or no evidence in humans
- Group C - Possible Human Carcinogen
- Group D - Not classifiable as to human carcinogenicity
- Group E - Evidence of non-carcinogenicity for humans

In 2005, USEPA identified a new method for classifying carcinogens by a weight-of-evidence narrative (USEPA, 2005). Because USEPA has not updated the classification system in its IRIS database for all COPCs at this time, the previous weight-of-evidence classification was retained for this report to maintain internal consistency.

The USEPA's Carcinogen Assessment Group reviews human, animal, and *in vitro* data regarding suspected chemical carcinogens and derives oral cancer slope factors (CSFs) and inhalation unit risks (URs) for those chemicals determined to be known, probable or possible carcinogens (Groups A, B, or C;

[5] BLLs exceeding 10 μg/dL in children trigger a tiered approach to reducing exposure and possibly absorption of lead from the environment. Individualized case management, which includes parent education, medical monitoring, and nutritional supplements, usually begins in children with BLLs exceeding 20 μg/dL. At BLLs greater than or equal to 45 μg/dL, chelation therapy is generally considered (AAP, 1998).

however, a CSF or UR may not be derived for all of these known/probable/possible carcinogens). CSFs are upper-bound estimates of the excess risk of developing cancer as a result of a period of continuous exposure to a chemical averaged throughout the course of a 70-year lifetime and are developed based on the assumption that there is no threshold level of exposure below which adverse effects will not be seen. CSFs are generally derived using data from animal bioassays, although human data are used when available. The excess carcinogenic risk for an experimental animal is then extrapolated to an expected excess carcinogenic risk for humans. The resulting values are more likely to overestimate than to underestimate the potential risk. A CSF has units of the inverse of milligrams of chemical per kilogram of body weight per day [1/(mg chemical/kg body weight-day)] or 1/(mg/kg-day).

The inhalation UR is the 95% Upper Confidence Limit of the mean incremental lifetime cancer risk estimated to result from lifetime exposure to an agent if it is in the air at a concentration of 1 microgram per cubic meter ($\mu g/m^3$). These values are used in lieu of the chemical's slope factor when an estimate of a lifetime average concentration of the chemical is available (MADEP, 1995). Table 3-31c summarizes oral and dermal carcinogenic toxicity values for the COPCs identified at the Site. Dermal CSFs were derived from oral CSFs using the gastrointestinal ABS values (ABS_{gi}) recommended in USEPA 2004. Where no ABS_{gi} was recommended for a particular COPC, we assumed an ABS_{gi} of 100%. Carcinogenic inhalation toxicity values are summarized in Table 3-31d.

Mutagenic Mode of Action Carcinogens

Cancer risk typically has been associated with aging, resulting from extended exposure durations and prolonged latency periods. However, exposures early in life can result in the development of cancer. As described in "Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens", EPA 2005, evidence suggests that chemicals with a mutagenic mode of action, which would be expected to cause irreversible changes to DNA, would exhibit a greater effect in early-life versus later-life exposures.

For carcinogens that are known to have a mutagenic mode of action, an Age-Dependent Adjustment Factor (ADAF) is applied to early-life exposures (USEPA, 2005). The ADAF accounts for susceptibility differences between early and later-life exposures, and is applied to the CSF or inhalation UR. For children under the age of two, an ADAF of 10 is applied to cancer toxicity values; for children ages 2 through 15, an ADAF of three is applied, in accordance with USEPA guidance.

For this Site, ADAFs are applicable only to the resident and trespasser scenarios, each of which encompasses age groups younger than 16 years. Residents encompass either a 9 year (CT) or 30 year (RME) exposure duration, whereas trespassers encompass a 14 year exposure duration. Mutagenic COPCs identified for the Site include vinyl chloride and the carcinogenic PAHs. For vinyl chloride, the USEPA IRIS database provides a "lifetime" cancer slope factor and unit risk for long-term scenarios that incorporate childhood exposures and "adulthood" cancer toxicity values for adult exposures. We used the "lifetime" cancer toxicity values when evaluating cancer risks for the resident scenario, whereas we used the "adulthood" cancer values to evaluate the facility worker and construction worker scenarios. (Vinyl chloride was not a COPC in the media to which we assumed a trespasser/recreational user would be exposed.)

For the carcinogenic PAHs, we derived age-weighted ADAFs for both scenarios, in accordance with USEPA guidance (2005). For receptors ages younger than two years, we applied an ADAF of 10. For receptors between the ages of 2 and 15, we applied an ADAF of 3. These factors were applied to the

exposure dose calculated for each relevant age range; thus, cancer risks for these receptors incorporated ADAFs specific to each type of exposure pathway[6] and age group.

3.4 RISK CHARACTERIZATION

Risk characterization is the final step of the risk assessment process, which combines the information from the Exposure and Dose-Response Assessments to yield estimated non-cancer health hazard and cancer risks from exposure to site contaminants. The risk characterization step also includes an evaluation of the uncertainties in the risk assessment process. These uncertainties are discussed in Section 3.5.

Cumulative risk estimates for each receptor, for all relevant exposure pathways, are compared to USEPA risk limits. In this section, risks under both central tendency (CT) and reasonable maximum exposure (RME) scenarios are evaluated, primary risk drivers identified, and site-related risks discussed relative to risks attributable to reference sources.

3.4.1 Non-Cancer Risk

Not all chemicals are carcinogenic, but exposure to them may affect developmental, reproductive, neurobehavioral, and other physiological functions. These effects are assumed to have a threshold dose, below which no effects are expected. The potential for non-carcinogenic health effects is characterized by the Hazard Quotient (HQ), which is the ratio of the estimated average daily dose (or exposure) and a toxicity value considered to be the level above which adverse health effects would not be observed (i.e., RfD or RfC):

$$HQ = ADD / RfD \text{ or } HQ = ADE/RfC$$

To account for exposures that a receptor may receive from multiple chemicals and exposure routes, the cumulative noncancer risk estimate, known as the Hazard Index (HI), is calculated as the sum of the chemical-specific HQs. As shown in the following two equations, the cumulative HI for the receptor is calculated by summing the route-specific HI. Route-specific HIs are calculated as the sum of all chemical-specific HQs:

$$\text{Total } HI_{\text{route-specific}} = \sum HQ_{\text{chemical-specific}}$$

$$\text{Cumulative } HI_{\text{receptor}} = \sum HI_{\text{route-specific}}$$

Route-specific HIs may also be broken down further by summing the cumulative risks for each target organ or adverse effect. The cumulative HI for each receptor is then compared with the USEPA noncancer risk threshold of one. If the HI is less than or equal to one, a condition of no significant risk of harm to human health exists for the Site. In this assessment, and as described further in Section 3.4.2, segregation of non-cancer risks by target organ was not performed because this segregation would not alter the results of the HHRA. Groundwater (Groups 1/2 and Groups 3-6) was the only source/ exposure medium that had non-cancer cumulative risks greater than one. However, the risks for this medium were so much greater than one (e.g., for the Group 3-6 RME residential scenario receptor, the non-cancer HI for exposures to groundwater was approximately 2,000) with many individual chemicals contributing to these risks also with HIs greater than one, that segregation by target organ would not result in a reduction of risks to less than one, and thus, would not alter the results.

[6] PAHs were not COPCs for inhalation exposure pathways; thus, the ADAFs were not applied to unit risks for any receptor.

For this assessment, we have segregated risks attributable to reference contaminants (identified in the Hazard Identification) from risks attributed to site-related COPCs. Differentiating reference risks from site-related risks aids in focusing remedial efforts, if warranted.

3.4.1.1 Cancer Risk

As discussed previously, the dose-response assessment for carcinogens assumes that there is no threshold dose for carcinogenicity. The potential for carcinogenic health effects is characterized as the Incremental Lifetime Cancer Risk (ILCR) above background. The ILCR represents the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. For a given chemical, the ILCR is the product of the quantified exposure and the measure of carcinogenic potency (i.e., CSF or UR):

$$\text{ICLR} = \text{ADD} \times \text{CSF} \text{ or } \text{ADE} \times \text{UR}$$

The ILCR, which represents the probability of developing cancer relative to the background incidence of cancer in the general population, is presented in scientific notation. For example, the ILCR of a specific chemical might be expressed as 1×10^{-6} or one in one million, which means that the probability of an individual developing cancer is one in one million, over a lifetime of exposure to the potential carcinogen.

To account for exposures that a receptor may receive from multiple chemicals, the ILCRs for all COPCs are summed to calculate a route-specific ILCR. The cumulative ILCR is then calculated by summing all of the route-specific ILCRs for each type of exposure, as demonstrated by the following equations:

$$\text{Total ILCR}_{\text{route-specific}} = \sum \text{ILCR}_{\text{chemical-specific}}$$

$$\text{Cumulative ILCR} = \sum \text{ILCR}_{\text{route-specific}}$$

The cumulative ILCR is compared to USEPA's cumulative receptor cancer risk limits, which range from one-in-one million (1×10^{-6}) to one in ten thousand (1×10^{-4}). If the cumulative cancer risk exceeds the upper end of the target ILCR range, then it may be concluded that a condition of no significant risk of harm to human health does not exist for the Site.

3.4.2 Quantification of Carcinogenic and Noncarcinogenic Risk Estimates

Cumulative risk estimates were calculated for all evaluated receptors, by medium and exposure pathway, and these cumulative non-cancer and cancer risk estimates were compared to the relevant EPA risk limits. Both cancer and noncancer risks were quantified for the relevant exposure pathways, and cumulative risks were calculated by summing all of the pathway-specific risks for each identified receptor. Both central tendency (CT) and reasonable maximum exposure (RME) scenarios were evaluated for each receptor. Cumulative noncancer hazard indices (HI) were compared to the EPA noncancer risk limit of one; cumulative incremental lifetime cancer risks (ILCR) were compared to the EPA target risk range of 1×10^{-6} to 1×10^{-4}. As indicated in Section 3.4.1 above, though it is permissible to segregate cumulative non-cancer risks (HIs) by target organ and compare these segregated risks to the limit of 1, this segregation was not performed for this risk characterization since it would not impact the results or conclusions. That is, for the one medium that had non-cancer risks in excess of 1 (groundwater), several individual chemicals (affecting various target organs) had non-cancer risks above 1. Thus, the target organ risks would also exceed 1, confirming the results presented herein.

Calculation of risk estimates for each receptor and the relevant exposure pathways is provided in Tables 3-32 through 3-35; cumulative risks for each receptor are discussed in the following sections. As described in the HHRA First Interim Deliverable (March 2005), three cumulative risks are presented in

the risk tables: total, reference-related risk and site-related risk. The 'total' reflects risk posed by both site-related COPCs and COPCs that are attributed to reference (i.e., not site-related) conditions. Risk summaries showing the primary risk "drivers" at each exposure point (in all cases, these include chemicals with concentrations resulting in a cumulative noncancer hazard index >1 or a cumulative ILCR > 1 x 10^{-6}) are provided in Table 3-36 through Table 3-39.

3.4.2.1 Current and Future Youth Trespasser or Recreational User

We assumed that a current youth (ages 8-18 years) trespasser or recreational user may encounter COPCs in upland soils in Groups 3 or 4, ambient air, and wetland soil, sediment and surface water in the Groups 5 and 6 (wetland) areas of the Site. Calculation of cumulative cancer risks and noncancer hazard quotients for Group 3 trespassers are presented in Table 3-32a for CT exposures and Table 3-32b for RME exposures. CT and RME risk estimates for Group 4 trespassers are presented in Tables 3-32c and 3-32d, respectively. The only difference between these two sets of trespasser risks is the exposure to upland soils in Group 3 or Group 4. Risk summary tables for trespassers/recreational users for each Group (Group 3 or Group 4), future or current scenarios, and for CT and RME exposure scenarios is presented in Tables 3-32g through 3-32l. Calculation of cumulative cancer risks for COPCs with a mutagenic mode of action for current/future trespassers is provided in Table 3-32m (CT) and Table 3-32n (RME).

Cumulative risks for these receptors are summarized below.

Current/future youth trespasser/recreational user

Exposure Point	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3 (0-10' bgs)				
Total Risk	4 x 10^{-1}	3 x 10^{-5}	6 x 10^{-1}	4 x 10^{-5}
Reference-related risk	3 x 10^{-1}	2 x 10^{-5}	5 x 10^{-1}	3 x 10^{-5}
Site-related risk	8 x 10^{-2}	6 x 10^{-6}	1 x 10^{-1}	9 x 10^{-6}
Group 3 Primary Risk Drivers:	None	Benzo(a)pyrene; Arsenic	None	Benzo(a)pyrene; arsenic; phthalates

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

Current youth trespasser/recreational user

Exposure Point	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4 (0-1' bgs)				
Total Risk	4×10^{-1}	3×10^{-5}	5×10^{-1}	4×10^{-5}
Reference-related risk	3×10^{-1}	2×10^{-5}	5×10^{-1}	3×10^{-5}
Site-related risk	5×10^{-2}	3×10^{-6}	7×10^{-2}	4×10^{-6}
Group 4 Primary Risk Drivers:	None	Benzo(a)pyrene; arsenic	None	Benzo(a)pyrene; arsenic

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

The future youth trespasser/recreational user scenario is identical to that of the current trespasser scenario, with the exception that this receptor is assumed to be exposed to both surface and subsurface upland soil (0-10 feet bgs) in Group 4[7]. Cumulative risks for the Group 4 future youth trespasser/recreational user scenario are presented below:

Future youth trespasser/recreational user

Exposure Point	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4 (0-10' bgs)				
Total Risk	4×10^{-1}	7×10^{-5}	6×10^{-1}	1×10^{-4}
Reference-related risk	3×10^{-1}	3×10^{-5}	5×10^{-1}	4×10^{-5}
Site-related risk	6×10^{-2}	4×10^{-5}	8×10^{-2}	6×10^{-5}
Group 4 Primary Risk Drivers:	None	PAHs; arsenic	None	PAHs; arsenic

Cumulative hazard indices for the CT and RME exposure scenarios for both the Group 3 and Group 4 trespasser/recreational user scenarios are below the EPA HI limit of one. The cumulative ILCRs estimated for all trespasser scenarios do not exceed the upper limit (1×10^{-4}) of the EPA cancer risk range of 1×10^{-6} to 1×10^{-4}, although the future Group 4 scenario ILCR is at the upper limit of the range. The primary noncancer and cancer risk drivers in all cases include benzo(a)pyrene and arsenic in wetland

[7] As discussed in Section 3.2.1.5, data from samples collected 0-10' in Group 3 were used to evaluate both current and future exposure scenarios; thus, we did not differentiate between current and future exposures for the Group 3 trespasser.

sediment, with benzo(a)pyrene and other carcinogenic PAHs in upland and/or wetland soils also contributing to the cumulative cancer risks. Note that arsenic is present at concentrations consistent with reference concentrations. When risks for arsenic, as well as the other constituents identified in Section 3.1.4 as Reference-related, are removed from cumulative receptor risks, the site-related risk estimates decrease by approximately one order of magnitude. COPCs in surface soils located at the former residence, garage, and storage area soils (in Group 4) and in surface water of Sutton Brook do not drive risks for the current trespasser/recreational user scenario. The elevated concentrations of PAHs in subsurface Group 4 soils, however, contribute approximately 60% of the cumulative cancer risk for this scenario. In summary, neither the Group 3 or Group 4 current Trespasser/Recreational user scenarios had non-cancer risks above the cumulative limit of 1 or cancer risks above the upper end of the USEPA risk range (i.e., greater than 1×10^{-4}) .

3.4.2.2 Future Area or Site Resident

Under current conditions, local neighborhood residents are anticipated to have an exposure potential similar to that of the trespasser/recreational user, under both current and future conditions. Media evaluated included ambient air, wetland soil, sediment and surface water. As required by USEPA guidance for baseline HHRAs, we also assumed that Groups 3 and 4 may be redeveloped as residences in the future, and that site groundwater (Groups 3-6) may be used as a potable water source. Thus, future residents may be exposed to COPCs in upland soil, indoor air and drinking water. The table below summarizes the cumulative cancer and noncancer risks for a resident in Group 3 and Group 4. Risk calculations for these two receptors are provided in Tables 3-33a through 3-33d for both CT and RME scenarios. Note that risks for both Group 3 and Group 4 scenarios include risks for exposure to all wetland media (surface water, wetland soil and sediment), ambient air, and potable water from Groups 3-6.

Future Resident

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3				
Total Risk	1×10^{3}	2×10^{-2}	2×10^{3}	9×10^{-2}
Reference-related risk	6×10^{1}	6×10^{-5}	1×10^{2}	1×10^{-4}
Site-related risk	9×10^{2}	2×10^{-2}	2×10^{3}	9×10^{-2}
Primary Risk Drivers:	Tetrahydrofuran; methylphenols; acrylonitrile; toluene; phthalates; xylenes; metals	chlorinated VOCs; phthalates; arsenic; PAHs	Tetrahydrofuran; methylphenols; acrylonitrile, toluene, 2-butanone, xylenes, metals	bis-2-ethylhexyl phthalate chlorinated VOCs; arsenic

Exposure Point/Receptor	Central Tendency		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4				
Total Risk	9×10^{2}	2×10^{-2}	2×10^{3}	9×10^{-2}
Reference-related risk	6×10^{1}	1×10^{-4}	1×10^{2}	2×10^{-4}
Site-related risk	9×10^{2}	2×10^{-2}	2×10^{3}	9×10^{-2}
Primary Risk Drivers:	Tetrahydrofuran; methylphenols; acrylonitrile, toluene, xylenes, metals	bis-2-ethylhexyl phthalate; chlorinated VOCs; PAHs; acrylonitrile arsenic; cadmium	Tetrahydrofuran; methylphenols; acrylonitrile, toluene, ethylbenzene, xylenes, metals	chlorinated VOCs; benzene, bis-2-ethylhexyl phthalate, PAHs, arsenic; cadmium

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

As indicated in this table, both cancer risks and non cancer HIs are well above EPA risk limits for both Group 3 and Group 4. Risks are primarily attributed to use of groundwater as a potable water supply. A variety of both chlorinated and non-chlorinated VOCs (including primarily vinyl chloride and xylenes) and metals (including arsenic, manganese, and beryllium) contribute to the majority of cancer and noncancer risks. Although many of the metals detected in site groundwater are present at Reference concentrations, subtracting Reference risks from the cumulative estimated risks still results in site-related risks significantly above EPA limits.

Childhood residential lead exposures for the RME scenario were evaluated separately for Groups 3 and 4 of the Site using the IEUBK lead model. IEUBK parameters and output are presented in Appendix E. Model results indicate estimated probabilities of 0.08 % and 0.4% of the exposed population will have BLL above the EPA threshold BLL of 10 µg/dL for Group 3 and 4 soils, respectively. This probability is well below the EPA probability limit of 5%, indicating that lead in soil does not pose a significant risk. As indicated previously, lead is present at Reference concentrations in Group 3 soil; slightly higher concentrations were detected in Group 4 soil.

We also conducted a separate quantitative evaluation of residential health risks associated with potable use of Groups 1 and 2 groundwater. Risk estimates for the CT and RME scenarios are presented in Tables 3-33e and Table 3-33f, respectively. As shown in the table below, noncancer hazard indices and ILCRs for both CT and RME scenarios exceed EPA risk limits. As with Groups 3-6 groundwater, risks are driven primarily by VOCs and metals, as well as SVOCs.

Future resident

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 1 and 2				
Total Risk	5×10^{2}	2×10^{-2}	9×10^{2}	5×10^{-2}
Reference-related risk	4×10^{1}	--	7×10^{1}	--
Site-related risk	5×10^{2}	2×10^{-2}	9×10^{2}	5×10^{-2}
Primary Risk Drivers:	metals, methylphenols, toluene, naphthalene, tetrahydrofuran	Chlorinated VOCs, arsenic	metals, methylphenols, toluene, naphthalene, tetrahydrofuran	Chlorinated VOCs, arsenic

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

We did not evaluate lead risks for Group 1 and 2 groundwater; however, the lead EPC of 0.07 mg/L in Groups 1 and 2 groundwater is slightly higher than the lead EPC in Groups 3-6 of 0.02 mg/L. This lead EPC exceeds the Federal drinking water standard of 0.015 mg/L.

In addition to the quantitative risks presented above, groundwater EPCs (maximum detected concentrations) were compared to Federal Drinking Water Standards (MCLs). Numerous constituents had EPCs in excess of these standards, as indicated on Tables 3-1 and 3-14.

Risk summary tables for the resident for each Group under CT and RME exposure scenarios is presented on Tables 3-33g through 3-33l. Calculation of cumulative cancer risks for COPC with a mutagenic mode of action in all Groups is provided in Table 3-33m (CT) and Table 3-33n (RME).

3.4.2.3 Future Commercial or Industrial Facility Worker

We assumed that Group 3 and 4 of the Site may be developed for commercial or industrial purposes under future conditions, and that, consequently, future facility workers may be exposed to COPCs in soil within each group and to indoor air, should VOCs in groundwater migrate into a future building. Furthermore, in keeping with USEPA guidance, we assumed that groundwater from Groups 3-6 could be used as a potable water source for a future facility. Cumulative risks for each exposure point are presented in Table 3-34a through 3-34d and summarized below.

Future Facility Worker

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3				
Total Risk	1×10^{2}	2×10^{-3}	2×10^{2}	2×10^{-2}
Reference-related risk	7×10^{0}	3×10^{-7}	1×10^{1}	2×10^{-6}
Site-related risk	9×10^{1}	2×10^{-3}	2×10^{2}	2×10^{-2}

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 4				
Total Risk	9×10^{1}	2×10^{-3}	2×10^{2}	2×10^{-2}
Reference-related risk	7×10^{0}	3×10^{-6}	1×10^{1}	1×10^{-5}
Site-related risk	8×10^{1}	2×10^{-3}	2×10^{2}	2×10^{-2}
Primary Risk Drivers:	Acrylonitrile, 4-methyl-2-pentanone,toluene, xylenes, arsenic	Arsenic, acrylonitrile, chlorinated VOCs; PAHs	Acrylonitrile, toluene, xylenes, arsenic	Arsenic, acrylonitrile, chlorinated VOCs

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

As indicated above, cumulative hazard indices for both areas of the Site and for both CT and RME scenarios are well over the EPA threshold of one. Cancer risks for the RME scenarios are above the upper limit of the EPA cancer risk range of 1×10^{-4}. Noncancer risks are primarily associated with ingestion of and dermal contact with VOCs, SVOCs and metals in drinking water; to a lesser extent, volatile COPCs (notably, xylenes) in indoor air contribute to noncancer risks. Risks from soil exposures are substantially lower than those from groundwater exposures. Cancer risks are driven primarily by chlorinated VOCs and arsenic in drinking water and acrylonitrile in both indoor air and drinking water. Primary noncancer risk drivers in drinking water include heavy metals (arsenic), 4-methyl-2-pentanone, 2-butanone and toluene. Although some of the heavy metals (antimony, beryllium, zinc and silver) present in groundwater are at levels consistent with Reference concentrations, site-related risks, exclusive of Reference-related risks, still exceed EPA risk limits.

For lead exposures, we used the ALM to estimate fetal BLLs in pregnant workers. Results from the ALM model are presented as the estimated probability that fetal blood lead levels (BLLs) in a pregnant worker will exceed the EPA target lead blood level of 10 µg/dL. The EPA threshold probability is 5%. ALM model results are presented in Appendix E; the estimated probabilities for each scenario are summarized in the table below.

Exposure Point	Central Tendency Exposure	Reasonable Maximum Exposure
Group 3 Facility Worker	0.7 %	0.8%
Group 4 Facility Worker	0.8%	1%

As noted in the above table, estimated probabilities of exceeding the BLL of 10 µg/dL for all commercial/industrial scenarios in Groups 3 and 4 are well below the USEPA "limit" of 5%. Furthermore, note that lead in Group 3 soils is present at levels consistent with Reference concentrations. Thus, lead in soil in either Groups 3 or 4 is not likely to result in adverse health effects to future facility workers.

Risk summary tables for the future commercial facility worker for each Group under CT and RME exposure scenarios is presented on Tables 3-34e through 3-34h.

3.4.2.4 Future Construction Worker

During future site redevelopment, construction workers may be exposed to COPCs in soil and shallow groundwater within Groups 3 and 4. Additionally, as VOCs are present in shallow groundwater within each of these areas, we assumed that construction workers may inhale volatiles that have emanated from standing water or saturated soils in an excavation trench. Risk estimates for a Group 3 and Group 4 construction workers are provided in Tables 3-35a through 3-35h. Cumulative risk estimates for the construction worker scenario are provided in the table below.

Future Construction Worker

Exposure Point/Receptor	Central Tendency Exposure		Reasonable Maximum Exposure	
	HI	ILCR	HI	ILCR
Group 3				
Total Risk	8×10^{-1}	9×10^{-7}	2×10^{0}	2×10^{-6}
Reference-related risk	1×10^{-1}	8×10^{-8}	1×10^{-1}	2×10^{-7}
Site-related risk	7×10^{-1}	9×10^{-7}	1×10^{0}	2×10^{-6}
Primary Risk Drivers:	Toluene, xylenes	Tetrachloroethene, bis-2-ethyl hexyl phthalate	Toluene, xylenes, bis-2-ethylhexyl phthalate	Tetrachloroethene, benzo(a)pyrene, bis-2-ethyl hexyl phthalate
Group 4				
Total Risk	6×10^{-2}	4×10^{-6}	1×10^{-1}	8×10^{-6}
Reference-related risk	3×10^{-2}	5×10^{-7}	6×10^{-2}	1×10^{-6}
Site-related risk	3×10^{-2}	3×10^{-6}	6×10^{-2}	7×10^{-6}
Primary Risk Drivers:	None	PAHs	None	PAHs

Note: risk estimates are presented to one significant figure. Due to rounding, risks do not always appear to sum correctly.

As indicated in the table above, cumulative noncancer risks for a construction worker in the former drum disposal area (Group 3) exceed EPA risk limits for the RME scenario, primarily due to the presence of Aroclor 1254 in groundwater. Cancer risks are driven by PCE and bis-2-ethylhexyl phthalate (BEHP) and, to a lesser extent, benzo(a)pyrene and arsenic in soil; cumulative cancer risks, however, are within the EPA risk limits.

For construction workers exposed to media in the former residence, garage, and storage area (Group 4), both cumulative cancer and noncancer risks were within or below EPA acceptable risk limits. Benzo(a)pyrene and other PAHs in Group 4 soils contribute most to cumulative cancer risk.

For lead exposures, we used the ALM to estimate fetal BLLs in hypothetical pregnant workers. ALM model results are presented in Appendix E; the estimated probabilities for each exposure point are summarized in the table below.

Exposure Point	Central Tendency Exposure	Reasonable Maximum Exposure
Group 3		
Construction Worker	0.8 %	1%
Group 4		
Construction Worker	1%	2%

As noted in the above table, estimated probabilities for all scenarios are below the USEPA threshold of 5%. Thus, lead in soil in either Groups 3 or 4 is not likely to result in adverse health effects to future construction workers.

Final risk summary tables for each receptor group and CT and RME exposure scenario are presented in Tables 3-36a – 3-36d (trespasser), Tables 3-37a – 3-37d (future resident), Tables 3-38a – 3-38d (facility worker), and Tables 3-39a – 3-39b (construction worker).

3.5 UNCERTAINTY ANALYSIS

Uncertainty analysis is an important component of all risk characterizations. The uncertainty analysis identifies and evaluates the uncertainties typically associated with key parameters in the risk characterization, including the environmental concentrations, toxicity values and exposure assumptions used to estimate magnitude of exposure and to quantify health risks. Each section of the risk characterization is based on a number of assumptions intended to be protective of human health. Uncertainties in this risk characterization may bias the risk result to either overestimate or underestimate risk. Many assumptions incorporated into this risk characterization are inherently conservative (i.e., protective). Therefore, the risk estimates presented in this report are typically more likely to overestimate rather than underestimate the potential risk from a Site.

The summary table on the following pages highlights some of the potential sources of uncertainty and the likely direction of their effect.

It is also important to stress that the risks calculated are *estimated* risks. When using high dose toxicity data to predict risks for a chemical exposure at low doses, there is considerable uncertainty whether any disease will occur due to exposure; therefore, the risks generated in this evaluation are *hypothetical* rather than actual and are by design intended to be conservative (tend to overestimate actual risks).

Component of Risk Characterization	Description of Uncertainty	Potential Bias in Risk Estimate	
		Underestimate	Overestimate
Hazard Identification	We included historic soil, sediment, surface water and groundwater data in our data set. Generally, these data are consistent with relatively recent data collected from the Site. In some instances, however, use of older data may reflect higher concentrations of certain contaminants (such as VOCs) that have since decreased with time.	X	X
	The assessment included use of censored (non-detect) data that in many instances, especially for sediment and wetland soil samples, had elevated detection limits due to high moisture content of the sample. Inflated detection limits may potentially mask the presence of contaminants in these media, providing a false negative result (i.e., the compound is truly present, but at a level below laboratory reporting limits). We have included ½ the detection limit in derivation of the exposure point concentrations as a means of balancing use of these elevated results. However, this inclusion may potentially overestimate actual exposures if the COPC is not truly present at the Site.	X	X
	For selection of sediment COPCs, we compared maximum detected concentrations to residential soil screening criteria (PRGs), as directed by the EPA. This comparison is very conservative since these soil PRGs reflect a much higher frequency and intensity of use relative to sediment exposures. Likewise, we compared surface water concentrations to drinking water standards or tap water PRGs; however, Sutton Brook and standing water in the adjacent wetlands is not used a potable source of water. These conservative screening criteria led to the inclusion of numerous detected constituents as COPCs when, in reality, risks from many of these constituents are negligible.		X
	TICs were not quantitatively evaluated as part of the risk assessment, due to the significant uncertainty associated with the lack of identification of compounds and/or appropriate surrogates, the associated lack of toxicity information and/or standards, and the imprecision associated with quantification of concentrations of these chemicals. Although this may potentially lead to an underestimate of risk, the relative contribution of risk by these TICs is anticipated to be small relative to the large number of positively identified COPCs carried through this analysis. N-n-dimethylformamide was characterized as a TIC and consequently not included as a COPC, although it was present at a relatively high concentration. The presence of this constituent (and other TICs) could therefore potentially increase cumulative risks.	X	

Component of Risk Characterization	Description of Uncertainty	Potential Bias in Risk Estimate	
		Underestimate	Overestimate
Exposure Assessment	This risk analysis includes evaluation of the "Reasonable Maximum Exposure" (RME) for each receptor as well as evaluation of "Central Tendency" (CT) exposures. The RME exposure assumptions (including receptor specific variables, such as ingestion rate of soil or water) reflect upper-bound or maximum values and thus likely overstate risks. Some specific sources of uncertainty are described below.		X
	For the evaluation of future hypothetical on-site potable water use, it was assumed that all of the daily water ingestion would occur at the home, with no proportion from the workplace and/or school. Similar assumptions were made for evaluation of soil ingestion and contact. Thus, potential risks are likely overestimated.		X
	In the derivation of soil, sediment, and surface water exposure point concentrations (EPC), for each COPC, 95% UCL or maximum concentrations were calculated in each dataset. The lower of these two concentrations was selected as the EPC for each COPC. EPCs for these media likely provide a conservative estimate of average site exposures. However, the EPC may be underestimated by use of the maximum if the conservative estimate of the mean (95% UCL) exceeds the maximum concentration.	X	X
	We used the maximum detected concentration as the EPC for groundwater exposures. In many instances, EPCs were biased toward only a few site monitoring wells and thus do not represent likely/typical groundwater exposures at the Site. We assumed that future residents or facility workers may be drawing in water from any area of the Site, including areas under the landfill lobes. Although contaminants in groundwater may migrate from these areas, groundwater data indicate natural attenuation is occurring with distance from source areas. Furthermore, the plume appears to be stable. Thus, use of upper-bound values to estimate potential future drinking water exposures likely overstates risks associated with potable water use.		X
	The maximum detected concentration in ambient air samples was used as the EPC for the relevant exposure scenarios. The highest concentrations of COPCs were detected in samples collected from the landfill lobes. As discussed, these lobes will be capped and landfill gas managed. Use of the maximum concentration biases ambient air inhalation risks toward areas of the Site that will be remediated or controlled in the future, thereby overestimating potential health risks.		X

Component of Risk Characterization	Description of Uncertainty	Potential Bias in Risk Estimate	
		Underestimate	Overestimate
Exposure Assessment	For the trespasser and residential scenarios, we did not quantify risks associated with the inhalation of fugitive dust at the Site. The exclusion of this exposure pathway may potentially underestimate health risks for these receptors; however, this pathway generally contributes relatively minimal risks compared to the dermal and oral exposure routes.	X	
	Contributions from soil to the vapor intrusion pathway were not quantified, based on the relatively higher levels and prevalence of VOCs in groundwater from Groups 3 & 4. Though this may potentially underestimate the full contribution of VOCs from the subsurface into indoor air, the extent of the bias is likely to be low due to the much lower prevalence and concentration of volatile constituents in soil relative to groundwater.	X	
	For the trespasser and resident, we assumed that these receptors would be exposed to wetland media for 90 days per year, each year of their respective exposure duration. Furthermore, we used adherence factors associated with high intensity activities (e.g., children playing in wet soil) to estimate dermal risks. Given that Sutton Brook and associated wetlands are heavily vegetated and not used as a primary recreational area, this assumption about exposure frequency is highly conservative and likely overestimates risks for these exposure scenarios.		X
	Facility workers were assumed to be exposed to both fugitive dust emissions and indoor air 8 hours per day. This effectively double-counts risks, as it is unlikely that a worker would be exposed to both media for the same length of time on a routine basis.		X
	Although VOCs are present in upland soil, we did not quantify the contribution of VOCs from soil into indoor air of a future building, as impacted soils were typically collected from the saturated zone and thus reflect groundwater impacts (which were evaluated through use of the J&E vapor intrusion model).	X	

Component of Risk Characterization	Description of Uncertainty	Potential Bias in Risk Estimate	
		Underestimate	Overestimate
	Dermal absorption of VOCs and select inorganics was not evaluated in the HHRA for the soil exposure pathway, due to a lack of published dermal absorption fraction values. Although dermal absorption of these constituents is unlikely to be significant (e.g., VOCs would be expected to volatilize from the skin surface before penetrating the skin), the exclusion of these COPCs from the dermal pathway may potentially underestimate cumulative risks.	X	
	Estimated dermal permeability coefficients for PAHs and PCBs are outside of the model predictive domain and therefore, we did not quantify risks for these COPCs associated with dermal aqueous exposures. This exclusion may potentially underestimate cumulative risks.	X	
	High intensity exposures to soil for the construction worker were assumed to persist every day over an assumed one-year project. This included use of the 330 mg/event soil ingestion rates (RME), and the 95th percentile soil adherence (to skin) factor, as well as breathing soil-borne dust 8 hours/day. In reality, soil excavation and grading activities that could result in these high intensity exposures typically occur for only a fraction of the project, such as prior to installation of a foundation or slab.		X
Dose Response Assessment	Cancer slope factors developed by EPA represent plausible upper-bound estimates, which means that the EPA is reasonably confident that the actual cancer risk will not exceed the estimated cancer risk calculated using the cancer slope factor.		X
	RfDs and RfCs are defined by EPA as estimates (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It is more likely that these toxicity values overestimate rather than underestimate potential health hazards.		X
	The cancer slope factor for trichloroethylene is under review by EPA. Estimates of the cancer potency ranges over nearly two orders of magnitude. The high end of the range of values was used in this assessment. Because a toxicity value for tetrachloroethylene is not available from EPA, a peer-reviewed value developed by the California EPA was used, consistent with EPA's tiered approach to the selection of toxicity values.	X	X

Component of Risk Characterization	Description of Uncertainty	Potential Bias in Risk Estimate	
		Underestimate	Overestimate
	Oral toxicity values were converted to dermal toxicity values for several COPCs (primarily metals). For other compounds, we used the oral toxicity values to evaluate dermal risks. Use of oral values may potentially over- or underestimate potential risks via dermal exposure routes.	X	X
	For some compounds lacking toxicity data, we utilized toxicity values from surrogate compounds with similar chemical structure. For example, pyrene is used as a surrogate compound for the C11-C22 aliphatic hydrocarbon range. Use of surrogate compounds may potentially over or underestimate risks associated with these compounds.	X	X
Risk Characterization	In general, conservative assumptions and parameters were used in developing risk estimates.		X
	Trespasser/recreational user risks associated with exposure to lead were not calculated, as the IEUBK and ALM models are not appropriate for the trespasser age range. Because residential lead risks for a child resident, calculated using the IEUBK model, were below the EPA threshold, we have assumed that lead risks for trespassers will also be within EPA acceptable limits. Thus, this uncertainty is considered to be small.	X	
	Cumulative non-cancer risks in excess of 1 can be segregated by target organ and then compared to the non-cancer risk limit. In this HHRA, the non-cancer risks in excess of 1 were associated with facility worker and residential exposure to groundwater via its assumed use for potable purposes. However, since the risks associated with these pathways were so far in excess of 1, and even individual chemical risks were well above 1 in many cases, this segregation by target organ was not necessary and thus not included. Therefore, the cumulative non-cancer risks presented in the risk characterization reflect threshold effects associated with exposure to all COPCs, not just those with the same target organ, and likely overestimate the non-cancer risks.		X

Characterization	Description of Uncertainty	Potential Bias in Risk Estimate	
		Underestimate	Overestimate
	Trespasser/recreational user risks associated with exposure to both upland (soil) and wetland soil, sediment and surface water were summed, though it is unlikely that the same youth (8-18) would actually contact COPCs in all these media during each exposure event, every time they ventured onto the Site.		X

3.6 SUMMARY

In summary, cumulative noncancer hazard indices for the Group 3 and 4 trespasser and Group 4 construction worker scenarios are below the EPA target HI of one, and cumulative ILCRs do not exceed the upper end of the EPA target ILCR range of 1x 10^{-4}. Cumulative risks for future Group 3 and 4 Site residents and facility workers and Group 3 construction workers, however, exceed the EPA target risk limits for carcinogenic and/or noncarcinogenic effects.

For facility workers and residents, excess risks are primarily driven by various COPCs (notably chlorinated VOCs, phthalates and heavy metals) in groundwater, which is assumed to be used as a potable water source under future hypothetical residential and commercial development scenarios for Groups 1-2 (i.e., landfill lobes) and Groups 3-6 (remainder of Site). Volatile organic compounds in groundwater also may volatilize and migrate into indoor air of a future site building(s), resulting in indoor air concentrations that may also pose a potential risk to these receptors. For Group 3 and 4 future residents and facility workers, cumulative cancer and noncancer risk estimates associated with the vapor intrusion pathway exceed EPA risk management criteria. Note that site groundwater risks were based on the maximum groundwater concentrations detected at the Site, however, and represent a highly conservative estimate of exposure. Highest levels of many of the compounds detected in groundwater at the Site are located in the former drum disposal area (Group 3).

Soils in the former drum disposal area (Group 3) and the former residence, garage, and storage area (Group 4) also contribute to excess health risks, with primary site-related risk drivers in upland soil including bis(2-ethylhexyl)phthalate, tetrachloroethene, PAHs, and arsenic. Furthermore, as described in Section 3.1.2.3 of this report, the potential for soil to impact indoor air of a future building exists for Group 3 soils. However, the risks associated with potential volatile emissions from soils are anticipated to be low relative to those associated with potable groundwater use. Lastly, arsenic and benzo(a)pyrene in sediment and wetland soil contribute to risks for the future site resident. In all cases where potable water exposures were assessed (i.e., for future site residents and facility workers), the risks for this exposure medium contributed most significantly to the cumulative receptor risks, relative to other media.

3.7 REFERENCES

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TABLE 3-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 1-2 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 1-2 Groundwater	57-12-5	Cyanide, Total	0.0028	0.0053	mg/L	MW-3S	4 / 10	0.0009 - 0.01	0.0053		0.073	0.2	MCL	N	SL
	7429-90-5	Aluminum, Total	0.023	2.5	mg/L	PMW-2	22 / 47	0.0075 - 0.1	2.5	(N/C)	--	NA	NA	N	NTX
	7440-36-0	**Antimony, Total**	0.0013	0.0052	mg/L	MW-5	3 / 60	0.001 - 0.1	**0.0052**		0.0015	0.006	MCL	Y	SL
	7440-38-2	**Arsenic, Total**	0.0038 J	2	mg/L	MW-4B	62 / 77	0.002 - 0.05	**2**		0.000045	0.01	MCL	Y	SL
	7440-39-3	**Barium, Total**	0.004 J	1.59	mg/L	MW-4B	50 / 51	0.0025 - 0.01	**1.59**		0.26	2	MCL	Y	SL
	7440-41-7	**Beryllium, Total**	0.0005 J	0.03	mg/L	MW-2S	13 / 57	0.0001 - 0.004	**0.03**		0.0073	0.004	MCL	Y	SL
	7440-43-9	**Cadmium, Total**	0.0004	0.36	mg/L	MW-5	23 / 76	0.0001 - 0.01	**0.36**		0.0018	0.005	MCL	Y	SL
	7440-70-2	Calcium, Total	13	501	mg/L	MW-4S	47 / 47	0.025 - 1	501		NA	NA	NA	N	EN
	7440-47-3	Chromium, Total	0.0012 J	0.0082	mg/L	MW-3B	20 / 62	0.001 - 0.06	0.0082		0.011	0.1	MCL	N	SL
	7440-48-4	**Cobalt, Total**	0.001 J	0.0763	mg/L	MW-4B	30 / 47	0.001 - 0.01	**0.0763**		0.073	NA	NA	Y	SL
	7440-50-8	**Copper, Total**	0.003	0.179	mg/L	PMW-3	16 / 64	0.002 - 0.01	**0.179**		0.15	1.3	MCL	Y	SL
	7439-89-6	Iron, Total	0.26	780 J	mg/L	MW-4S	65 / 65	0.01 - 1	780		1.1	0.3	SMCL	N	EN
	7439-92-1	**Lead, Total**	0.0014 J	0.24	mg/L	MW-5	18 / 77	0.001 - 0.05	**0.24**		0.015	0.015	MCL	Y	SL
	7439-95-4	Magnesium, Total	1.2	153	mg/L	MW-4B	60 / 60	0.025 - 0.1	153		NA	NA	NA	N	EN
	7439-96-5	**Manganese, Total**	0.04	20.2 J	mg/L	MW-4S	64 / 64	0.0025 - 0.01	**20.2**		0.088	0.05	SMCL	Y	SL
	7440-02-0	**Nickel, Total**	0.0016 J	0.21	mg/L	MW-4B	42 / 59	0.0007 - 0.025	**0.21**		0.073	0.1	ORSG	Y	SL
	7440-09-7	Potassium, Total	2.04	170 J	mg/L	MW-4S	47 / 47	0.15 - 50	170		NA	NA	NA	N	EN
	7782-49-2	**Selenium, Total**	0.0024 J	0.07	mg/L	MW-5	5 / 64	0.0018 - 0.05	**0.07**		0.018	0.05	MCL	Y	SL
	7440-22-4	Silver, Total	0.0007 J	0.009	mg/L	MW-3S	3 / 64	0.0004 - 0.01	0.009		0.018	0.1	SMCL	N	SL
	7440-23-5	Sodium, Total	2.46	414	mg/L	MW-4B	47 / 47	0.15 - 100	414		NA	20	ORSG	N	EN
	7440-28-0	**Thallium, Total**	0.0038	0.0047 J	mg/L	MW-4B	3 / 60	0.0001 - 0.2	**0.0047**		0.00024	0.002	MCL	Y	SL
	7440-62-2	**Vanadium, Total**	0.001 J	0.03 J	mg/L	MW-4S	27 / 47	0.0008 - 0.01	**0.03**		0.0036	NA	NA	Y	SL
	7440-66-6	Zinc, Total	0.005	0.35	mg/L	MW-3B	29 / 64	0.0025 - 0.05	0.35		1.1	5	SMCL	N	SL
	1031-07-8	Endosulfan sulfate	0.000031 J	0.000031 J	mg/L	MW-4B	1 / 12	0.00002 - 0.0001	0.000031		0.022	NA	NA	N	SL
	95-50-1	1,2-Dichlorobenzene	0.00063 J	0.005	mg/L	MW-4B	8 / 75	0.00024 - 2.5	0.005		0.037	0.6	MCL	N	SL
	106-46-7	**1,4-Dichlorobenzene**	0.00048 J	0.011 J	mg/L	GP-5	20 / 74	0.001 - 2.5	**0.011**		0.0005	0.005	MCL	Y	SL
	105-67-9	2,4-Dimethylphenol	0.058 J	0.058 J	mg/L	MW-4S	1 / 46	0.0038 - 5	0.058		0.073	NA	NA	N	SL
	121-14-2	2,4-Dinitrotoluene	0.000586	0.000586	mg/L	MW-3S	1 / 46	0.0005 - 3	0.000586		0.0073	0.1	DWEL	N	SL
	91-57-6	**2-Methylnaphthalene**	0.00083	0.00083	mg/L	MW-12	1 / 49	0.0008 - 4	**0.00083**		0.00062	NA	NA	Y	SL
	95-48-7	2-Methylphenol	0.018	0.18 J	mg/L	MW-4B	13 / 46	0.001 - 3	0.18		0.18	NA	NA	N	SL
	108-39-4/106-44-5	**3-Methylphenol/4-Methylphenol**	0.0066	10	mg/L	MW-4S	20 / 38	0.0015 - 3	**10**		0.018	NA	NA	Y	SL
	106-44-5	**4-Methylphenol**	6.6 J	11	mg/L	MW-4S	4 / 8	0.01 - 2.5	**11**		0.018	NA	NA	Y	SL
	100-02-7	4-Nitrophenol	0.00118	0.00118	mg/L	MW-6	1 / 46	0.0005 - 5	0.00118		0.0032	NA	NA	N	SL
	83-32-9	**Acenaphthene**	0.000714	0.000714	mg/L	MW-2S	1 / 49	0.0005 - 2.5	**0.000714**		0.037	NA	NA	Y	SL
	98-86-2	**Acetophenone**	0.0049 J	0.0308	mg/L	MW-4B	3 / 40	0.0008 - 10	**0.0308**		NA	NA	NA	Y	SL
	65-85-0	Benzoic acid	0.12 J	12 J	mg/L	MW-4S	13 / 38	0.01 - 25	12		15	NA	NA	N	SL
	84-66-2	Diethyl phthalate	0.0024 J	0.163	mg/L	MW-4S	15 / 46	0.0013 - 2.5	0.163		2.9	NA	NA	N	SL
	84-74-2	Di-n-butylphthalate	0.00143	0.00143	mg/L	MW-12	1 / 46	0.0008 - 2.5	0.00143		0.36	NA	NA	N	SL
	78-59-1	Isophorone	0.000549	0.000549	mg/L	MW-2S	1 / 46	0.0005 - 2.5	0.000549		0.071	NA	NA	N	SL
	91-20-3	**Naphthalene**	0.00048	0.24 J	mg/L	MW-4B	15 / 77	0.0003 - 2.5	**0.24**		0.00062	0.14	ORSG	Y	SL
	924-16-3	**N-Nitrosodi-n-butylamine**	0.00108	0.00108	mg/L	MW-6	1 / 9	0.0005 - 0.0135	**0.00108**		0.000002	NA	NA	Y	SL
	930-55-2	**N-Nitrosopyrrolidine**	0.00968	0.00968	mg/L	MW-12	1 / 9	0.0005 - 0.0135	**0.00968**		0.0000032	NA	NA	Y	SL
	95-53-4	**o-Toluidine**	0.00316	0.00316	mg/L	MW-12	1 / 9	0.0025 - 0.0675	**0.00316**		0.00035	NA	NA	Y	SL

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Scenario Timeframe:	Future
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Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 1-2 Groundwater	108-95-2	**Phenol**	0.000287		2.6		mg/L	MW-4S	17 / 46	0.0003 - 3.5	**2.6**		1.1	2	EPA Health Advisory - Lifetime	Y	SL
	110-86-1	**Pyridine**	0.029	J	0.042		mg/L	MW-5	2 / 38	0.0013 - 25	**0.042**	(N/C)	0.0036	NA	NA	Y	SL
	71-55-6	1,1,1-Trichloroethane	0.13		0.13		mg/L	GP-13	1 / 72	0.0005 - 1	0.13		0.32	0.2	MCL	N	SL
	75-34-3	**1,1-Dichloroethane**	0.00028		0.53		mg/L	GP-13	26 / 74	0.0007 - 1	**0.53**		0.081	0.07	ORSG	Y	SL
	75-35-4	1,1-Dichloroethene	0.00024	J	0.00024	J	mg/L	MW-4B	1 / 73	0.0005 - 1	0.00024		0.034	0.007	MCL	N	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.00043	J	2.6		mg/L	GP-12	15 / 65	0.00043 -1	**2.6**		0.0012	NA	NA	Y	SL
	107-06-2	**1,2-Dichloroethane**	0.002	J	0.0069	J	mg/L	MW-4B	2 / 73	0.0005 - 1	**0.0069**		0.00012	0.005	MCL	Y	SL
	540-59-0	**1,2-Dichloroethene (Total)**	0.15		0.15		mg/L	MW-4S	1 / 6	0.01 - 1	**0.15**		0.0061	0.07	MCL	Y	SL
	540-59-0	**cis-1,2-Dichloroethene**	0.00047	J	0.45		mg/L	GP-11	20 / 68	0.0005 - 0.25	**0.45**		0.0061	0.07	MCL	Y	SL
	540-59-0	trans-1,2-Dichloroethene	0.00057	J	0.00057	J	mg/L	MW-4B	1 / 67	0.00075 - 0.3	0.00057		0.012	0.1	MCL	N	SL
	78-87-5	**1,2-Dichloropropane**	0.00037	J	0.0034	J	mg/L	MW-4B	2 / 73	0.001 - 1	**0.0034**		0.00016	0.005	MCL	Y	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.0013	J	0.64		mg/L	GP-12	9 / 63	0.00043 - 1	**0.64**		0.0012	NA	NA	Y	SL
	123-91-1	**1,4-Dioxane**	0.0022		0.83		mg/L	MW-4B	40 / 53	0.005 - 1	**0.83**		0.0061	0.003	ORSG	Y	SL
	78-93-3	**2-Butanone**	0.017		27	J	mg/L	MW-4S	21 / 65	0.005 - 2	**27**		0.7	4	ORSG	Y	SL
	591-78-6	**2-Hexanone**	0.0094		0.45	J	mg/L	MW-4S	4 / 65	0.005 - 2	**0.45**		0.2	NA	NA	Y	SL
	108-10-1	**4-Methyl-2-pentanone**	0.01		13	J	mg/L	MW-4B	28 / 65	0.005 - 2	**13**		0.2	0.35	ORSG	Y	SL
	67-64-1	**Acetone**	0.0025		21	J	mg/L	MW-4S	25 / 65	0.005 - 2	**21**		0.55	6.3	ORSG	Y	SL
	71-43-2	**Benzene**	0.00031	J	0.038	J	mg/L	MW-4S	28 / 69	0.00028 - 1	**0.038**		0.00035	0.005	MCL	Y	SL
	75-15-0	Carbon disulfide	0.00037	J	0.00037	J	mg/L	MW-4B	1 / 64	0.001 - 2	0.00037		0.1	NA	NA	N	SL
	108-90-7	**Chlorobenzene**	0.00037	J	0.028		mg/L	GP-5	20 / 68	0.00017 - 1	**0.028**		0.011	0.1	MCL	Y	SL
	75-00-3	**Chloroethane**	0.00051	J	4.3		mg/L	GP-13	11 / 73	0.001 - 1	**4.3**		0.0046	NA	NA	Y	SL
	67-66-3	**Chloroform**	0.0017		0.0017		mg/L	MW-5	1 / 73	0.0007 - 1	**0.0017**		0.00017	0.07	ORSG	Y	SL
	74-87-3	Chloromethane	0.002	J	0.002	J	mg/L	MW-4B	1 / 73	0.001 - 1	0.002		0.016	0.03	Health Advisory (Lifetime)	N	SL
	75-71-8	**Dichlorodifluoromethane**	0.00058	J	0.095	J	mg/L	GP-15	7 / 66	0.001 - 2	**0.095**		0.039	1.4	ORSG	Y	SL
	60-29-7	**Ethyl Ether**	0.0015	J	0.3	J	mg/L	MW-4B	25 / 59	0.0025 - 1	**0.3**		0.12	NA	NA	Y	SL
	100-41-4	**Ethylbenzene**	0.0013		2		mg/L	GP-12	32 / 74	0.00031 - 0.25	**2**		0.13	0.7	MCL	Y	SL
	98-82-8	Isopropylbenzene	0.00055		0.048	J	mg/L	GP-12	25 / 65	0.00037 - 0.25	0.048		0.066	NA	NA	N	SL
	1634-04-4	Methyl tert butyl ether	0.00038	J	0.00056	J	mg/L	MW-12	2 / 57	0.001 - 0.4	0.00056		0.011	0.07	ORSG	N	SL
	75-09-2	**Methylene Chloride**	0.00042	J	2.14		mg/L	MW-4S	8 / 72	0.0005 - 3.8	**2.14**		0.0043	0.005	MCL	Y	SL
	103-65-1	**n-Propylbenzene**	0.00042	J	0.26		mg/L	GP-12	14 / 63	0.00044 - 0.25	**0.26**		0.024	NA	NA	Y	SL
	99-87-6	p-Isopropyltoluene	0.0055	J	0.015	J	mg/L	MW-4S	4 / 62	0.0005 - 0.25	0.015		0.066	NA	NA	N	SL
	100-42-5	**Styrene**	0.24		0.24		mg/L	GP-11	1 / 66	0.0005 - 1	**0.24**		0.16	0.1	MMCL	Y	SL
	104-51-8	n-Butylbenzene	0.00918		0.00918		mg/L	MW-12	1 / 60	0.0005 - 0.25	0.00918		0.024	NA	NA	N	SL
	98-06-6	tert-Butylbenzene	0.0228		0.0228		mg/L	MW-12	1 / 60	0.001 - 1	0.0228		0.024	NA	NA	N	SL
	127-18-4	**Tetrachloroethene**	0.00072		0.017	J	mg/L	MW-4S	3 / 72	0.0005 - 1	**0.017**		0.0001	0.005	MCL	Y	SL
	109-99-9	**Tetrahydrofuran**	0.0025		10		mg/L	GP-13	40 / 57	0.005 - 4	**10**		0.0016	1.3	ORSG	Y	SL
	108-88-3	**Toluene**	0.00053		21		mg/L	GP-13	39 / 76	0.0003 - 0.5	**21**		0.072	1	MCL	Y	SL
	79-01-6	**Trichloroethene**	0.0011		0.076	J	mg/L	MW-4S	9 / 74	0.0005 - 1	**0.076**		0.000028	0.005	MCL	Y	SL
	75-69-4	**Trichlorofluoromethane**	0.00068	J	0.41	J	mg/L	MW-4S	9 / 67	0.001 - 1	**0.41**		0.13	2	EPA Health Advisory - Lifetime	Y	SL
	75-01-4	**Vinyl chloride**	0.001		0.035	J	mg/L	GP-16	4 / 72	0.001 - 1	**0.035**		0.00002	0.002	MCL	Y	SL
	1330-20-7	**Xylenes (total)**	0.00038		0.49		mg/L	GP-12	46 / 76	0.0004 - 0.25	**0.49**		0.021	10	MCL	Y	SL
	95-49-8	o-Chlorotoluene	0.0028	J	0.0028	J	mg/L	GP-14	1 / 60	0.001 - 1	0.0028		0.012	0.1	Health Advisory (Lifetime)	N	SL
	106-46-7	**1,2,4-Trichlorobenzene**	0.0025	J	0.0025	J	mg/L	MW-3B	1 / 73	0.00075 - 2.5	**0.0025**		0.00072	0.07	MMCL	Y	SL

Footnotes:

(1) Summary statistics were calculated from groundwater samples from monitoring wells in Groups 1 and 2 of the site. See Appendix C for wells and sampling events used in risk assessment.

(2) Maximum detected concentration in groundwater was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and constituent retained as COPC.

(3) We conducted a statistical evaluation of site conditions relative to background/reference conditions. See Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tapwater were used as screening toxicity values. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1.

(5) For compounds without MCLs, we used federal health advisories or MADEP Office of Research and Standards Guidelines (OSRG). TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. MCL = Maximum contaminant level.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.

NTX = no toxicity information available.

TABLE 3-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Landfill Ambient Air

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Air
Exposure Medium:	Ambient Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Ambient Air	100-41-4	Ethylbenzene	22	83	ug/m^3	STA 2 (92)	2 / 6	4.407 - 4.407	83	--	110	--	--	N	
	98-82-8	Isopropylbenzene	4	7.8	ug/m^3	STA 2 (92)	2 / 6	4.989 - 4.989	7.8	--	40	--	--	N	
	95-63-6	**1,2,4-Trimethylbenzene**	3	3.0	ug/m^3	STA 2 (92)	1 / 6	4.989 - 4.989	**3**	(N/C) --	0.62	--	--	**Y**	SL
	108-67-8	**1,3,5-Trimethylbenzene**	6.2	9.9	ug/m^3	STA 2 (92)	2 / 6	4.989 - 4.989	**9.9**	--	0.62	--	--	**Y**	SL
	71-43-2	**Benzene**	4	4	ug/m^3	STA 2 (92)	1 / 6	3.243 - 3.243	**4**	--	0.25	--	--	**Y**	SL
	103-65-1	n-Propylbenzene	4	4	ug/m^3	STA 2 (92)	1 / 6	4.989 - 4.989	4	--	15	--	--	N	
	99-87-6	p-Isopropyltoluene	3	3	ug/m^3	STA 2 (92)	1 / 6	5.572 - 5.572	3	--	40	--	--	N	
	108-88-3	Toluene	22	22	ug/m^3	STA 2 (92)	1 / 6	3.825 - 3.825	22	--	40	--	--	N	
	1330-20-7	**Xylenes (total)**	21	92	ug/m^3	STA 2 (92)	2 / 6	13.221 - 13.221	**92**	--	11	--	--	**Y**	SL

Footnotes:

(1) Summary statistics were calculated from ambient air samples STA-1(92) through STA-6(92), collected from Areas 1 and 2 in 1992.

(2) Maximum detected concentration in ambient air was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level.

(3) No constituents were detected in the one background sample collected for the site (STA-7(92)).

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for air were used as screening toxicity values for sediment. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1. No PRG available for p-isopropyltoluene; used value for isopropylbenzene as surrogate.

(5) TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. EPA National Ambient Air Quality Standards (NAAQS) are applicable ARARs for ambient air; however, no NAAQS are available for the constituents detected in ambient air at the site.

(6) SL = Constituent was selected as a COPC if the detected concentration exceeded the screening level or if no screening level is available.

TABLE 3-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 3 - Soil

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 3 Soil	7429-90-5	Aluminum	3900	7400	mg/kg	SB-1 (04)	6/6 100%	4.5-5.1	7400		--			N	NTX
	7440-38-2	**Arsenic**	4.2	6.7	mg/kg	SB-1 (04)	6/6 100%	0.22-0.26	**6.7**	(N/C)	0.39			**Y**	SL
	7440-39-3	Barium	12	35	mg/kg	SB-1 (04)	3/6 50%	0.45-9.9	35		540			N	SL
	7440-43-9	**Cadmium**	0.5	3.8	mg/kg	SB-5 (04)	2/6 33%	0.22-0.26	**3.8**		3.7			**Y**	SL
	7440-47-3	Chromium	7.3	19	mg/kg	SB-5 (04)	6/6 100%	0.45-0.51	19		30			N	SL
	7440-48-4	Cobalt	1.7	4.4	mg/kg	SB-1 (04)	6/6 100%	0.89-1	4.4		900			N	SL
	7440-50-8	Copper	21	25	mg/kg	SB-1 (04)	2/6 33%	0.45-4.5	25		310			N	SL
	7439-89-6	Iron	3100	10000	mg/kg	SB-1 (04)	6/6 100%	2.2-2.6	10000		2300			N	EN
	7439-92-1	**Lead**	4.6	73	mg/kg	SB-1 (04)	3/6 50%	2.2-2.6	**73**		40			**Y**	SL
	7439-95-4	Magnesium	1800	2500	mg/kg	SB-1 (04)	4/6 67%	4.5-1200	2500		NA			N	EN
	7439-96-5	Manganese	38	140	mg/kg	SB-1 (04)	6/6 100%	0.45-0.51	140		180			N	SL
	7439-97-6	Mercury	0.11	0.17	mg/kg	SB-1 (04)	2/6 33%	0.09-0.1	0.17		2.3			N	SL
	7440-02-0	Nickel	4.4	12	mg/kg	SB-1 (04)	6/6 100%	1.1-1.3	12		160			N	SL
	7440-62-2	**Vanadium**	6.1	16	mg/kg	SB-1 (04)	6/6 100%	0.45-0.51	**16**		7.8			**Y**	SL
	7440-66-6	Zinc	25	65	mg/kg	SB-1 (04)	3/6 50%	2.2-16	65		2300			N	SL
	120-12-7	Anthracene	0.43	0.43	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	0.43		2200			N	SL
	56-55-3	**Benzo(a)anthracene**	1.1	1.1	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	**1.1**		0.62			**Y**	SL
	50-32-8	**Benzo(a)pyrene**	1.1	1.1	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	**1.1**		0.062			**Y**	SL
	205-99-2	**Benzo(b)fluoranthene**	0.84	0.84	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	**0.84**		0.62			**Y**	SL
	192-97-2	**Benzo(e)Pyrene**	0.76	0.76	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	**0.76**		0.062			**Y**	SL
	191-24-2	Benzo(g,h,i)perylene	0.8	0.8	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	0.8		500			N	SL
	207-08-9	Benzo(k)fluoranthene	0.96	0.96	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	0.96		6.2			N	SL
	117-81-7	**Bis(2-Ethylhexyl)phthalate**	3.6	1500	mg/kg	SB-6 (04)	5/6 83%	0.85-300	**1500**		35			**Y**	SL
	85-68-7	Butylbenzylphthalate	1.1	2.3	mg/kg	SB-5 (04)	2/6 33%	0.37-7.6	2.3		1200			N	SL
	218-01-9	Chrysene	1.2	1.2	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	1.2		62			N	SL
	117-84-0	**Di-n-octylphthalate**	0.98	1600	mg/kg	SB-6 (04)	5/6 83%	0.43-150	**1600**		240			**Y**	SL
	206-44-0	Fluoranthene	0.37	2.4	mg/kg	SB-1 (04)	2/6 33%	0.37-7.6	2.4		230			N	SL
	193-39-5	**Indeno(1,2,3-cd)Pyrene**	0.72	0.72	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	**0.72**		0.62			**Y**	SL
	91-20-3	**Naphthalene**	0.024 J	100	mg/kg	SB-6 (04)	6/7 86%	0.0035-49	**100**		5.6			**Y**	SL
	85-01-8	Phenanthrene	1.6	1.6	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	1.6		350			N	SL
	129-00-0	Pyrene	2.1	2.1	mg/kg	SB-1 (04)	1/6 17%	0.37-7.6	2.1		230			N	SL
	71-55-6	1,1,1-Trichloroethane	420	420	mg/kg	SB-6 (04)	1/6 17%	0.0007-9.8	420		1200			N	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.0098 J	590	mg/kg	SB-6 (04)	5/6 83%	0.0035-49	**590**		5.2			**Y**	SL
	108-67-8	**1,3,5-Trimethylbenzene**	2.4	200	mg/kg	SB-6 (04)	4/6 67%	0.0035-49	**200**		2.1			**Y**	SL
	67-64-1	Acetone	0.0083	0.024 J	mg/kg	SB-1 (04)	2/6 33%	0.007-98	0.024		1400			N	SL
	71-43-2	Benzene	0.0035	0.0035	mg/kg	SB-1 (04)	1/6 17%	0.0007-9.8	0.0035		0.64			N	SL
	100-41-4	Ethylbenzene	0.0018 J	400	mg/kg	SB-6 (04)	5/6 83%	0.0007-9.8	400		400			N	SL
	98-82-8	Isopropylbenzene	0.00094 J	39	mg/kg	SB-6 (04)	5/6 83%	0.0007-9.8	39		57			N	SL
	104-51-8	n-Butylbenzene	0.013 J	54	mg/kg	SB-6 (04)	5/6 83%	0.0007-9.8	54		240			N	SL
	103-65-1	n-Propylbenzene	0.0012 J	82	mg/kg	SB-6 (04)	5/6 83%	0.0007-9.8	82		240			N	SL
	99-87-6	p-Isopropyltoluene	0.0024 J	26	mg/kg	SB-6 (04)	5/6 83%	0.0007-9.8	26		57			N	SL
	127-18-4	**Tetrachloroethene**	27	27	mg/kg	SB-6 (04)	1/6 17%	0.0007-9.8	**27**		0.48			**Y**	SL
	108-88-3	**Toluene**	0.0025	710	mg/kg	SB-6 (04)	5/6 83%	0.001-15	**710**		520			**Y**	SL
	1330-20-7	**Xylenes (total)**	0.0041 J	1500	mg/kg	SB-6 (04)	5/6 83%	0.0007-9.8	**1500**		27			**Y**	SL

Footnotes:

(1) Summary statistics were calculated from soil samples collected within the 0-12' depth interval (includes: SB-1(04) (4'-5'), SB-1(04) (5'-6'), SB-2(04) (6'-8'), SB-2(04) (8'-10'), SB-2(04) (10'-12'), SB-3(04) (0'-2'), SB-3(04) (4'-6'), SB-4(04) (5'-7'), SB-4(04) (7'-8'), SB-5(04) (2'-4'), SB-5(04) (4'-6'), SB-6(04) (4'-5') and SB-6(04) (5'-7').) J = estimated value. EB = equipment blank contamination.

(2) Maximum detected concentration in upland soil from Group 3 was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and was retained as a COPC.

(3) We conducted a statistical evaluation of Site and background/reference concentrations. See Appendix D.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for residential soil were considered as screening toxicity values for soil. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1. For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 S-1/GW-1 soil standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) ARAR =Applicable or relevant and appropriate requirements. TBC = To be considered. No ARARs/TBCs were identified for soils.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeded the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient. NTX = no toxicity information available.

TABLE 3-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 3 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 3	7429-90-5	Aluminum, Total	0.019	J	1		mg/L	GP-24	13 / 17	0.0075 - 0.13	1		--	NA	NA	N	NTX
	7440-38-2	**Arsenic, Total**	0.0056		0.58		mg/L	MW-7M	17 / 20	0.0025 - 0.005	**0.58**	(N/C)	0.000045	0.01	MCL	Y	SL
	7440-39-3	**Barium, Total**	0.03		0.3		mg/L	MW-7M	17 / 17	0.0025 - 0.01	**0.3**		0.26	2	MCL	Y	SL
	7440-41-7	Beryllium, Total	0.0004	J	0.004	J	mg/L	MW-9	4 / 17	0.0004 - 0.003	0.004		0.0073	0.004	MCL	N	SL
	7440-43-9	**Cadmium, Total**	0.0005	J	0.002		mg/L	GP-25	8 / 20	0.0001 - 0.002	**0.002**		0.0018	0.005	MCL	Y	SL
	7440-70-2	Calcium, Total	27		366		mg/L	MW-16B	17 / 17	0.025 - 0.1	366		NA	NA	NA	N	EN
	7440-47-3	Chromium, Total	0.002	J	0.007	J	mg/L	MW-9	4 / 15	0.0025 - 0.01	0.007		0.011	0.1	MCL	N	SL
	7440-48-4	**Cobalt, Total**	0.001	J	0.14		mg/L	MW-9	11 / 17	0.0025 - 0.01	**0.14**		0.073	NA	NA	Y	SL
	7440-50-8	Copper, Total	0.003	J	0.1		mg/L	MW-7M	4 / 17	0.0025 - 0.01	0.1		0.15	1.3	MCL	N	SL
	7439-89-6	Iron, Total	0.0541		280		mg/L	MW-9	22 / 23	0.023 - 0.05	280		1.1	0.3	SMCL	N	EN
	7439-92-1	Lead, Total	0.0058	J	0.0058	J	mg/L	MW-7M	1 / 20	0.0015 - 0.01	0.0058		0.015	0.015	MCL	N	SL
	7439-95-4	Magnesium, Total	0.83		48		mg/L	GP-25	20 / 20	0.025 - 0.1	48		NA	NA	NA	N	EN
	7439-96-5	**Manganese, Total**	0.02		29		mg/L	MW-9	20 / 20	0.0025 - 0.01	**29**		0.088	0.05	SMCL	Y	SL
	7439-97-6	Mercury, Total	0.00002	J	0.00007	J	mg/L	MW-7S	4 / 17	0.0002 - 0.0002	0.00007		0.0011	0.002	MCL	N	SL
	7440-02-0	**Nickel, Total**	0.0033	J	0.058		mg/L	MW-9	10 / 17	0.0025 - 0.025	0.058		0.073	0.1	ORSG	N	SL
	7440-09-7	Potassium, Total	3.1		73		mg/L	MW-7M	17 / 17	0.15 - 2.5	73		NA	NA	NA	N	EN
	7440-22-4	**Silver, Total**	0.0012	J	0.0014	J	mg/L	MW-9	3 / 17	0.0007 - 0.007	0.0014		0.018	0.1	SMCL	N	SL
	7440-23-5	Sodium, Total	14		137		mg/L	MW-10	17 / 17	0.15 - 20	137		NA	20	ORSG	N	EN
	7440-28-0	Thallium, Total	0.00005	B	0.00005	B	mg/L	MW-10	1 / 17	0.00005 - 0.025	0.00005		0.00024	0.002	MCL	N	SL
	7440-62-2	**Vanadium, Total**	0.001	J	0.01		mg/L	MW-9	10 / 17	0.0025 - 0.01	**0.01**		0.0036	NA	NA	Y	SL
	7440-66-6	Zinc, Total	0.013	J	0.044	J	mg/L	MW-7M	7 / 17	0.0025 - 0.05	0.044		1.1	5	SMCL	N	SL
	11097-69-1	**Aroclor 1254**	0.0012	J	0.0012	J	mg/L	MW-16D	1 / 3	0.0002 - 0.0002	**0.0012**		0.000034	NA	NA	Y	SL
	120-82-1	1,2,4-Trichlorobenzene	0.0004	J	0.0004	J	mg/L	GP-25	1 / 24	0.001 - 12	0.0004		0.00072	0.07	MMCL	N	SL
	95-50-1	1,2-Dichlorobenzene	0.00027	J	0.00036	J	mg/L	GP-25	2 / 24	0.001 - 12	0.00036		0.037	0.6	MCL	N	SL
	106-46-7	**1,4-Dichlorobenzene**	0.0011	J	0.0012	J	mg/L	GP-25	2 / 24	0.001 - 12	**0.0012**		0.0005	0.005	MCL	Y	SL
	105-67-9	**2,4-Dimethylphenol**	0.16		0.18		mg/L	MW-7M	2 / 16	0.0053 - 2.1	**0.18**		0.073	NA	NA	Y	SL
	95-48-7	**2-Methylphenol**	0.43		1	J	mg/L	MW-9	6 / 16	0.0053 - 1.3	**1**		0.18	NA	NA	Y	SL
	108-39-4/106-44-5	**3-Methylphenol/4-Methylphenol**	0.04		2.1		mg/L	MW-9	7 / 13	0.006 - 1.3	**2.1**		0.018	NA	NA	Y	SL
	65-85-0	Benzoic acid	3.3	J	5.2	J	mg/L	MW-9	6 / 13	0.05 - 10	5.2		15	NA	NA	N	SL
	117-81-7	**Bis(2-Ethylhexyl)phthalate**	0.61		0.61		mg/L	MW-9	1 / 16	0.00013 - 1	**0.61**		0.0048	0.006	MCL	Y	SL
	131-11-3	Dimethyl phthalate	0.08	J	0.08	J	mg/L	MW-9	1 / 16	0.005 - 1	0.08		360	NA	NA	N	SL
	91-20-3	**Naphthalene**	0.00049	J	0.011		mg/L	MW-7M	3 / 24	0.001 - 12	**0.011**		0.00062	0.14	ORSG	Y	SL
	108-95-2	**Phenol**	5		9.4		mg/L	MW-9	6 / 16	0.0053 - 1.5	**9.4**		1.1	2	EPA Health Advisory - Lifetime	Y	SL
	71-55-6	1,1,1-Trichloroethane	0.00058		0.00058		mg/L	MW-10	1 / 24	0.0005 - 2.5	0.00058		0.32	0.2	MCL	N	SL
	75-34-3	1,1-Dichloroethane	0.00023	J	0.0028		mg/L	MW-7S	9 / 24	0.00075 - 3.8	0.0028		0.081	0.07	ORSG	N	SL
	75-35-4	1,1-Dichloroethene	0.0004	J	0.0015		mg/L	MW-10	2 / 24	0.0005 - 2.5	0.0015		0.034	0.007	MCL	N	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.6		1.4		mg/L	MW-7M	5 / 24	0.001 - 12	**1.4**		0.0012	NA	NA	Y	SL

TABLE 3-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 3 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 3 Groundwater	107-06-2	**1,2-Dichloroethane**	0.00038	J	0.00038	J	mg/L	GP-25	1 / 24	0.0005 - 2.5	**0.00038**	(N/C)	0.00012	0.005	MCL	Y	SL
	540-59-0	cis-1,2-Dichloroethene	0.00024	J	0.0014		mg/L	GP-25	5 / 24	0.0005 - 2.5	0.0014		0.0061	0.07	MCL	N	SL
	78-87-5	**1,2-Dichloropropane**	0.00035	J	0.00035	J	mg/L	GP-25	1 / 24	0.001 - 8.8	**0.00035**		0.00016	0.005	MCL	Y	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.35		0.42		mg/L	MW-7M	2 / 24	0.001 - 12	**0.42**		0.0012	NA	NA	Y	SL
	123-91-1	**1,4-Dioxane**	0.0016	J	3	J	mg/L	MW-9	15 / 24	0.005 - 10	**3**		0.0061	0.003	ORSG	Y	SL
	78-93-3	**2-Butanone**	52		77		mg/L	MW-9	6 / 24	0.005 - 25	**77**		0.7	4	ORSG	Y	SL
	108-10-1	**4-Methyl-2-pentanone**	0.086	J	190		mg/L	MW-9	7 / 24	0.005 - 25	**190**		0.2	0.35	ORSG	Y	SL
	67-64-1	**Acetone**	40	UJ	73		mg/L	MW-9	6 / 24	0.005 - 25	**73**		0.55	6.3	ORSG	Y	SL
	71-43-2	**Benzene**	0.00014	J	0.0036		mg/L	GP-25	4 / 24	0.0005 - 2.5	**0.0036**		0.00035	0.005	MCL	Y	SL
	75-15-0	Carbon disulfide	0.00065	J	0.00065	J	mg/L	GP-25	1 / 24	0.005 - 25	0.00065		0.1	NA	NA	N	SL
	108-90-7	Chlorobenzene	0.0002	J	0.0042		mg/L	GP-25	3 / 24	0.0005 - 2.5	0.0042		0.011	0.1	MCL	N	SL
	75-00-3	**Chloroethane**	0.0018		2.3		mg/L	MW-7M	3 / 24	0.001 - 5	**2.3**		0.0046	NA	NA	Y	SL
	74-87-3	Chloromethane	0.0005		0.0005		mg/L	MW-16B	1 / 24	0.001 - 12	0.0005		0.016	0.03	Health Advisory (Lifetime)	N	SL
	75-71-8	Dichlorodifluoromethane	0.012		0.012		mg/L	MW-10	1 / 24	0.001 - 25	0.012		0.039	1.4	ORSG	N	SL
	60-29-7	Ethyl Ether	0.00042	J	0.019		mg/L	GP-25	6 / 24	0.0025 - 12	0.019		0.12	NA	NA	N	SL
	100-41-4	**Ethylbenzene**	1.3		8.4		mg/L	MW-9	8 / 24	0.0005 - 2.5	**8.4**		0.13	0.7	MCL	Y	SL
	98-82-8	Isopropylbenzene	0.00011	J	0.057		mg/L	MW-7M	5 / 24	0.0005 - 2.5	0.057		0.066	NA	NA	N	SL
	1634-04-4	Methyl tert butyl ether	0.00083	J	0.005		mg/L	GP-23	3 / 24	0.001 - 5	0.005		0.011	0.07	ORSG	N	SL
	75-09-2	**Methylene Chloride**	2.2		2.2		mg/L	MW-9	1 / 24	0.001 - 25	**2.2**		0.0043	0.005	MCL	Y	SL
	103-65-1	**n-Propylbenzene**	0.082		0.082		mg/L	MW-7M	1 / 24	0.0005 - 2.5	**0.082**		0.024	NA	NA	Y	SL
	135-98-8	sec-Butylbenzene	0.00007	J	0.00007	J	mg/L	MW-10	1 / 24	0.0005 - 2.5	0.00007		0.024	NA	NA	N	SL
	127-18-4	**Tetrachloroethene**	0.00022	J	0.00022	J	mg/L	MW-16D	1 / 24	0.0005 - 2.5	**0.00022**		0.0001	0.005	MCL	Y	SL
	109-99-9	**Tetrahydrofuran**	0.002	J	20	J	mg/L	MW-9	13 / 20	0.01 - 50	**20**		0.0016	1.3	ORSG	Y	SL
	108-88-3	**Toluene**	0.00032	J	78		mg/L	MW-9	9 / 24	0.00075 - 3.8	**78**		0.072	1	MCL	Y	SL
	79-01-6	**Trichloroethene**	0.0001	J	0.00039	J	mg/L	GP-24	2 / 24	0.0005 - 2.5	**0.00039**		0.000028	0.005	MCL	Y	SL
	75-69-4	Trichlorofluoromethane	0.00033	J	0.00033	J	mg/L	MW-16D	2 / 24	0.001 - 12	0.00033		0.13	2	EPA Health Advisory - Lifetime	N	SL
	75-01-4	**Vinyl chloride**	0.00044	J	0.00044	J	mg/L	GP-25	1 / 24	0.001 - 5	**0.00044**		0.00002	0.002	MCL	Y	SL
	1330-20-7	**Xylenes (total)**	0.00043		28.2		mg/L	MW-9	10 / 24	0.0005 - 2.5	**28.2**		0.021	10	MCL	Y	SL
	7440-36-0	**Antimony, Total**	0.0038	J	0.0038	J	mg/L	MW-9	1 / 17	0.001 - 0.006	**0.0038**		0.0015	0.006	MCL	Y	SL
	7782-49-2	Selenium	0.01		0.012		mg/L	MW-9	2 / 17	0.0025 - 0.005	0.012		0.018	0.05	MCL	N	SL
	107-13-1	**Acrylonitrile**	0.8	J	1.3	J	mg/L	MW-9	3 / 24	0.005 - 25	**1.3**		0.000039	NA	NA	Y	SL
	97-63-2	**Ethyl Methacrylate**	4	J	4	J	mg/L	MW-9	1 / 24	0.005 - 25	**4**		0.055	NA	NA	Y	SL
	99-87-6	**p-Isopropyltoluene**	0.096		0.096		mg/L	MW-7M	1 / 24	0.0005 - 2.5	**0.096**		0.066	NA	NA	Y	SL

Footnotes:

(1) Summary statistics were calculated from groundwater samples from monitoring wells in Group 3 of the site. See Appendix C for wells and sampling events used in risk assessment.

(2) Maximum detected concentration in groundwater was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and constituent retained as COPC.

(3) We conducted a statistical evaluation of site conditions relative to background/reference conditions. See Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tapwater were used as screening toxicity values. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1.

(5) For compounds without MCLs, we used federal health advisories or MADEP Office of Research and Standards Guidelines (OSRG). TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. MCL = Maximum contaminant level.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level was available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.

NTX = no toxicity information available.

TABLE 3-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 4 - Soil

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 4	7429-90-5	Aluminum	3910	J	8100		mg/kg	SB-10 (04)	13/13	100%	4.4-4.8	8100		--			N	NTX
Soil	7440-38-2	**Arsenic**	4.2	J	9.4		mg/kg	SO-05 (99)	11/13	85%	0.22-3.6	**9.4**		0.39			Y	SL
	7440-39-3	Barium	14		60.5	J	mg/kg	SO-07 (99)	13/13	100%	0.44-0.48	60.5	(N/C)	540			N	SL
	7440-41-7	Beryllium	0.2	J	0.34	J	mg/kg	SO-05 (99)	9/13	69%	0.22-0.24	0.34		15			N	SL
	7440-43-9	Cadmium	0.23	J	0.91		mg/kg	SB-8 (04)	7/13	54%	0.1-0.24	0.91		3.7			N	SL
	7440-70-2	Calcium	318	J	8500		mg/kg	SB-8 (04)	10/13	77%	4.5-1900	8500		NA			N	EN
	7440-47-3	Chromium	7.5	J	28.3	J	mg/kg	SO-05 (99)	13/13	100%	0.44-0.48	28.3		30			N	SL
	7440-48-4	Cobalt	2	J	5.9	J	mg/kg	SO-07 (99)	13/13	100%	0.89-0.97	5.9		900			N	SL
	7440-50-8	Copper	6.7	J	88.3	J	mg/kg	SO-01 (99)	13/13	100%	0.44-0.48	88.3		310			N	SL
	7439-89-6	Iron	6740	J	22000	J	mg/kg	SO-10 (99)	13/13	100%	2.2-2.4	22000		2300			N	EN
	7439-92-1	**Lead**	8	J	233	J	mg/kg	SO-01 (99)	13/13	100%	2.2-2.4	**233**		40			Y	SL
	7439-95-4	Magnesium	1060	J	3000		mg/kg	SB-8 (04)	12/13	92%	4.5-1200	3000		NA			N	EN
	7439-96-5	**Manganese**	70.5	J	224	J	mg/kg	SO-10 (99)	13/13	100%	0.44-0.48	**224**		180			Y	SL
	7439-97-6	Mercury	0.13		0.29		mg/kg	SB-8 (04)	3/13	23%	0.05-0.13	0.29		2.3			N	SL
	7440-02-0	Nickel	5.8	J	23.2	J	mg/kg	SO-07 (99)	13/13	100%	1.1-1.2	23.2		160			N	SL
	7440-09-7	Potassium	399	J	1070	J	mg/kg	SO-07 (99)	9/13	69%	440-1500	1070		NA			N	EN
	7440-22-4	Silver	0.42	J	1.1	J	mg/kg	SO-10 (99)	8/13	62%	0.29-0.48	1.1		39			N	SL
	7440-62-2	**Vanadium**	9.2	J	19		mg/kg	SB-8 (04)	13/13	100%	0.44-0.48	**19**		7.8			Y	SL
	7440-66-6	Zinc	19.8	J	379	J	mg/kg	SO-07 (99)	13/13	100%	2.2-2.4	379		2300			N	SL
	12672-29-6	Aroclor 1248	0.019	J	0.11		mg/kg	SO-06 (99)	5/13	38%	0.034-0.438	0.11		0.22			N	SL
	11097-69-1	Aroclor 1254	0.119		0.119		mg/kg	SB-10 (04)	1/13	8%	0.034-0.438	0.119		0.22			N	SL
	11096-82-5	Aroclor 1260	0.012	J	0.096		mg/kg	SO-04 (99)	8/13	62%	0.034-0.438	0.096		0.22			N	SL
	72-54-8	4,4'-DDD	0.0016	J	1.08		mg/kg	SB-8 (04)	8/13	62%	0.0029-0.702	1.08		2.4			N	SL
	72-55-9	4,4'-DDE	0.00048	J	0.0086		mg/kg	SO-04 (99)	7/13	54%	0.00048-0.702	0.0086		1.7			N	SL
	50-29-3	4,4'-DDT	0.014	J	0.014	J	mg/kg	SO-07 (99)	1/6	17%	0.0029-0.702	0.014		1.7			N	SL
	309-00-2	Aldrin	0.00041	J	0.00041	J	mg/kg	SO-10 (99)	1/12	8%	0.00145-0.351	0.00041		0.029			N	SL
	5103-71-9	alpha-Chlordane	0.002	J	0.002	J	mg/kg	SO-10 (99)	1/7	14%	0.0018-0.0019	0.002		1.6			N	SL
	319-86-8	Delta-BHC	0.0014	J	0.0014	J	mg/kg	SO-09 (99)	1/13	8%	0.00145-0.351	0.0014		0.09			N	SL
	60-57-1	Dieldrin	0.0011	J	0.0056	J	mg/kg	SO-09 (99)	5/13	38%	0.0029-0.702	0.0056		0.03			N	SL
	33213-65-9	Endosulfan II	0.0013	J	0.0013	J	mg/kg	SO-08 (99)	1/13	8%	0.0029-0.702	0.0013		37			N	SL
	72-20-8	Endrin	0.00088	J	0.0062	J	mg/kg	SO-09 (99)	3/11	27%	0.0029-0.702	0.0062		1.8			N	SL
	7421-93-4	Endrin aldehyde	0.00092	J	0.0021	J	mg/kg	SO-06 (99)	4/10	40%	0.0029-0.702	0.0021		1.8			N	SL
	72-43-5	Methoxychlor	0.0046	J	0.017	J	mg/kg	SO-09 (99)	5/13	38%	0.0145-3.51	0.017		31			N	SL
	--	**C11-C22 Aromatic Hydrocarbons**	13		130		mg/kg	SO-05 (99)	7/9	78%	8.5-9	**130**		100			Y	SL
	--	C19-C36 Aliphatic Hydrocarbons	64		820		mg/kg	SO-05 (99)	8/9	89%	4-4.2	820		1250			N	SL
	--	C9-C10 Aromatic Hydrocarbons	12		12		mg/kg	SO-09 (99)	1/9	11%	7.6-15	12		50			N	SL
	120-82-1	1,2,4-Trichlorobenzene	0.054	J	0.56		mg/kg	SO-07 (99)	3/16	19%	0.0035-4.4	0.56		6.2			N	SL
	90-12-0	**1-Methylnaphthalene**	12		12		mg/kg	SB-8 (04)	1/4	25%	0.36-4.4	**12**		5.6			Y	SL
	108-60-1	2,2'-Oxybis(1-chloropropane)	0.34	J	0.34	J	mg/kg	SO-07 (99)	1/9	11%	0.34-0.37	0.34		2.9			N	SL
	88-06-2	2,4,6-Trichlorophenol	0.043	J	0.39		mg/kg	SO-07 (99)	2/13	15%	0.34-4.4	0.39		0.61			N	SL
	120-83-2	2,4-Dichlorophenol	0.28	J	0.28	J	mg/kg	SO-07 (99)	1/13	8%	0.34-8.8	0.28		18			N	SL
	105-67-9	2,4-Dimethylphenol	0.089	J	0.089	J	mg/kg	SO-07 (99)	1/13	8%	0.34-8.8	0.089		120			N	SL
	51-28-5	2,4-Dinitrophenol	0.068	J	0.068	J	mg/kg	SO-07 (99)	1/13	8%	0.85-18	0.068		12			N	SL
	606-20-2	2,6-Dinitrotoluene	0.22	J	0.22	J	mg/kg	SO-07 (99)	1/13	8%	0.34-4.4	0.22		6.1			N	SL
	91-58-7	2-Chloronaphthalene	0.19	J	0.19	J	mg/kg	SO-07 (99)	1/13	8%	0.014-5.3	0.19		490			N	SL
	95-57-8	2-Chlorophenol	0.44		0.44		mg/kg	SO-07 (99)	1/13	8%	0.34-5.3	0.44		6.3			N	SL
	91-57-6	**2-Methylnaphthalene**	0.27		17		mg/kg	SB-8 (04)	2/13	15%	0.34-7	**17**		5.6			Y	SL
	88-75-5	2-Nitrophenol	0.28	J	0.28	J	mg/kg	SO-07 (99)	1/13	8%	0.34-18	0.28		18			N	SL
	91-94-1	3,3'-Dichlorobenzidine	0.34		0.34		mg/kg	SO-08 (99)	1/13	8%	0.34-44	0.34		1.1			N	SL
	534-52-1	4,6-Dinitro-2-methylphenol	0.25	J	0.25	J	mg/kg	SO-07 (99)	1/9	11%	0.85-0.93	0.25		0.61			N	SL
	35421-08-0	**4-Chloro-3-methylphenol**	0.038	J	0.37		mg/kg	SO-07 (99)	2/9	22%	0.34-0.37	**0.37**		NA			Y	SL
	100-02-7	4-Nitrophenol	0.22	J	0.22	J	mg/kg	SO-07 (99)	1/13	8%	0.35-8.8	0.22		23			N	SL
	83-32-9	Acenaphthene	0.053	J	25		mg/kg	SB-8 (04)	4/13	31%	0.34-4.4	25		370			N	SL

TABLE 3-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 4 - Soil

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 4 Soil	120-12-7	Anthracene	0.035	J	54		mg/kg	SB-8 (04)	7/13	54%	0.34-4.4	54		2200			N	SL
	56-55-3	**Benzo(a)anthracene**	0.046	J	45		mg/kg	SB-8 (04)	10/13	77%	0.34-4.4	**45**		0.62			Y	SL
	50-32-8	**Benzo(a)pyrene**	0.042	J	27		mg/kg	SB-8 (04)	10/13	77%	0.18-4.4	**27**	(N/C)	0.062			Y	SL
	205-99-2	**Benzo(b)fluoranthene**	0.066	J	19		mg/kg	SB-8 (04)	10/13	77%	0.34-4.4	**19**		0.62			Y	SL
	192-97-2	**Benzo(e)Pyrene**	0.63		17		mg/kg	SB-8 (04)	2/4	50%	0.36-4.4	**17**		0.062			Y	SL
	191-24-2	Benzo(g,h,i)perylene	0.042	J	11		mg/kg	SB-8 (04)	10/13	77%	0.25-4.4	11		500			N	SL
	207-08-9	**Benzo(k)fluoranthene**	0.08	J	24		mg/kg	SB-8 (04)	8/13	62%	0.08-4.4	**24**		6.2			Y	SL
	92-52-4	Biphenyl	4.4		4.4		mg/kg	SB-8 (04)	1/4	25%	0.36-4.4	4.4		300			N	SL
	111-91-1	**Bis(2-chloroethoxy)methane**	0.054	J	0.49		mg/kg	SO-07 (99)	2/13	15%	0.34-4.4	**0.49**		NA			Y	SL
	117-81-7	Bis(2-Ethylhexyl)phthalate	0.066	J EB	1.3	EB	mg/kg	SO-09 (99)	9/13	69%	0.34-8.8	1.3		35			N	SL
	85-68-7	Butylbenzylphthalate	0.051	J	0.66		mg/kg	SO-07 (99)	6/13	46%	0.34-4.4	0.66		1200			N	SL
	86-74-8	**Carbazole**	0.086	J	26		mg/kg	SB-8 (04)	3/13	23%	0.34-4.4	**26**		24			Y	SL
	218-01-9	Chrysene	0.05	J	43		mg/kg	SB-8 (04)	10/13	77%	0.34-4.4	43		62			N	SL
	53-70-3	**Dibenzo(a,h)anthracene**	0.068	J	4.5		mg/kg	SB-8 (04)	5/13	38%	0.34-4.4	**4.5**		0.062			Y	SL
	132-64-9	**Dibenzofuran**	0.044	J	24		mg/kg	SB-8 (04)	3/13	23%	0.34-4.4	**24**		15			Y	SL
	84-66-2	Diethyl phthalate	0.09	J	0.56		mg/kg	SO-07 (99)	3/13	23%	0.34-4.4	0.56		4900			N	SL
	131-11-3	Dimethyl phthalate	0.051	J	0.46		mg/kg	SO-07 (99)	3/13	23%	0.34-4.4	0.46		100000			N	SL
	84-74-2	Di-n-butylphthalate	0.037	J	0.43		mg/kg	SO-07 (99)	4/13	31%	0.34-4.4	0.43		610			N	SL
	117-84-0	Di-n-octylphthalate	0.099	J	0.56		mg/kg	SO-09 (99)	3/13	23%	0.34-4.4	0.56		240			N	SL
	206-44-0	Fluoranthene	0.083	J	100		mg/kg	SB-8 (04)	11/13	85%	0.34-4.4	100		230			N	SL
	86-73-7	Fluorene	0.073	J	37		mg/kg	SB-8 (04)	3/13	23%	0.34-4.4	37		270			N	SL
	118-74-1	Hexachlorobenzene	0.22	J	0.22	J	mg/kg	SO-07 (99)	1/13	8%	0.34-4.4	0.22		0.3			N	SL
	87-68-3	Hexachlorobutadiene	0.05	J	0.55		mg/kg	SO-07 (99)	3/16	19%	0.0035-8.8	0.55		6.2			N	SL
	67-72-1	Hexachloroethane	0.13	J	0.13	J	mg/kg	SO-07 (99)	1/13	8%	0.34-4.4	0.13		35			N	SL
	193-39-5	**Indeno(1,2,3-cd)Pyrene**	0.11	J	10		mg/kg	SB-8 (04)	9/13	69%	0.2-4.4	**10**		0.62			Y	SL
	78-59-1	Isophorone	0.044	J	0.31	J	mg/kg	SO-07 (99)	2/13	15%	0.34-4.4	0.31		510			N	SL
	91-20-3	**Naphthalene**	0.0077	J	19		mg/kg	SB-8 (04)	6/16	38%	0.0035-4.4	**19**		5.6			Y	SL
	98-95-3	Nitrobenzene	0.26	J	0.26	J	mg/kg	SO-07 (99)	1/13	8%	0.34-4.4	0.26		2			N	SL
	87-86-5	Pentachlorophenol	0.18	J	0.18	J	mg/kg	SO-07 (99)	1/13	8%	0.85-18	0.18		3			N	SL
	198-55-0	Perylene	5.1		5.1		mg/kg	SB-8 (04)	1/4	25%	0.36-4.4	5.1		5.6			N	SL
	85-01-8	Phenanthrene	0.05	J	160		mg/kg	SB-8 (04)	11/13	85%	0.34-4.4	160		350			N	SL
	108-95-2	Phenol	0.048	J EB	0.24	J EB	mg/kg	SO-07 (99)	2/13	15%	0.34-6.1	0.24		1800			N	SL
	129-00-0	Pyrene	0.09	J	93		mg/kg	SB-8 (04)	11/13	85%	0.34-4.4	93		230			N	SL
	57-12-5	Cyanide	0.17	J	1.6	J	mg/kg	SO-01 (99)	9/9	100%	-	1.6		120			N	SL
	78-93-3	2-Butanone	0.025		0.12	J	mg/kg	SB-10 (04)	2/13	15%	0.007-1.2	0.12		2200			N	SL
	67-64-1	Acetone	0.022	J	0.33	J	mg/kg	SB-10 (04)	8/13	62%	0.007-1.2	0.33		1400			N	SL
	71-43-2	Benzene	0.0044	J	0.028		mg/kg	SO-10 (99)	3/13	23%	0.0007-0.38	0.028		0.64			N	SL
	75-15-0	Carbon disulfide	0.001	J	0.001	J	mg/kg	SO-05 (99)	1/12	8%	0.005-1.2	0.001		36			N	SL
	100-41-4	Ethylbenzene	0.0008	J	0.7		mg/kg	SB-8 (04)	4/13	31%	0.0007-0.38	0.7		400			N	SL
	98-82-8	Isopropylbenzene	0.015	J	0.21		mg/kg	SB-8 (04)	2/4	50%	0.0007-0.12	0.21		57			N	SL
	104-51-8	n-Butylbenzene	0.54		0.54		mg/kg	SB-8 (04)	1/3	33%	0.0007-0.12	0.54		240			N	SL
	103-65-1	n-Propylbenzene	0.005	J	0.24		mg/kg	SB-8 (04)	2/4	50%	0.0007-0.12	0.24		240			N	SL
	99-87-6	p-Isopropyltoluene	0.27		0.27		mg/kg	SB-8 (04)	1/3	33%	0.0007-0.12	0.27		57			N	SL
	100-42-5	Styrene	0.74		0.74		mg/kg	SB-8 (04)	1/12	8%	0.0007-0.12	0.74		1700			N	SL
	108-88-3	Toluene	0.0006	J	0.23		mg/kg	SB-8 (04)	6/13	46%	0.001-1.1	0.23		520			N	SL
	1330-20-7	Xylenes (total)	0.0028	J	0.96		mg/kg	SB-8 (04)	4/13	31%	0.0007-0.12	0.96		27			N	SL

Footnotes:

(1) Summary statistics were calculated from soil samples collected within the 0-10' depth interval. Includes: SO-1(99) (0'-0.5'), SO-2(99) (0'-0.5'), SO-4(99) (0'-0.5'), SO-5(99) (0'-0.5'), SO-6(99) (0'-0.5'), SO-7(99) (0'-0.5'), SO-8(99) (0'-0.5'), SO-9(99) (0'-0.5'), SO-10(99) (0'-0.5'), SB-7(04) (0.5'-1'), SB-7(04) (1.5'-2'), SB-7(04) (2'-2.5'), SB-8(04) (2.5'), SB-8(04) (2'-2.5'), SB-8(04) (2.5'-3'), SB-9(04) (2.8'), SB-9(04) (2.5'-3.5'), SB-10(04) (1.5'-2'), SB-10(04) (4'-5') and SB-10(04) (7.5'). J = estimated value. EB = equipment blank contamination.

(2) Maximum detected concentration in upland soil from Group 4 was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and was retained as a COPC.

(3) We conducted a statistical evaluation of Site and background/reference concentrations. See Appendix D.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for residential soil were considered as screening toxicity values for soil. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1. For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 S-1/GW-1 soil standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) ARAR =Applicable or relevant and appropriate requirements. TBC = To be considered. No ARARs/TBCs were identified for soils.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeded the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient. NTX = no toxicity information available.

TABLE 3-6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 4 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (6)	COPC Flag (Y/N)	Rationale for Selection or Deletion (7)
Group 4 Groundwater	57-12-5	Cyanide, Total	0.0024		0.0104		mg/L	WES-06	4 / 5	0.0009 - 0.0009	0.0104		0.073	0.2	MCL	N	SL
	7429-90-5	Aluminum, Total	0.0000269		2.34		mg/L	WES-06	11 / 11	0.0075 - 0.1	2.34	(N/C)	--	NA	NA	N	NTX
	7440-38-2	**Arsenic, Total**	0.0000195		0.43		mg/L	MW-1S	7 / 14	0.0025 - 0.05	**0.43**		0.000045	0.01	MCL	Y	SL
	7440-39-3	Barium, Total	0.004	J	0.14		mg/L	WED-07	9 / 11	0.0023 - 0.01	0.14		0.26	2	MCL	N	SL
	7440-41-7	**Beryllium, Total**	0.56		0.56		mg/L	MW-1S	1 / 14	0.0001 - 0.003	**0.56**		0.0073	0.004	MCL	Y	SL
	7440-43-9	**Cadmium, Total**	0.025		0.025		mg/L	MW-1S	1 / 14	0.0001 - 0.005	**0.025**		0.0018	0.005	MCL	Y	SL
	7440-70-2	Calcium, Total	0.0282		140		mg/L	WED-07	11 / 11	0.025 - 0.1	140		NA	NA	NA	N	EN
	7440-48-4	Cobalt, Total	0.003	J	0.009		mg/L	DEP-4	2 / 11	0.0006 - 0.01	0.009		0.073	NA	NA	N	SL
	7440-50-8	Copper, Total	0.003	J	0.04		mg/L	MW-1S	2 / 14	0.002 - 0.0121	0.04		0.15	1.3	MCL	N	SL
	7439-89-6	Iron, Total	0.11		26		mg/L	WES-06	9 / 11	0.025 - 0.05	26		1.1	0.3	SMCL	N	EN
	7439-92-1	**Lead, Total**	0.0059		0.06		mg/L	MW-1S	2 / 14	0.001 - 0.02	**0.06**		0.015	0.015	MCL	Y	SL
	7439-95-4	Magnesium, Total	0.00259		32		mg/L	WED-07	11 / 11	0.025 - 0.1	32		NA	NA	NA	N	EN
	7439-96-5	**Manganese, Total**	0.0000595		3.71	J	mg/L	DEP-4	11 / 11	0.0025 - 0.01	**3.71**		0.088	0.05	SMCL	Y	SL
	7440-02-0	**Nickel, Total**	0.0026	B	0.08		mg/L	MW-1S	6 / 14	0.0007 - 0.025	**0.08**		0.073	0.1	ORSG	Y	SL
	7440-09-7	Potassium, Total	0.00151		38		mg/L	WES-06	10 / 11	0.15 - 2.5	38		NA	NA	NA	N	EN
	7440-22-4	**Silver, Total**	0.8		0.8		mg/L	MW-1R	1 / 14	0.0004 - 0.007	**0.8**		0.018	0.1	SMCL	Y	SL
	7440-23-5	Sodium, Total	0.00932		160		mg/L	WES-06	11 / 11	0.15 - 20	160		NA	20	ORSG	N	EN
	7440-62-2	**Vanadium, Total**	0.001	J	0.0044		mg/L	MW-1S	3 / 11	0.0008 - 0.01	**0.0044**		0.0036	NA	NA	Y	SL
	7440-66-6	Zinc, Total	0.0048	B	0.22		mg/L	MW-1S	6 / 14	0.0025 - 0.05	0.22		1.1	5	SMCL	N	SL
	117-81-7	**Bis(2-Ethylhexyl)phthalate**	0.0073		0.0073		mg/L	MW-1S	1 / 14	0.00039 - 0.01	**0.0073**		0.0048	0.006	MCL	Y	SL
	84-74-2	Di-n-butylphthalate	0.00149		0.00149		mg/L	MW-1R	1 / 14	0.00075 - 0.01	0.00149		0.36	NA	NA	N	SL
	75-34-3	1,1-Dichloroethane	0.0003	J	0.0003	J	mg/L	MW-1R	1 / 16	0.00075 - 0.01	0.0003		0.081	0.07	ORSG	N	SL
	100-41-4	Ethylbenzene	0.001	J	0.001	J	mg/L	MW-1S	1 / 16	0.0005 - 0.01	0.001		0.13	0.7	MCL	N	SL
	127-18-4	**Tetrachloroethene**	0.00034	J	0.00034	J	mg/L	MW-1R	1 / 16	0.0005 - 0.01	**0.00034**		0.0001	0.005	MCL	Y	SL
	79-01-6	**Trichloroethene**	0.00034	J	0.00034	J	mg/L	MW-1R	1 / 16	0.0005 - 0.01	**0.00034**		0.000028	0.005	MCL	Y	SL
	1330-20-7	Xylenes (total)	0.0001	J	0.02		mg/L	MW-1R	7 / 16	0.001 - 0.01	0.02		0.021	10	MCL	N	SL
	18540-29-9	Chromium, Total	0.0011	J	0.0029		mg/L	WES-06	2 / 14	0.001 - 0.06	0.0029		0.011	0.1	MCL	N	SL
	106-44-5	4-Methylphenol	0.004	J	0.004	J	mg/L	WED-07	1 / 7	0.0056 - .01	0.004		0.018	NA	NA	N	SL
	75-00-3	Chloroethane	0.0025		0.0025		mg/L	WES-06	1 / 16	0.001 - 0.01	0.0025		0.0046	NA	NA	N	SL

Footnotes:

(1) Summary statistics were calculated from groundwater samples from monitoring wells in Group 4 of the site. See Appendix C for wells and sampling events used in risk assessment.

(2) Maximum detected concentration in groundwater was chosen as the concentration used for screening**Bold** = concentration exceeds screening level and constituent retained as COPC.

(3) We conducted a statistical evaluation of site conditions relative to background/reference conditions. See Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tapwater were used as screening toxicity values. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1.

(5) For compounds without MCLs, we used federal health advisories or MADEP Office of Research and Standards Guidelines (OSRG). TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. MCL = Maximum contaminant level.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.
NTX = no toxicity information available.

TABLE 3-7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 5 - Wetland Soil

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Wetland Soil
Exposure Medium:	Wetland Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 5 Soil	7429-90-5	Aluminum	3800		12000	J	mg/kg	WS-106 (05)	12/12 100%	4.7-18	12000	--	--	--	--	N	NTX
	7440-36-0	Antimony	0.29	J	0.29	J	mg/kg	SS-13 (04)	1/12 8%	1.3-8.9	0.29	(N/C)	3.1	--	--	N	SL
	7440-38-2	**Arsenic**	2.3	J	30	J	mg/kg	SS-9 (04)	12/12 100%	0.24-0.89	**30**	--	0.39	--	--	Y	SL
	7440-39-3	Barium	9		43.4		mg/kg	SD-13 (99)	12/12 100%	0.47-1.8	43.4	--	540	--	--	N	SL
	7440-41-7	Beryllium	0.12		4.2		mg/kg	GP-7 (04)	6/12 50%	0.24-0.89	4.2	--	15	--	--	N	SL
	7440-43-9	Cadmium	0.03	J	1.2	J	mg/kg	WS-106 (05)	7/12 58%	0.24-0.89	1.2	--	3.7	--	--	N	SL
	7440-70-2	Calcium	120		8300	J	mg/kg	WS-106 (05)	12/12 100%	4.7-18	8300	--	NA	--	--	N	EN
	7440-47-3	Chromium	4.2		15		mg/kg	SS-14 (04)	12/12 100%	0.47-1.8	15	--	30	--	--	N	SL
	7440-48-4	Cobalt	0.67	J	8.6		mg/kg	WS-107 (05)	12/12 100%	0.94-3.6	8.6	--	900	--	--	N	SL
	7440-50-8	Copper	0.6	J	43.9		mg/kg	SD-13 (99)	12/12 100%	0.47-1.8	43.9	--	310	--	--	N	SL
	7439-89-6	Iron	1200		12000		mg/kg	SS-14 (04)	12/12 100%	2.4-8.9	12000	--	2300	--	--	N	EN
	7439-92-1	**Lead**	3.8		104		mg/kg	SD-12 (99)	12/12 100%	2.4-8.9	**104**	--	40	--	--	Y	SL
	7439-95-4	Magnesium	320		2300		mg/kg	SS-14 (04)	12/12 100%	4.7-18	2300	--	NA	--	--	N	SL
	7439-96-5	**Manganese**	12		1000		mg/kg	WS-107 (05)	12/12 100%	0.47-1.8	**1000**	--	180	--	--	Y	SL
	7439-97-6	Mercury	0.027	J	0.3	J	mg/kg	WS-106 (05)	10/12 83%	0.09-0.36	0.3	--	2.3	--	--	N	SL
	7440-02-0	Nickel	2		9.3	J	mg/kg	WS-106 (05)	12/12 100%	1.2-4.5	9.3	--	160	--	--	N	SL
	7440-09-7	Potassium	93	J	1700		mg/kg	SS-14 (04)	12/12 100%	120-450	1700	--	NA	--	--	N	EN
	7782-49-2	Selenium	0.24	J	2.4	J	mg/kg	WS-106 (05)	9/12 75%	0.47-1.8	2.4	--	39	--	--	N	SL
	7440-22-4	Silver	1.1		1.1		mg/kg	SS-14 (04)	1/11 9%	0.1-1.8	1.1	--	39	--	--	N	SL
	7440-23-5	Sodium	29	J	560	J	mg/kg	WS-106 (05)	10/12 83%	94-360	560	--	NA	--	--	N	EN
	7440-62-2	**Vanadium**	2.6		16.1		mg/kg	SD-13 (99)	12/12 100%	0.47-1.8	**16.1**	--	7.8	--	--	Y	SL
	7440-66-6	Zinc	4.8		76.9		mg/kg	SD-12 (99)	12/12 100%	2.4-12	76.9	--	2300	--	--	N	SL
	72-54-8	4,4'-DDD	0.013		0.044		mg/kg	SS-13 (04)	2/9 22%	0.00317-0.118	0.044	--	2.4	--	--	N	SL
	72-55-9	4,4'-DDE	0.01		0.0381		mg/kg	SS-13 (04)	2/9 22%	0.00317-0.118	0.0381	--	1.7	--	--	N	SL
	50-29-3	4,4'-DDT	0.00602	J	0.00602	J	mg/kg	SS-13 (04)	1/8 13%	0.00317-0.118	0.00602	--	1.7	--	--	N	SL
	309-00-2	Aldrin	0.0051	J	0.0051	J	mg/kg	SD-12 (99)	1/9 11%	0.00159-0.0592	0.0051	--	0.029	--	--	N	SL
	56-55-3	**Benzo(a)anthracene**	1.2		1.2		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	**1.2**	--	0.62	--	--	Y	SL
	50-32-8	**Benzo(a)pyrene**	1.2		1.2		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	**1.2**	--	0.062	--	--	Y	SL
	205-99-2	**Benzo(b)fluoranthene**	1.7		1.7		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	**1.7**	--	0.62	--	--	Y	SL
	191-24-2	Benzo(g,h,i)perylene	0.82	J	0.82	J	mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	0.82	--	500	--	--	N	SL
	207-08-9	Benzo(k)fluoranthene	0.58	J	0.58	J	mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	0.58	--	6.2	--	--	N	SL
	65-85-0	Benzoic Acid	0.48	J	0.78	J	mg/kg	SS-9 (04)	2/8 25%	4-11	0.78	--	100000	--	--	N	SL
	117-81-7	Bis(2-Ethylhexyl)phthalate	0.29	J	0.29	J	mg/kg	SS-13 (04)	1/9 11%	0.79-2.2	0.29	--	35	--	--	N	SL
	218-01-9	Chrysene	1.4		1.4		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	1.4	--	62	--	--	N	SL
	206-44-0	Fluoranthene	2.6		2.6		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	2.6	--	230	--	--	N	SL
	193-39-5	**Indeno(1,2,3-cd)Pyrene**	0.96	J	0.96	J	mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	**0.96**	--	0.62	--	--	Y	SL
	198-55-0	**Perylene**	0.25	J	0.25	J	mg/kg	SS-9 (04)	1/8 13%	0.4-1.1	0.25	--	5.6	--	--	N	SL
	85-01-8	Phenanthrene	1.5		1.5		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	1.5	--	350	--	--	N	SL
	129-00-0	Pyrene	2.3		2.3		mg/kg	SD-12 (99)	1/9 11%	0.4-1.1	2.3	--	230	--	--	N	SL
	78-93-3	2-Butanone	0.089	J	0.089	J	mg/kg	GP-7 (04)	1/9 11%	0.0069-0.038	0.089	--	2200	--	--	N	SL
	591-78-6	2-Hexanone	0.0027	J	0.0027	J	mg/kg	GP-23 (04)	1/8 13%	0.0064-0.026	0.0027	--	530	--	--	N	SL
	67-64-1	Acetone	0.025		0.33	J	mg/kg	GP-7 (04)	9/9 100%	0.0064-0.026	0.33	--	1400	--	--	N	SL
	71-43-2	Benzene	0.00054	J	0.017	J	mg/kg	SS-9 (04)	3/9 33%	0.00064-0.026	0.017	--	0.64	--	--	N	SL
	108-90-7	Chlorobenzene	0.0095	J	0.019	J	mg/kg	SS-9 (04)	2/9 22%	0.00064-0.026	0.019	--	15	--	--	N	SL
	75-00-3	Chloroethane	0.0087	J	0.029	J	mg/kg	GP-7 (04)	2/9 22%	0.0013-0.026	0.029	--	3.0	--	--	N	SL
	540-59-0	cis-1,2-Dichloroethene	0.0023	J	0.0061	J	mg/kg	SS-5 (04)	2/9 22%	0.00064-0.026	0.0061	--	4.3	--	--	N	SL
	60-29-7	Ethyl ether	0.0046	J	0.0046	J	mg/kg	SS-9 (04)	1/8 13%	0.0032-0.011	0.0046	--	1800	--	--	N	SL
	99-87-6	p-Isopropyltoluene	0.01	J	0.01	J	mg/kg	GP-8 (04)	1/8 13%	0.00064-0.026	0.01	--	57	--	--	N	SL
	108-88-3	Toluene	0.0043		0.11		mg/kg	GP-23 (04)	5/8 63%	0.00097-0.026	0.11	--	520	--	--	N	SL

Footnotes:

(1) Summary statistics were calculated from soil samples collected within the 0-2' depth interval. Includes: GP-23(04) (0'-1'), SS-13(04) (0'-1'), SS-14(04) (0'-1'), SD-12(99) (0'-0.5'), SD-13(99) (0'-0.5'), GP-7(04) (0'-1'), GP-8(04) (0'-1'), SS-5(04) (0'-2'), WS-6(04) (0'-1'), SS-9(04) (0'-1'), WS-106(05) (0'-1'), and WS-107(05) (0'-1'). J = estimated value. EB = equipment blank contamination.

(2) Maximum detected concentration in wetland soil from Group 5 was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and was retained as a COPC.

(3) We conducted a statistical evaluation of site and background/reference concentrations. See text and Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for residential soil were considered as screening toxicity values for wetland soil. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1. For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 S-1/GW-1 soil standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) ARAR =Applicable or relevant and appropriate requirements. TBC = To be considered. No ARARs/TBCs were identified for soils.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeded the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient. NTX = no toxicity information available.

TABLE 3-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 5 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 5 Groundwater	57-12-5	Cyanide, Total	0.0016	J	0.004		mg/L	MW-8M	3 / 4	0.0009 - 0.0009	0.004	(N/C)	0.073	0.2	MCL	N	SL
	7429-90-5	Aluminum, Total	0.0187		5.9		mg/L	MW-13B	36 / 86	0.0075 - 0.1	**5.9**		--	NA	NA	N	NTX
	7440-36-0	**Antimony, Total**	0.0036	J	0.1		mg/L	MW-13D/MW-8R	3 / 90	0.001 - 0.05	**0.1**		0.0015	0.006	MCL	**Y**	SL
	7440-38-2	**Arsenic, Total**	0.0037	J	2.32		mg/L	MW-11	64 / 94	0.0025 - 0.05	**2.32**		0.000045	0.01	MCL	**Y**	SL
	7440-39-3	**Barium, Total**	0.0086		0.36		mg/L	MW-8M	86 / 86	0.0025 - 0.01	**0.36**		0.26	2	MCL	**Y**	SL
	7440-41-7	**Beryllium, Total**	0.0004	J	0.03		mg/L	MW-11	14 / 88	0.0001 - 0.003	**0.03**		0.0073	0.004	MCL	**Y**	SL
	7440-43-9	**Cadmium, Total**	0.0004	J	0.06		mg/L	MW-11	8 / 94	0.0001 - 0.005	**0.06**		0.0018	0.005	MCL	**Y**	SL
	7440-70-2	Calcium, Total	1.8		150		mg/L	MW-22M	86 / 86	0.025 - 0.1	150		NA	NA	NA	N	EN
	7440-47-3	Chromium, Total	0.001	J	0.03		mg/L	MW-13B	24 / 88	0.0003 - 0.06	**0.03**		0.011	0.1	MCL	Y	SL
	7440-48-4	Cobalt, Total	0.001	J	0.04		mg/L	MW-22M	49 / 86	0.0006 - 0.01	0.04		0.073	NA	NA	N	SL
	7440-50-8	Copper, Total	0.0026	J	0.02		mg/L	MW-13B	7 / 90	0.002 - 0.01	0.02		0.15	1.3	MCL	N	SL
	7439-89-6	Iron, Total	0.032	J	680		mg/L	GP-10	81 / 91	0.025 - 0.186	680		1.1	0.3	SMCL	N	EN
	7439-92-1	**Lead, Total**	0.0083	J	0.04		mg/L	MW-8R	2 / 94	0.001 - 0.02	**0.04**		0.015	0.015	MCL	**Y**	SL
	7439-95-4	Magnesium, Total	0.089	J	56		mg/L	MW-22M	90 / 90	0.025 - 0.1	56		NA	NA	NA	N	EN
	7439-96-5	**Manganese, Total**	0.001	J	8.77		mg/L	MW-11S	87 / 90	0.0025 - 0.01	**8.77**		0.088	0.05	SMCL	Y	SL
	7439-97-6	Mercury, Total	0.00001	J	0.00001	J	mg/L	MW-17D	2 / 90	0.0001 - 0.0005	0.00001		0.0011	0.002	MCL	N	SL
	7440-02-0	Nickel, Total	0.0008	J	0.04		mg/L	MW-11	66 / 90	0.0007 - 0.025	0.04		0.073	0.1	ORSG	N	SL
	7440-09-7	Potassium, Total	0.95	J	100		mg/L	MW-8M	86 / 86	0.15 - 50	100		NA	NA	NA	N	EN
	7782-49-2	Selenium, Total	0.0021	J	0.0021	J	mg/L	MW-8M	1 / 90	0.0018 - 0.05	0.0021		0.018	0.05	MCL	N	SL
	7440-22-4	**Silver, Total**	0.0007	J	0.37		mg/L	MW-8R	9 / 90	0.0004 - 0.007	**0.37**		0.018	0.1	SMCL	Y	SL
	7440-23-5	Sodium, Total	8.6		310		mg/L	MW-11	86 / 86	0.15 - 40	310		NA	20	ORSG	N	EN
	7440-28-0	**Thallium, Total**	0.0035	J	0.0048	J	mg/L	MW-13B	5 / 90	0.00005 - 0.2	**0.0048**		0.00024	0.002	MCL	Y	SL
	7440-62-2	**Vanadium, Total**	0.001	J	0.01		mg/L	MW-13B	37 / 86	0.0008 - 0.01	**0.01**		0.0036	NA	NA	Y	SL
	7440-66-6	**Zinc, Total**	0.0041	B	20		mg/L	WP-9	21 / 90	0.0025 - 0.25	**20**		1.1	5	SMCL	Y	SL
	319-84-6	**Alpha-BHC**	0.000047	J	0.000047	J	mg/L	MW-8M	1 / 14	0.00001 - 0.00005	**0.000047**		0.000011	NA	NA	Y	SL
	120-82-1	1,2,4-Trichlorobenzene	0.00036	J	0.00036	J	mg/L	MW-21M	1 / 92	0.00075 - 0.25	0.00036		0.00072	0.07	MMCL	N	SL
	95-50-1	1,2-Dichlorobenzene	0.00036	J	0.0012	J	mg/L	MW-22M	2 / 92	0.001 - 0.25	0.0012		0.037	0.6	MCL	N	SL
	106-46-7	**1,4-Dichlorobenzene**	0.00056	J	0.0032	J	mg/L	GP-7	8 / 92	0.001 - 0.25	**0.0032**		0.0005	0.005	MCL	Y	SL
	105-67-9	2,4-Dimethylphenol	0.00061	J	0.066	J	mg/L	MW-8M	5 / 40	0.00375 - 0.055	0.066		0.073	NA	NA	N	SL
	95-48-7	**2-Methylphenol**	0.0033	J	0.26		mg/L	MW-8M	7 / 40	0.001 - 0.053	**0.26**		0.18	NA	NA	Y	SL
	108-39-4/106-44-5	**3-Methylphenol/4-Methylphenol**	0.048		1.68		mg/L	MW-11	4 / 26	0.0015 - 0.033	**1.68**		0.018	NA	NA	Y	SL
	106-44-5	**4-Methylphenol**	0.0011	J	0.27		mg/L	MW-8M	5 / 14	0.0052 - 0.053	**0.27**		0.018	NA	NA	Y	SL
	117-81-7	**Bis(2-Ethylhexyl)phthalate**	0.008		0.008		mg/L	MW-11	1 / 40	0.00016 - 0.1	**0.008**		0.0048	0.006	MCL	Y	SL
	105-60-2	Caprolactam	0.01	J	0.01	J	mg/L	MW-11S	1 / 10	0.0052 - 0.053	0.01		1.8	NA	NA	N	SL
	84-66-2	Diethyl phthalate	0.0016	J	0.0394		mg/L	MW-11	9 / 40	0.00125 - 0.1	0.0394		2.9	NA	NA	N	SL
	91-20-3	**Naphthalene**	0.0018	J	0.0032		mg/L	MW-22M	2 / 94	0.00075 - 0.25	**0.0032**		0.00062	0.14	ORSG	Y	SL
	108-95-2	Phenol	0.089	J	0.26		mg/L	MW-8M	2 / 40	0.00025 - 0.089	0.26		1.1	2	EPA Health Advisory - Lifetime	N	SL
	71-55-6	**1,1,1-Trichloroethane**	0.00059	J	0.49	J	mg/L	MW-8M	5 / 94	0.0005 - 0.05	**0.49**		0.32	0.2	MCL	Y	SL
	79-00-5	**1,1,2-Trichloroethane**	0.003	J	0.00692		mg/L	MW-8M	2 / 93	0.00075 - 0.075	**0.00692**		0.0002	0.005	MCL	Y	SL
	75-34-3	**1,1-Dichloroethane**	0.00027	J	3.6	J	mg/L	MW-8M	29 / 95	0.00075 - 1	**3.6**		0.081	0.07	ORSG	Y	SL

TABLE 3-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 5 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 5 Groundwater	75-35-4	**1,1-Dichloroethene**	0.00055		0.13	J	mg/L	MW-8M	9 / 94	0.0005 - 0.05	**0.13**		0.034	0.007	MCL	Y	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.0022	J	0.62	J	mg/L	MW-8M	26 / 91	0.001 - 0.25	**0.62**		0.0012	NA	NA	Y	SL
	107-06-2	**1,2-Dichloroethane**	0.00029	J	0.0444		mg/L	MW-11	18 / 94	0.0005 - 0.05	**0.0444**	(N/C)	0.00012	0.005	MCL	Y	SL
	540-59-0	**1,2-Dichloroethene (Total)**	0.002	J	0.13		mg/L	MW-8M	2 / 4	0.01 - 0.01	**0.13**		0.0061	0.07	MCL	Y	SL
	540-59-0	**cis-1,2-Dichloroethene**	0.00018	J	0.22	J	mg/L	MW-8M	35 / 91	0.0005 - 0.05	**0.22**		0.0061	0.07	MCL	Y	SL
	78-87-5	**1,2-Dichloropropane**	0.00043	J	0.0036	J	mg/L	MW-11S	2 / 94	0.001 - 0.18	**0.0036**		0.00016	0.005	MCL	Y	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.0017	J	1.2	J	mg/L	MW-8M	25 / 91	0.001 - 0.25	**1.2**		0.0012	NA	NA	Y	SL
	123-91-1	**1,4-Dioxane**	0.0016	J	0.81		mg/L	GP-7	40 / 85	0.005 - 0.5	**0.81**		0.0061	0.003	ORSG	Y	SL
	78-93-3	**2-Butanone**	0.022	J	2.2		mg/L	MW-8M	3 / 90	0.005 - 0.5	**2.2**		0.7	4	ORSG	Y	SL
	108-10-1	**4-Methyl-2-pentanone**	0.001	J	7.1	J	mg/L	MW-8M	7 / 91	0.005 - 0.5	**7.1**		0.2	0.35	ORSG	Y	SL
	67-64-1	**Acetone**	0.0021	J	2		mg/L	MW-8M	9 / 89	0.005 - 0.5	**2**		0.55	6.3	ORSG	Y	SL
	71-43-2	**Benzene**	0.00012	J	0.045		mg/L	MW-8M	32 / 94	0.0005 - 0.05	**0.045**		0.00035	0.005	MCL	Y	SL
	75-15-0	Carbon disulfide	0.00044	J	0.00044	J	mg/L	MW-11D	1 / 89	0.004 - 0.5	0.00044		0.1	NA	NA	N	SL
	56-23-5	**Carbon tetrachloride**	0.052		0.052		mg/L	MW-8M	1 / 93	0.0005 - 0.05	**0.052**		0.00017	0.005	MCL	Y	SL
	108-90-7	Chlorobenzene	0.00099		0.0038		mg/L	WP-9	10 / 92	0.0005 - 0.05	0.0038		0.011	0.1	MCL	N	SL
	75-00-3	**Chloroethane**	0.00056	J	2.5	J	mg/L	MW-8M	36 / 95	0.001 - 0.1	**2.5**		0.0046	NA	NA	Y	SL
	67-66-3	**Chloroform**	0.00028	J	0.00028	J	mg/L	MW-17D	1 / 93	0.00075 - 0.075	**0.00028**		0.00017	0.07	ORSG	Y	SL
	74-87-3	Chloromethane	0.006		0.006		mg/L	MW-8M	1 / 93	0.001 - 0.25	0.006		0.016	0.03	Health Advisory (Lifetime)	N	SL
	75-71-8	Dichlorodifluoromethane	0.00043	J	0.036	J	mg/L	MW-8M	11 / 89	0.001 - 0.5	0.036		0.039	1.4	ORSG	N	SL
	60-29-7	Ethyl Ether	0.00041	J	0.076		mg/L	MW-22M	37 / 86	0.0025 - 0.25	0.076		0.12	NA	NA	N	SL
	100-41-4	**Ethylbenzene**	0.00004	J	2.8	J	mg/L	MW-8M	25 / 95	0.0005 - 1	**2.8**		0.13	0.7	MCL	Y	SL
	98-82-8	**Isopropylbenzene**	0.0014	J	0.082		mg/L	MW-22M	25 / 91	0.0005 - 0.05	**0.082**		0.066	NA	NA	Y	SL
	1634-04-4	Methyl tert butyl ether	0.00019	J	0.0016	J	mg/L	GP-7	10 / 85	0.001 - 0.1	0.0016		0.011	0.07	ORSG	N	SL
	75-09-2	**Methylene Chloride**	0.00055	J	0.282		mg/L	MW-8M	4 / 93	0.001 - 1.8	**0.282**		0.0043	0.005	MCL	Y	SL
	103-65-1	**n-Propylbenzene**	0.00039	J	0.092	J	mg/L	MW-8M	23 / 91	0.0005 - 0.05	**0.092**		0.024	NA	NA	Y	SL
	99-87-6	p-Isopropyltoluene	0.0003	J	0.0092	J	mg/L	MW-22M	6 / 89	0.0005 - 0.05	0.0092		0.066	NA	NA	N	SL
	100-42-5	Styrene	0.00005	J	0.00005	J	mg/L	MW-17B	1 / 92	0.0005 - 0.05	0.00005		0.16	0.1	MMCL	N	SL
	104-51-8	**n-Butylbenzene**	0.0022		0.0899		mg/L	MW-8M	2 / 88	0.0005 - 0.05	**0.0899**		0.024	NA	NA	Y	SL
	98-06-6	**tert-Butylbenzene**	0.015		0.0668		mg/L	MW-8M	2 / 88	0.001 - 0.25	**0.0668**		0.024	NA	NA	Y	SL
	127-18-4	**Tetrachloroethene**	0.00046	J	0.006		mg/L	MW-17D	7 / 93	0.0005 - 0.05	**0.006**		0.0001	0.005	MCL	Y	SL
	109-99-9	**Tetrahydrofuran**	0.0021	J	2.1		mg/L	MW-22M	23 / 80	0.01 - 1	**2.1**		0.0016	1.3	ORSG	Y	SL
	108-88-3	**Toluene**	0.00032	J	21	J	mg/L	MW-8M	17 / 95	0.00075 - 1	**21**		0.072	1	MCL	Y	SL
	79-01-6	**Trichloroethene**	0.00026	J	0.006		mg/L	MW-8M	17 / 94	0.0005 - 0.05	**0.006**		0.000028	0.005	MCL	Y	SL
	75-69-4	Trichlorofluoromethane	0.0345		0.0345		mg/L	MW-11	1 / 89	0.001 - 0.25	0.0345		0.13	2	EPA Health Advisory - Lifetime	N	SL
	75-01-4	**Vinyl chloride**	0.00031	J	0.071	J	mg/L	MW-8M	13 / 93	0.001 - 0.1	**0.071**		0.00002	0.002	MCL	Y	SL
	95-47-6	**o-Xylene**	0.00037	J	0.64		mg/L	MW-8M	19 / 77	0.0005 - 0.05	**0.64**		0.021	10	MCL	Y	SL
	106-42-3/108-38-3	**p/m-Xylene**	0.002		2.1		mg/L	MW-8M	21 / 77	0.0005 - 0.05	**2.1**		0.021	10	MCL	Y	SL
	1330-20-7	**Xylenes (total)**	0.00027	J	13	J	mg/L	MW-8M	28 / 95	0.001 - 1	**13**		0.021	10	MCL	Y	SL
	156-60-5	trans-1,2-Dichloroethene	0.00097		0.00097		mg/L	MW-22M	1 / 89	0.00075 - 0.075	0.00097		0.012	0.1	MCL	N	SL
	87-68-3	Hexachlorobutadiene	0.00049	J	0.00049	J	mg/L	MW-17S	1 / 95	0.000052 - 0.25	0.00049		0.00086	NA	NA	N	SL
	135-98-8	sec-Butylbenzene	0.00066		0.00066		mg/L	MW-22M	1 / 88	0.0005 - 0.05	0.00066		0.024	NA	NA	N	SL

Footnotes:

(1) Summary statistics were calculated from groundwater samples from monitoring wells in Group 5 of the site. See Appendix C for wells and sampling events used in risk assessment.

(2) Maximum detected concentration in groundwater was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and constituent retained as COPC.

(3) We conducted a statistical evaluation of site conditions relative to background/reference conditions. See Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tapwater were used as screening toxicity values. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1.

(5) For compounds without MCLs, we used federal health advisories or MADEP Office of Research and Standards Guidelines (OSRG). TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. MCL = Maximum contaminant level.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.

NTX = no toxicity information available.

TABLE 3-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 5 - Sediment

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 5	95-63-6	1,2,4-Trimethylbenzene	0.0024	J	3		mg/kg	SD-22 (99)	7/28	25%	0.0038-0.56	3	--	5.2	--	--	N	SL
Sediment	95-50-1	1,2-Dichlorobenzene	0.012	J	0.012	J	mg/kg	WS-15 (04)	1/31	3%	0.0038-23	0.012	--	600	--	--	N	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.014	J	16		mg/kg	SD-23 (99)	6/28	21%	0.0038-0.56	**16**	(N/C)	2.1	--	--	**Y**	SL
	106-46-7	1,4-Dichlorobenzene	0.062	J	0.062	J	mg/kg	WS-15 (04)	1/31	3%	0.0038-23	0.062	--	3.4	--	--	N	SL
	78-93-3	2-Butanone	0.0069	J	0.61	J	mg/kg	SD-216 (06)	20/33	61%	0.006-1.1	0.61	--	2200	--	--	N	SL
	108-10-1	4-Methyl-2-pentanone	0.034		0.1		mg/kg	SD-21 (99)	2/28	7%	0.006-1.1	0.1	--	530	--	--	N	SL
	67-64-1	Acetone	0.011		4.4	J EB	mg/kg	WS-101 (05)	25/33	76%	0.0075-1.1	4.4	--	1400	--	--	N	SL
	71-43-2	Benzene	0.0021	J	0.063		mg/kg	SD-23 (99)	8/29	28%	0.00075-0.11	0.063	--	0.64	--	--	N	SL
	75-15-0	Carbon Disulfide	0.006	J	0.017	J	mg/kg	SD-216 (06)	5/29	17%	0.006-1.1	0.017	--	36	--	--	N	SL
	108-90-7	Chlorobenzene	0.0013	J	0.16	J	mg/kg	WS-15 (04)	5/29	17%	0.00075-0.22	0.16	--	15	--	--	N	SL
	75-00-3	Chloroethane	0.005	J	0.085		mg/kg	SD-23 (99)	5/29	17%	0.0015-0.22	0.085	--	3	--	--	N	SL
	540-59-0	cis-1,2-Dichloroethene	0.0013	J	1.7	J	mg/kg	SD-33 (04)	5/28	18%	0.00075-0.11	1.7	--	4.3	--	--	N	SL
	60-29-7	Ethyl ether	0.0059	J	0.0059	J	mg/kg	WS-15 (04)	1/21	5%	0.0038-0.56	0.0059	--	1800	--	--	N	SL
	100-41-4	Ethylbenzene	0.0022	J	3.3		mg/kg	SD-22 (99)	10/30	33%	0.00075-0.11	3.3	--	400	--	--	N	SL
	98-82-8	Isopropylbenzene	0.01	J	0.58		mg/kg	SD-32 (04)	9/30	30%	0.00075-0.11	0.58	--	57	--	--	N	SL
	75-09-2	Methylene Chloride	0.006	J	0.006	J	mg/kg	SD-24 (99)	6/30	20%	0.004-1.1	0.006	--	9.1	--	--	N	SL
	91-20-3	Naphthalene	0.25	J	1.5		mg/kg	SD-32 (04)	4/31	13%	0.0038-23	1.5	--	5.6	--	--	N	SL
	104-51-8	n-Butylbenzene	0.023	J	0.13		mg/kg	SD-33 (04)	2/29	7%	0.00075-0.11	0.13	--	240	--	--	N	SL
	103-65-1	n-Propylbenzene	0.011	J	0.69		mg/kg	SD-32 (04)	8/28	29%	0.00075-0.11	0.69	--	240	--	--	N	SL
	1330-20-7	Xylenes (Total)	0.004		10.2		mg/kg	SD-22 (99)	13/33	39%	0.0012-0.11	10.2	--	27	--	--	N	SL
	99-87-6	p-Isopropyltoluene	0.011	J	0.14		mg/kg	SD-33 (04)	5/28	18%	0.00075-0.11	0.14	--	57	--	--	N	SL
	135-98-8	sec-Butylbenzene	0.005	J	0.007	J	mg/kg	WS-15 (04)	2/28	7%	0.00075-0.11	0.007	--	220	--	--	N	SL
	127-18-4	Tetrachloroethene	0.012	J	0.012	J	mg/kg	WS-101 (05)	1/28	4%	0.00075-0.11	0.012	--	0.48	--	--	N	SL
	109-99-9	Tetrahydrofuran	0.025	J	0.21	J	mg/kg	WS-15 (04)	3/21	14%	0.015-2.2	0.21	--	9.4	--	--	N	SL
	108-88-3	Toluene	0.00086	J	4.8	J	mg/kg	SD-33 (04)	20/32	63%	0.0011-0.17	4.8	--	520	--	--	N	SL
	79-01-6	**Trichloroethene**	0.062		0.062		mg/kg	SD-33 (04)	1/28	4%	**0.00075-0.11**	**0.062**	--	0.053	--	--	Y	SL
	95-48-7	2-Methylphenol	0.24	J	0.24	J	mg/kg	SD-21 (99)	1/31	3%	0.21 - 28	0.24	--	310	--	--	N	SL
	108-39-4/106-44-5	3-Methylphenol/4-Methylphenol	1.2		1.2		mg/kg	SD-33 (04)	1/21	5%	0.21 - 28	1.2	--	31	--	--	N	SL
	50-32-8	**Benzo(a)pyrene**	0.44	J	0.44	J	mg/kg	SD-14 (99)	1/31	3%	**0.17 - 23**	**0.44**	--	0.062	--	--	Y	SL
	65-85-0	Benzoic Acid	0.2	J	2.9	J	mg/kg	WS-101 (05)	2/21	10%	1.7 - 230	2.9	--	100000	--	--	N	SL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.27	J	6.4		mg/kg	SD-33 (04)	4/31	13%	0.35 - 47	6.4	--	35	--	--	N	SL
	117-84-0	Di-n-octylphthalate	0.65		0.65		mg/kg	SD-33 (04)	1/31	3%	0.17 - 23	0.65	--	240	--	--	N	SL

TABLE 3-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 5 - Sediment

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 5 Sediment	72-54-8	4,4'-DDD	0.0088		0.012		mg/kg	SD-16 (99)	2/24	8%	0.0035-0.356	0.012	--	2.4	--	--	N	SL
	72-55-9	4,4'-DDE	0.0018	J	0.0066	J	mg/kg	SD-24 (99)	4/24	17%	0.00376 - 0.356	0.0066	--	1.7	--	--	N	SL
	33213-65-9	Endosulfan II	0.0018	J	0.0018	J	mg/kg	SD-21 (99)	1/24	4%	0.00376 - 0.356	0.0018	-(N/C)	37	--	--	N	SL
	7429-90-5	Aluminum, Total	1600		7300	J	mg/kg	WS-11 (04)	30/30	100%	4.9-26	7300	--	--	--	--	N	NTX
	7440-38-2	**Arsenic, Total**	2.1		767	J	mg/kg	SD-15 (99)	42/42	100%	**0.24 - 5.8**	**767**	--	0.39	--	--	Y	SL
	7440-39-3	Barium, Total	8.4		66	J	mg/kg	WS-101 (05)	30/30	100%	0.49-2.6	66	--	540	--	--	N	SL
	7440-41-7	Beryllium, Total	0.043	J	2.1	J	mg/kg	WS-11 (04)	10/30	33%	0.19-1.3	2.1	--	15	--	--	N	SL
	7440-43-9	Cadmium, Total	0.067	J	1.5	J	mg/kg	WS-11 (04)	12/30	40%	0.08-1.3	1.5	--	3.7	--	--	N	SL
	7440-70-2	Calcium, Total	570	J	9500	J	mg/kg	WS-101 (05)	30/30	100%	4.9-26	9500	--	NA	--	--	N	EN
	7440-47-3	Chromium, Total	1.6	J	19.6		mg/kg	SD-26 (99)	30/30	100%	0.49-2.6	19.6	--	30	--	--	N	SL
	7440-48-4	Cobalt, Total	0.54	J	18		mg/kg	SD-33 (04)	30/30	100%	0.97-5.3	18	--	900	--	--	N	SL
	7440-50-8	Copper, Total	1.4	J	110	J	mg/kg	SD-33 (04)	24/30	80%	0.47-4.4	110	--	310	--	--	N	SL
	7439-89-6	Iron, Total	1600	J	85300	J	mg/kg	SD-15 (99)	42/42	100%	2.4 - 58	85300	--	2300	--	--	N	EN
	7439-92-1	**Lead, Total**	1.9	J	120		mg/kg	SD-33 (04)	27/30	90%	2.4-13	**120**	--	40	--	--	Y	SL
	7439-95-4	Magnesium, Total	200		1930		mg/kg	SD-20 (99)	30/30	100%	4.9-26	1930	--	NA	--	--	N	EN
	7439-96-5	**Manganese, Total**	28.1		550		mg/kg	SD-33 (04)	30/30	100%	0.49-2.6	**550**	--	180	--	--	Y	SL
	7439-97-6	Mercury, Total	0.032	J	0.3		mg/kg	SD-216 (06)	9/34	26%	0.04 - 0.55	0.3	--	2.3	--	--	N	SL
	7440-02-0	Nickel, Total	2.2		15	J	mg/kg	SD-33 (04) / WS-11 (04)	28/30	93%	0.4-6.6	15	--	160	--	--	N	SL
	7440-09-7	Potassium, Total	74.5		650		mg/kg	WS-15 (04)	30/30	100%	120-660	650	--	NA	--	--	N	EN
	7782-49-2	Selenium, Total	0.54	J	5.1	J	mg/kg	WS-11 (04)	7/18	39%	0.49-2.6	5.1	--	39	--	--	N	SL
	7440-23-5	Sodium, Total	38	J	710		mg/kg	WS-15 (04)	21/30	70%	97-530	710	--	NA	--	--	N	EN
	7440-62-2	**Vanadium, Total**	2.2		28	J	mg/kg	WS-11 (04)	30/30	100%	0.49-2.6	**28**	--	7.8	--	--	Y	SL
	7440-66-6	Zinc, Total	4.6	J	240	J	mg/kg	SD-33 (04)	26/30	87%	2.4-13	240	--	2300	--	--	N	SL
	75-34-3	1,1-Dichloroethane	0.0035	J	0.0035	J	mg/kg	SD-218 (06)	1/29	3%	0.0011 - 0.17	0.0035	--	51	--	--	N	SL
	198-55-0	Perylene	0.22		0.22		mg/kg	SD-215 (06)	1/21	5%	0.17 - 23	0.22	--	5.6	--	--	N	SL

Footnotes:

(1) Summary statistics were calculated from sediment samples SD-14(99), SD-15(99), SD-16(99), SD-17(99), SD-20(99), SD-21(99), SD-22(99), SD-23(99), SD-24(99), SD-25(99), SD-26(99), SD-28(99), SD-31(04), SD-32(04), SD-33(04), SD-34(04), SD-35(04), SD-36(04), SD-37(04), SD-38(04), SD-43(04), SS-12(05), WS-7(04), WS-10(04), WS-11(04), WS-15(04), WS-16(04), WS-101(05), WS-111(05) and SD-202(06) through SD-221(06). J = estimated value. EB = equipment blank contamination.

(2) Maximum detected concentration in sediment was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and was retained as a COPC.

(3) We conducted a statistical evaluation of site and background/reference concentrations. See text for explanation.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for residential soil were considered as screening toxicity values for sediment. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1. For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 S-1/GW-1 soil standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) ARAR =Applicable or relevant and appropriate requirements. TBC = To be considered. No ARARs/TBCs were identified for sediment.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeded the screening level or if no screening level is available. DL = Constituent selected as a COPC as maximum detection limit exceeded screening toxicity value. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient; NTX = no toxicity information available.

TABLE 3-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Group 5 - Surface Water

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value (4)	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Group 5	67-64-1	Acetone	2.3		180	J	ug/l	SW-08 (99)	18/33	55%	5-14	180	--	550	6300	ORSG	N	SL
Surface Water	71-43-2	Benzene	0.3	J	3	J	ug/l	SW-05 (99) / WS-08 (99)	7/37	19%	0.5-10	3	--	0.35	5	MCL	N	SL
	78-93-3	2-Butanone	1.9		180	J	ug/l	SW-08 (99)	15/33	45%	5-10	180	(N/C) --	700	4000	ORSG	N	SL
	108-90-7	Chlorobenzene	0.38	J	3	J	ug/l	SW-05 (99)	4/37	11%	0.5-10	3	--	11	100	MCL	N	SL
	75-00-3	Chloroethane	0.48	J	2.7		ug/l	SW-33(05)	10/37	27%	1-10	2.7	--	4.6		NA	N	SL
	540-59-0	cis-1,2-Dichloroethene	0.34	J	1.3		ug/l	SW-33(05)	5/31	16%	0.5-5	1.3	--	6.1	70	MCL	N	SL
	541-73-1	1,3-Dichlorobenzene	1	J	1	J	ug/l	SW-05 (99)	1/37	3%	1-12	1	--	18	600	EPA Health Advisory-Lifetime	N	SL
	106-46-7	1,4-Dichlorobenzene	0.29	J	0.76	J	ug/l	SW-33	3/37	8%	1-12	0.76	--	0.5	5	MCL	N	SL
	75-34-3	1,1-Dichloroethane	0.29	J	5	J	ug/l	SW-08 (99)	12/37	32%	0.75-10	5	--	81	70	ORSG	N	SL
	123-91-1	**1,4-Dioxane**	1.4	J	110		ug/l	SW-110 (05)	21/27	78%	5-5	**110**	--	6.1	3	ORSG	**Y**	SL
	60-29-7	Ethyl ether	0.36	J	3		ug/l	SW-110 (05)	11/27	41%	2.5-2.5	3	--	120		NA	N	SL
	100-41-4	Ethylbenzene	0.31	J	12		ug/l	SW-05 (99)	14/37	38%	0.5-10	12	--	130	700	MCL	N	SL
	98-82-8	Isopropylbenzene	0.32	J	2		ug/l	SW-33(05)	7/31	23%	0.5-5	2	--	66		NA	N	SL
	75-09-2	**Methylene Chloride**	0.51		13.4		ug/l	SW4-99	9/37	24%	5-10	13.4	--	4.3	5	MCL	**Y**	SL
	108-10-1	4-Methyl-2-pentanone	0.49	J	120		ug/l	SW-08 (99)	16/33	48%	5-10	120	--	200	350	ORSG	N	SL
	1634-04-4	Methyl tert butyl ether	0.16	J	2.6		ug/l	SW-38 (04)	4/28	14%	1-5	2.6	--	11	70	ORSG	N	SL
	91-20-3	Naphthalene	0.47		2.6		ug/l	SW-110 (05)	8/37	22%	0.75-50	2.6	--	0.62	140	ORSG	N	SL
	103-65-1	n-Propylbenzene	0.34	J	2.2		ug/l	SW-33(05)	5/31	16%	0.5-5	2.2	--	24		NA	N	SL
	109-99-9	Tetrahydrofuran	0.86	J	61		ug/l	SW-33(05)	19/27	70%	10-10	61	--	1.6	1300	ORSG	N	SL
	108-88-3	Toluene	0.32	J	123		ug/l	SW4-99	23/37	62%	0.75-10	123	--	72	1000	MCL	N	SL
	71-55-6	1,1,1-Trichloroethane	0.37	J	9.98		ug/l	SW4-99	10/37	27%	0.5-10	9.98	--	320	200	MCL	N	SL
	75-69-4	Trichlorofluoromethane	0.36	J	0.66	J	ug/l	SW-33	2/31	6%	2.5-5	0.66	--	130	2000	EPA Health Advisory - Lifetime	N	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.45	J	14		ug/l	SW-33(05)	14/31	45%	2.5-5	14	--	1.2		NA	**Y**	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.39	J	3.4		ug/l	SW-33(05)	8/31	26%	2.5-5	3.4	--	1.2		NA	**Y**	SL
	108-05-4	Vinyl acetate	1.6	J	1.6	J	ug/l	SW-34 (04) / SW-35 (04)	2/27	7%	5-5	1.6	--	41		NA	N	SL
	75-01-4	Vinyl Chloride	0.44	J	0.44	J	ug/l	SW-33	1/37	3%	1-10	0.44	--	0.02	2	MCL	N	SL
	1330-20-7	Xylenes (Total)	2.41		50.1		ug/l	SW4-99	22/38	58%	5-10	50.1	--	21	10000	MCL	N	SL
	105-67-9	2,4-Dimethylphenol	1	J	1	J	ug/l	SW-05 (99)	1/22	5%	3.75-12	1	--	73		NA	N	SL
	95-48-7	2-Methylphenol	2.73		3	J	ug/l	SW-05 (99)	2/22	9%	1-12	3	--	180		NA	N	SL
	108-39-4/106-44-5	3-Methylphenol/4-Methylphenol	11.7		11.7		ug/l	SW4-99	1/16	6%	1.5-6.4	11.7	--	18		NA	N	SL
	106-44-5	4-Methylphenol	2	J	15		ug/l	SW-05 (99)	2/6	33%	10-12	15	--	18		NA	N	SL
	117-81-7	bis(2-Ethylhexyl)phthalate	1	J	1	J	ug/l	SW-02 (99) / SW-05 (99)	2/22	9%	2-12	1	--	4.8	6	MCL	N	SL
	108-95-2	Phenol	20.2		20.2		ug/l	SW4-99	1/22	5%	0.25-12	20.2	--	1100	2000	EPA Health Advisory - Lifetime	N	SL
	--	C9-C12 Aliphatic Hydrocarbons	16.5		68.3		ug/l	SW3-99	4/4	100%	15-15	68.3	--	2000	700	ORSG	N	SL

TABLE 3-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Group 5 - Surface Water

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value (4)	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Group 5 Surface Water	50-29-3	4,4'-DDT	0.009	J	0.009	J	ug/l	SW-05 (99)	1/16	6%	0.04-0.12	0.009	--	0.2		NA	N	SL
	319-84-6	alpha-BHC	0.006	J	0.006	J	ug/l	SW-05 (99)	1/16	6%	0.02-0.06	0.006	--	0.011		NA	N	SL
	959-98-8	Endosulfan I	0.004	J	0.004	J	ug/l	SW-02 (99)	1/16	6%	0.02-0.06	0.004	(N/C) --	22		NA	N	SL
	7429-90-5	Aluminum, Total	26		3170		ug/l	SW-10 (99)	21/31	68%	29-250	3170	--	--		NA	N	NTX
	7440-38-2	**Arsenic, Total**	4.4		147		ug/l	SW-05 (99)	27/35	77%	1-50	147	--	0.045	10	MCL	**Y**	SL
	7440-39-3	Barium, Total	10		194		ug/l	SW-05 (99)	31/31	100%	10-10	194	--	260	2000	MCL	N	SL
	7440-41-7	Beryllium, Total	0.4		0.8	J	ug/l	SW-109 (05)	4/35	11%	0.4-3	0.8	--	7.3	4	MCL	N	SL
	7440-43-9	**Cadmium, Total**	20		30		ug/l	SW2-99	2/35	6%	1-5	30	--	1.8	5	MCL	**Y**	SL
	7440-70-2	Calcium, Total	9000		110000		ug/l	SW-110 (05)	31/31	100%	100-100	110000	--	NA		NA	N	EN
	7440-47-3	Chromium, Total	1	J	4.7	J	ug/l	SW-10 (99)	13/35	37%	1-60	4.7	--	11	100	MCL	N	SL
	7440-48-4	Cobalt, Total	1	J	5.5	J	ug/l	SW-10 (99)	23/31	74%	1-10	5.5	--	73		NA	N	SL
	7440-50-8	Copper, Total	2.3	J	20		ug/l	SW-109 (05)	12/35	34%	1-10	20	--	150	1300	MCL	N	SL
	7439-89-6	Iron, Total	760		110000		ug/l	SW-109 (05)	31/31	100%	50-50	110000	--	1100	300	SMCL	N	EN
	7439-92-1	**Lead, Total**	5		50		ug/l	SW-109 (05)	11/35	31%	1-20	50	--	15	15	MCL	**Y**	SL
	7439-95-4	Magnesium, Total	2800		50000		ug/l	SW-110 (05)	31/31	100%	100-100	50000	--	NA		NA	N	EN
	7439-96-5	**Manganese, Total**	120		1480		ug/l	SW-05 (99)	31/31	100%	10-10	1480	--	88	50	SMCL	**Y**	SL
	7439-97-6	Mercury, Total	0.03	J	0.19	J	ug/l	SW-05 (99)	7/35	20%	0.1-0.5	0.19	--	1.1	2	MCL	N	SL
	7440-02-0	Nickel, Total	1.5	J	30	J	ug/l	SW3-99	34/35	97%	10-25	30	--	73	100	ORSG	N	SL
	7440-09-7	Potassium, Total	3300	J	100000		ug/l	SW-110 (05)	31/31	100%	2500-25000	100000	--	NA		NA	N	EN
	7782-49-2	Selenium, Total	1	J	4.2	J	ug/l	SW-109 (05)	3/35	9%	1-50	4.2	--	18	50	MCL	N	SL
	7440-23-5	Sodium, Total	8000		200000		ug/l	SW-110 (05)	31/31	100%	2000-20000	200000	--	NA	20000	ORSG	N	EN
	7440-28-0	Thallium, Total	2		2		ug/l	SW4-99	1/35	3%	1-200	2	--	0.24	2	MCL	N	SL
	7440-62-2	**Vanadium, Total**	1		20		ug/l	SW-109 (05)	15/31	48%	1-10	20	--	3.6		NA	**Y**	SL
	7440-66-6	**Zinc, Total**	6	J	9440		ug/l	SW-10 (99)	33/35	94%	10-50	9440	--	1100	5000	SMCL	**Y**	SL
	87-61-6	1,2,3-Trichlorobenzene	0.41		0.41		ug/l	SW-214	1/31	3%	2.5-5	0.41	--	0.72	NA	NA	N	SL
	120-82-1	1,2,4-Trichlorobenzene	0.29		2.5		ug/l	SW-214	2/37	5%	0.75-12	2.5	--	0.72	70	MMCL	N	SL
	7440-36-0	Antimony, Total	3.5		3.5	J	ug/l	SW-36	1/35	3%	2-50	3.5	--	1.5	6	MCL	N	SL
	87-68-3	Hexachlorobutadiene	0.5		0.5		ug/l	SW-33	1/37	3%	0.19-12	0.5	--	0.86		NA	N	SL

Footnotes:

(1) Summary statistics were calculated from surface water samples: SW-1, SW-2, SW-3 and SW-4 (June 1999), SW-02, SW-03, SW-05, SW-08, SW-09 and SW-10 (Aug 99), SW-31, SW-32, SW-33, SW-34, SW-35, SW-36, SW-37, SW-38 and SW-43 (Oct 2004 through Oct 2006); SW-101, SW-106, SW-107, SW-108, SW-109, SW-110 and SW-111 (Dec 2005); and SW-214 and SW-215 (November 2006). J = estimated value.

(2) Maximum detected concentration in surface water from Group 5 was used as the concentration used for screening. **Bold** = concentration exceeds screening level and is retained as a COPC.

(3) We conducted a statistical evaluation of site and background/reference concentrations. See Appendix D for explanation.

(4) TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. Maximum Contaminant Levels (MCLs) were used as the primary screening criteria for the selection of surface water COPCs. For compounds without MCLs, we compared screening concentrations to USEPA Drinking Water Health Advisories or Massachusetts Office of Research and Standards (ORSG) drinking water guidelines. If neither of these alternative drinking water standards were available, we compared surface water concentrations to EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tap water. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1. For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 GW-1 groundwater standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.

NTX = no toxicity information available.

TABLE 3-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 6 - Sediment

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 6 Sediment	75-34-3	1,1-Dichloroethane	0.0076	J	0.038	J	mg/kg	WS-104 (05)	3/10	30%	0.001-0.17	0.038	--	51	--	--	N	SL
	95-63-6	1,2,4-Trimethylbenzene	0.0099	J	0.036	J	mg/kg	SD-02 (99)	4/10	40%	0.0035-0.57	0.036	-- (N/C)	5.2	--	--	N	SL
	108-67-8	1,3,5-Trimethylbenzene	0.014	J	0.014	J	mg/kg	WS-104 (05)	1/9	10%	0.0035-0.57	0.014	--	2.1	--	--	N	SL
	78-93-3	2-Butanone	0.14	J	0.17	J	mg/kg	WS-104 (05)	4/10	40%	0.005 - 1.1	0.17	--	2200	--	--	N	SL
	108-10-1	4-Methyl-2-pentanone	0.061	J	0.082	J	mg/kg	SD-01 (99)	2/10	20%	0.005 - 1.1	0.082	--	530	--	--	N	SL
	67-64-1	Acetone	0.009		2.1	J EB	mg/kg	WS-102 (05)	6/10	60%	0.005 - 1.1	2.1	--	1400	--	--	N	SL
	71-43-2	Benzene	0.014	J	0.14	J	mg/kg	SD-02 (99)	4/10	40%	0.00069-0.11	0.14	--	0.64	--	--	N	SL
	75-15-0	Carbon Disulfide	0.0014	J EB	0.0016	J EB	mg/kg	SD-39 (04)	2/10	20%	0.005 - 1.1	0.0016	--	36	--	--	N	SL
	75-00-3	Chloroethane	0.017	J	0.35	J	mg/kg	SD-02 (99)	5/10	50%	0.0014-0.23	0.35	--	3	--	--	N	SL
	67-66-3	Chloroform	0.0068	J	0.0068	J	mg/kg	WS-104 (05)	1/10	10%	0.001-0.17	0.0068	--	0.22	--	--	N	SL
	540-59-0	cis-1,2-Dichloroethene	0.0089	J	0.04	J	mg/kg	WS-104 (05)	3/10	30%	0.00069-0.11	0.04	--	4.3	--	--	N	SL
	100-41-4	Ethylbenzene	0.047	J	0.24	J	mg/kg	SD-02 (99)	4/10	40%	0.00069-0.11	0.24	--	400	--	--	N	SL
	98-82-8	Isopropylbenzene	0.01	J	0.063	J	mg/kg	SD-02 (99)	4/10	40%	0.00069-0.11	0.063	--	57	--	--	N	SL
	103-65-1	n-Propylbenzene	0.017	J	0.024	J	mg/kg	WS-104 (05)	2/10	20%	0.00069-0.11	0.024	--	240	--	--	N	SL
	1330-20-7	Xylenes (Total)	0.104	J	0.6	J	mg/kg	SD-02 (99)	4/10	40%	0.00069-0.11	0.6	--	27	--	--	N	SL
	99-87-6	p-Isopropyltoluene	0.002	J	0.0082	J	mg/kg	WS-102 (05)	3/10	30%	0.00069-0.11	0.0082	--	57	--	--	N	SL
	127-18-4	Tetrachloroethene	0.012	J	0.012	J	mg/kg	WS-104 (05)	1/10	10%	0.00069-0.11	0.012	--	0.48	--	--	N	SL
	109-99-9	Tetrahydrofuran	0.033	J	0.075	J	mg/kg	WS-103 (05)	2/8	25%	0.014-2.3	0.075	--	9.4	--	--	N	SL
	108-88-3	Toluene	0.0085	J	8.4	J	mg/kg	SD-02 (99)	4/10	40%	0.001-0.17	8.4	--	520	--	--	N	SL
	540-59-0	trans-1,2-Dichloroethene	0.0062	J	0.037	J	mg/kg	SD-02 (99)	2/10	20%	0.001-0.17	0.037	--	6.9	--	--	N	SL
	79-01-6	Trichloroethene	0.027	J	0.027	J	mg/kg	WS-104 (05)	1/9	10%	0.00069-0.11	0.027	--	0.053	--	--	N	SL
	75-01-4	Vinyl chloride	0.023	J	0.023	J	mg/kg	WS-104 (05)	1/10	10%	**0.0014-0.23**	0.023	--	0.079	--	--	N	SL

TABLE 3-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 6 - Sediment

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 6 Sediment	50-32-8	**Benzo(a)pyrene**	0.53	J	0.53	J	mg/kg	SD-01 (99)	1/10	10%	**0.42-2.6**	**0.53**	--	0.062	--	--	**Y**	SL
	65-85-0	Benzoic Acid	3.8	J	5.5	J	mg/kg	WS-104 (05)	3/8	38%	4.2-26	5.5	-- (N/C)	100000	--	--	N	SL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.66	J	3.8	J	mg/kg	WS-102 (05)	3/10	30%	0.66-5.1	3.8	--	35	--	--	N	SL
	7429-90-5	Aluminum, Total	1500	J	3100		mg/kg	SD-40 (04)	10/10	100%	5-30	3100	--	--	--	--	N	NTX
	7440-38-2	**Arsenic, Total**	2	J	27.9	J	mg/kg	SD-01 (99)	10/10	100%	**0.25-1.5**	**27.9**	--	0.39	--	--	**Y**	SL
	7440-39-3	Barium, Total	5.4		76	J	mg/kg	WS-102 (05)	10/10	100%	0.5-3	76	--	540	--	--	N	SL
	7440-41-7	Beryllium, Total	0.7	J	1.5	J	mg/kg	WS-103 (05)	4/10	40%	0.039-3.7	1.5	--	15	--	--	N	SL
	7440-43-9	Cadmium, Total	0.093	J	0.32	J	mg/kg	SD-01 (99)	3/10	30%	0.18-1.5	0.32	--	3.7	--	--	N	SL
	7440-70-2	Calcium, Total	260	J	13900		mg/kg	SD-01 (99)	10/10	100%	5-30	13900	--	NA	--	--	N	EN
	7440-47-3	Chromium, Total	1.6	J	5.3	J	mg/kg	SD-40 (04)	10/10	100%	0.5-3	5.3	--	30	--	--	N	SL
	7440-48-4	Cobalt, Total	1.1	J	4.5		mg/kg	SD-02 (99)	10/10	100%	0.99-6.1	4.5	--	900	--	--	N	SL
	7440-50-8	Copper, Total	2.6	J	15.8		mg/kg	SD-01 (99)	10/10	100%	0.5-3	15.8	--	310	--	--	N	SL
	7439-89-6	Iron, Total	1900	J	24800	J	mg/kg	SD-01 (99)	10/10	100%	2.5-15	24800	--	2300	--	--	N	EN
	7439-92-1	**Lead, Total**	2.9	J	75.6		mg/kg	SD-01 (99)	10/10	100%	2.5-15	**75.6**	--	40	--	--	**Y**	SL
	7439-95-4	Magnesium, Total	510		1600	J	mg/kg	WS-104 (05)	10/10	100%	5-30	1600	--	NA	--	--	N	EN
	7439-96-5	**Manganese, Total**	36		341	J	mg/kg	SD-02 (99)	10/10	100%	0.5-3	**341**	--	180	--	--	**Y**	SL
	7439-97-6	Mercury, Total	0.08	J	0.22	J	mg/kg	WS-102 (05)	6/10	60%	0.09-0.59	0.22	--	2.3	--	--	N	SL
	7440-02-0	Nickel, Total	2.6	J	8.4	J	mg/kg	SD-01 (99)	10/10	100%	1.2-7.6	8.4	--	160	--	--	N	SL
	7440-09-7	Potassium, Total	133		667		mg/kg	SD-01 (99)	10/10	100%	120-760	667	--	NA	--	--	N	EN
	7782-49-2	Selenium, Total	1.6	J	1.8	J	mg/kg	WS-102 (05) / WS-103 (05)	4/9	44%	0.5-3	1.8	--	39	--	--	N	SL
	7440-23-5	Sodium, Total	180	J	979		mg/kg	SD-02 (99)	6/10	60%	99-610	979	--	NA	--	--	N	EN
	7440-28-0	Thallium, Total	0.28	J	0.29	J	mg/kg	SD-42 (04)	2/10	20%	0.5-3	0.29	--	0.52	--	--	N	SL
	7440-62-2	**Vanadium, Total**	3.1		13.6		mg/kg	SD-02 (99)	10/10	100%	0.5-3	**13.6**	--	7.8	--	--	**Y**	SL
	7440-66-6	Zinc, Total	6.7	J	138		mg/kg	SD-01 (99)	6/10	60%	2.5-15	138	--	2300	--	--	N	SL

Footnotes:

(1) Summary statistics were calculated from sediment samples SD-01(99), SD-02(99), SD-39(04), SD-40(04), SD-41(04), SD-42(04), WS-102(05), WS-103(05), WS-104(05) and WS-105(05). J = estimated value. EB = equipment blank contamination.

(2) Maximum detected concentration in sediment was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and was retained as a COPC.

(3) We conducted a statistical evaluation of site and background/reference concentrations. See text for explanation.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for residential soil were considered as screening toxicity values for sediment. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1.

For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 S-1/GW-1 soil standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) ARAR =Applicable or relevant and appropriate requirements. TBC = To be considered. No ARARs/TBCs were identified for sediment.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeded the screening level or if no screening level is available. DL = Constituent selected as a COPC as maximum detection limit exceeded screening toxicity value. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient; NTX = no toxicity information available.

TABLE 3-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 6 - Surface Water

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current / Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Location of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value (5)	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 6 Surface Water	67-64-1	Acetone	1.8	J	2.3	J	ug/l	SW-105 (05)	3/8	38%	5-5	2.3	--	550	6300	ORSG	N	SL
	75-00-3	Chloroethane	1.1		1.1		ug/l	SW-105 (05)	1/8	13%	1-1	1.1	-- (N/C)	4.6		NA	N	SL
	540-59-0	cis-1,2-Dichloroethene	0.41	J	0.41	J	ug/l	SW-102 (05)	1/8	13%	0.5-0.5	0.41	--	6.1	70	MCL	N	SL
	75-34-3	1,1-Dichloroethane	0.32	J	0.32	J	ug/l	SW-102 (05)	1/8	13%	0.75-0.75	0.32	--	81	70	ORSG	N	SL
	123-91-1	1,4-Dioxane	1.7	J	1.7	J	ug/l	SW-105 (05)	1/8	13%	5-5	1.7	--	6.1	3	ORSG	N	SL
	100-41-4	Ethylbenzene	0.38	J	0.38	J	ug/l	SW-103 (05)	1/8	13%	0.5-0.5	0.38	--	130	700	MCL	N	SL
	60-29-7	Ethyl ether	0.5	J	0.5	J	ug/l	SW-105 (05)	1/8	13%	2.5-2.5	0.5	--	120		NA	N	SL
	109-99-9	Tetrahydrofuran	0.96	J	5.8	J	ug/l	SW-105 (05)	3/8	38%	10-10	5.8	--	1.6	1300	ORSG	N	SL
	108-88-3	Toluene	1.7		1.7		ug/l	SW-103 (05)	1/8	13%	0.75-0.75	1.7	--	72	1000	MCL	N	SL
	1330-20-7	Xylenes (Total)	1.31	J	1.31	J	ug/l	SW-103 (05)	1/8	13%	0.5-0.5	1.31	--	21	10000	MCL	N	SL
	7429-90-5	Aluminum, Total	160		330		ug/l	SW-40 (04)	3/8	38%	79-190	330	--	--		NA	N	NTX
	7440-36-0	Antimony, Total	5.1	J	5.1	J	ug/l	SW-102 (05)	1/8	13%	6-6	5.1	--	1.5	6	MCL	N	SL
	7440-38-2	Arsenic, Total	3.9	J	6		ug/l	SW-105 (05)	2/8	25%	5-5	6	--	0.045	10	MCL	N	SL
	7440-39-3	Barium, Total	8	J	30		ug/l	SW-105 (05)	8/8	100%	10-10	30	--	260	2000	MCL	N	SL
	7440-70-2	Calcium, Total	2000		15000		ug/l	SW-102 (05)	8/8	100%	100-100	15000	--	NA		NA	N	EN
	7440-47-3	Chromium, Total	2	J	2	J	ug/l	SW-40 (04)	1/8	13%	10-10	2	--	11	100	MCL	N	SL
	7440-48-4	Cobalt, Total	1	J	1	J	ug/l	SW-39 (04)	4/8	50%	10-10	1	--	73		NA	N	SL
	7440-50-8	Copper, Total	3	J	5	J	ug/l	SW-105 (05)	5/8	63%	10-10	5	--	150	1300	MCL	N	SL
	7439-89-6	Iron, Total	540		6600		ug/l	SW-105 (05)	8/8	100%	50-50	6600	--	1100	300	SMCL	N	EN
	7439-92-1	**Lead, Total**	5.2	J	22		ug/l	SW-40 (04)	8/8	100%	10-10	**22**	--	15	15	MCL	**Y**	SL
	7439-95-4	Magnesium, Total	860		3300		ug/l	SW-102 (05)	8/8	100%	100-100	3300	--	NA		NA	N	EN
	7439-96-5	**Manganese, Total**	27		430		ug/l	SW-39 (04)	8/8	100%	10-10	**430**	--	88	50	SMCL	**Y**	SL
	7440-02-0	Nickel, Total	1.6	J	2.7	J	ug/l	SW-105 (05)	5/8	63%	25-25	2.7	--	73	100	ORSG	N	SL
	7440-09-7	Potassium, Total	810	J	19000		ug/l	SW-102 (05)	8/8	100%	2500-2500	19000	--	NA		NA	N	EN
	7440-22-4	Silver, Total	1.3	J	10		ug/l	SW-41 (04)	2/8	25%	1.1-7	10	--	18	100	SMCL	N	SL
	7440-23-5	Sodium, Total	4000		17000		ug/l	SW-102 (05)	8/8	100%	2000-2000	17000	--	NA	20000	ORSG	N	EN
	7440-62-2	Vanadium, Total	1	J	2	J	ug/l	SW-102 (05)	5/8	63%	10-10	2	--	3.6		NA	N	SL
	7440-66-6	Zinc, Total	5	J	100		ug/l	SW-102 (05)	8/8	100%	50-50	100	--	1100	5000	SMCL	N	SL

Footnotes:

(1) Summary statistics were calculated from surface water samples: SW-39, SW-40, SW-41 and SW-42 (Oct 2004) and SW-102, SW-103, SW-104 and SW-105 (Dec 2005). J = estimated value.

(2) Maximum detected concentration in surface water from Group 6 was used as the concentration used for screening. **Bold** = concentration exceeds screening level and is retained as a COPC.

(3) We conducted a statistical evaluation of Site and background/reference concentrations. See Appendix D for explanation.

(4) TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. Maximum Contaminant Levels (MCLs) were used as the primary screening criteria for the selection of surface water COPCs. For compounds without MCLs, we compared screening concentrations to USEPA Drinking Water Health Advisories or Massachusetts Office of Research and Standards (ORSG) drinking water guidelines. If neither of these alternative drinking water standards were available, we compared surface water concentrations to EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tap water. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient (HQ) of 0.1. For constituents lacking PRGs, Massachusetts Contingency Plan Method 1 GW-1 groundwater standards were substituted (adjusted by 0.5 to reflect a HQ of 0.1). NA = No standard available.

(5) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.

NTX = no toxicity information available.

TABLE 3-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 6 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 6 Groundwater	7429-90-5	Aluminum, Total	0.0363	0.81	mg/L	MW-18B	7 / 8	0.0075 - 0.1	0.81		--	NA	NA	N	NTX
	7440-38-2	**Arsenic, Total**	0.0035	1.11	mg/L	GP-18	11 / 13	0.0025 - 0.05	**1.11**	(N/C)	0.000045	0.01	MCL	**Y**	SL
	7440-39-3	**Barium, Total**	0.004 J	0.37	mg/L	WP-7	7 / 8	0.0025 - 0.01	**0.37**		0.26	2	MCL	**Y**	SL
	7440-41-7	**Beryllium, Total**	0.0004 J	0.009	mg/L	MW-15	2 / 9	0.0001 - 0.003	**0.009**		0.0073	0.004	MCL	**Y**	SL
	7440-43-9	**Cadmium, Total**	0.02	0.02	mg/L	MW-15	1 / 13	0.0001 - 0.005	**0.02**		0.0018	0.005	MCL	**Y**	SL
	7440-70-2	Calcium, Total	12	144	mg/L	MW-18B	8 / 8	0.025 - 0.1	144		NA	NA	NA	N	EN
	7440-47-3	Chromium, Total	0.0007	0.0087	mg/L	MW-18B	4 / 9	0.0025 - 0.06	0.0087		0.011	0.1	MCL	N	SL
	7440-48-4	Cobalt, Total	0.001 J	0.005	mg/L	WP-6	3 / 8	0.0006 - 0.01	0.005		0.073	NA	NA	N	SL
	7440-50-8	Copper, Total	0.0022 J	0.015	mg/L	MW-18B	3 / 9	0.0025 - 0.01	0.015		0.15	1.3	MCL	N	SL
	7439-89-6	Iron, Total	0.106	140	mg/L	GP-21	13 / 13	0.025 - 0.05	140		1.1	0.3	SMCL	N	EN
	7439-92-1	Lead, Total	0.0087 J	0.0087 J	mg/L	WP-7	1 / 13	0.001 - 0.02	0.0087		0.015	0.015	MCL	N	SL
	7439-95-4	Magnesium, Total	0.0357	53	mg/L	GP-18	12 / 12	0.025 - 0.1	53		NA	NA	NA	N	EN
	7439-96-5	**Manganese, Total**	0.11	3.7	mg/L	GP-19	11 / 12	0.0025 - 0.01	**3.7**		0.088	0.05	SMCL	**Y**	SL
	7440-02-0	Nickel, Total	0.0029 J	0.04	mg/L	MW-15	3 / 9	0.0007 - 0.025	0.04		0.073	0.1	ORSG	N	SL
	7440-09-7	Potassium, Total	1.6 J	29	mg/L	WP-7	8 / 8	0.15 - 2.5	29		NA	NA	NA	N	EN
	7440-22-4	Silver, Total	0.01	0.01	mg/L	MW-15	1 / 9	0.0004 - 0.007	0.01		0.018	0.1	SMCL	N	SL
	7440-23-5	Sodium, Total	10	71	mg/L	WP-7	8 / 8	0.15 - 2	71		NA	20	ORSG	N	EN
	7440-62-2	**Vanadium, Total**	0.001 J	0.006 J	mg/L	MW-18B	4 / 8	0.0008 - 0.01	**0.006**		0.0036	NA	NA	**Y**	SL
	7440-66-6	**Zinc, Total**	0.005 J	55	mg/L	WP-7	5 / 9	0.0025 - 0.25	**55**		1.1	5	SMCL	**Y**	SL
	95-48-7	2-Methylphenol	0.0017 J	0.0017 J	mg/L	WP-7	1 / 9	0.001 - 0.01	0.0017		0.18	NA	NA	N	SL
	106-44-5	4-Methylphenol	0.0053 J	0.0053 J	mg/L	MW-18D	1 / 3	0.0053 - 0.01	0.0053		0.018	NA	NA	N	SL
	65-85-0	Benzoic acid	0.01 J	0.01 J	mg/L	WP-6	1 / 6	0.01 - 0.055	0.01		15	NA	NA	N	SL
	100-51-6	Benzyl Alcohol	0.0019 J	0.0019 J	mg/L	WP-7	1 / 6	0.001 - 0.011	0.0019		1.1	NA	NA	N	SL
	84-74-2	Di-n-butylphthalate	0.001 J	0.011	mg/L	WP-6	2 / 9	0.00075 - 0.01	0.011		0.36	NA	NA	N	SL
	108-95-2	Phenol	0.000559	0.011 J	mg/L	MW-18B	3 / 9	0.00025 - 0.01	0.011		1.1	2	EPA Health Advisory - Lifetime	N	SL
	75-34-3	1,1-Dichloroethane	0.0054	0.0054	mg/L	WP-7	1 / 13	0.00075 - 0.015	0.0054		0.081	0.07	ORSG	N	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.00009 J	0.52	mg/L	GP-21	3 / 12	0.001 - 0.05	**0.52**		0.0012	NA	NA	**Y**	SL
	107-06-2	**1,2-Dichloroethane**	0.0037	0.0083	mg/L	GP-18	2 / 13	0.0005 - 0.01	**0.0083**		0.00012	0.005	MCL	**Y**	SL
	540-59-0	**cis-1,2-Dichloroethene**	0.0013 J	0.0092	mg/L	GP-18	2 / 12	0.0005 - 0.01	**0.0092**		0.0061	0.07	MCL	**Y**	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.03	0.13	mg/L	GP-21	2 / 12	0.001 - 0.05	**0.13**		0.0012	NA	NA	**Y**	SL
	123-91-1	**1,4-Dioxane**	0.048	0.14	mg/L	GP-18	3 / 11	0.005 - 0.05	**0.14**		0.0061	0.003	ORSG	**Y**	SL
	78-93-3	2-Butanone	0.075 J	0.075 J	mg/L	MW-15	1 / 12	0.005 - 0.1	0.075		0.7	4	ORSG	N	SL
	108-10-1	4-Methyl-2-pentanone	0.17 J	0.17 J	mg/L	MW-15	1 / 12	0.005 - 0.1	0.17		0.2	0.35	ORSG	N	SL
	67-64-1	Acetone	0.12 J	0.12 J	mg/L	MW-15	1 / 12	0.005 - 0.1	0.12		0.55	6.3	ORSG	N	SL
	71-43-2	**Benzene**	0.0086	0.025	mg/L	GP-21	3 / 13	0.0005 - 0.01	**0.025**		0.00035	0.005	MCL	**Y**	SL
	75-27-4	Bromodichloromethane	0.00015 J	0.00015 J	mg/L	MW-18B	1 / 13	0.0005 - 0.01	0.00015		0.00018	0.08	MCL	N	SL
	75-15-0	Carbon disulfide	0.00006 J	0.00006 J	mg/L	MW-18B	1 / 12	0.005 - 0.1	0.00006		0.1	NA	NA	N	SL
	75-00-3	**Chloroethane**	0.00049 J	0.088	mg/L	GP-21	4 / 13	0.001 - 0.02	**0.088**		0.0046	NA	NA	**Y**	SL
	67-66-3	**Chloroform**	0.0057	0.0057	mg/L	MW-18B	1 / 13	0.00075 - 0.015	**0.0057**		0.00017	0.07	ORSG	**Y**	SL
	60-29-7	Ethyl Ether	0.00042 J	0.064	mg/L	GP-18	4 / 11	0.0025 - 0.05	0.064		0.12	NA	NA	N	SL
	100-41-4	**Ethylbenzene**	0.00012 J	0.32	mg/L	GP-21	5 / 13	0.0005 - 0.01	**0.32**		0.13	0.7	MCL	**Y**	SL
	98-82-8	Isopropylbenzene	0.04	0.044	mg/L	GP-21	2 / 12	0.0005 - 0.01	0.044		0.066	NA	NA	N	SL
	75-09-2	Methylene Chloride	0.0016	0.0016	mg/L	WP-7	1 / 13	0.001 - 0.1	0.0016		0.0043	0.005	MCL	N	SL
	103-65-1	**n-Propylbenzene**	0.011	0.052	mg/L	GP-21	2 / 12	0.0005 - 0.01	**0.052**		0.024	NA	NA	**Y**	SL
	109-99-9	**Tetrahydrofuran**	0.0019 J	1.7	mg/L	GP-21	4 / 11	0.01 - 0.2	**1.7**		0.0016	1.3	ORSG	**Y**	SL
	108-88-3	Toluene	0.0045	0.067	mg/L	WP-7	4 / 13	0.00075 - 0.015	0.067		0.072	1	MCL	N	SL
	1330-20-7	**Xylenes (total)**	0.00081 J	1.75	mg/L	GP-21	5 / 13	0.001 - 0.005	**1.75**		0.021	10	MCL	**Y**	SL

Footnotes:

(1) Summary statistics were calculated from groundwater samples from monitoring wells in Group 6 of the site. See Appendix C for wells and sampling events used in risk assessment.

(2) Maximum detected concentration in groundwater was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and constituent retained as COPC.

(3) We conducted a statistical evaluation of site conditions relative to background/reference conditions. See Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tapwater were used as screening toxicity values. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1.

(5) For compounds without MCLs, we used federal health advisories or MADEP Office of Research and Standards Guidelines (OSRG). TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. MCL = Maximum contaminant level.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient.
NTX = no toxicity information available.

TABLE 3-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 3-6 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
Group 3-6	57-12-5	Cyanide, Total	0.0016	J	0.0104		mg/L	0.01 - 0.01	0.0104		0.073	0.2	MCL	N	SL
	7429-90-5	Aluminum, Total	0.0187		5.9		mg/L	0.0075 - 0.13	**5.9**	(N/C)	--	NA	NA	N	NTX
	7440-36-0	**Antimony, Total**	0.0036		0.1		mg/L	0.001 - 0.05	**0.1**		0.002	0.006	MCL	Y	SL
	7440-38-2	**Arsenic, Total**	0.0000195		2.32		mg/L	0.0025 - 0.05	**2.32**		0.000	0.01	MCL	Y	SL
	7440-39-3	**Barium, Total**	0.004	J	0.37		mg/L	0.0023 - 0.01	**0.37**		0.260	2	MCL	Y	SL
	7440-41-7	**Beryllium, Total**	0.0004	J	0.56		mg/L	0.0001 - 0.003	**0.56**		0.007	0.004	MCL	Y	SL
	7440-43-9	**Cadmium, Total**	0.0004	J	0.06		mg/L	0.0001 - 0.005	**0.06**		0.002	0.005	MCL	Y	SL
	7440-70-2	Calcium, Total	0.0282		366		mg/L	0.025 - 0.1	366		NA	NA	NA	N	EN
	7440-47-3	**Chromium, Total**	0.0007		0.03		mg/L	0.0003 - 0.06	**0.03**		0.011	0.1	MCL	Y	SL
	7440-48-4	**Cobalt, Total**	0.001	J	0.14		mg/L	0.0006 - 0.01	**0.14**		0.073	NA	NA	Y	SL
	7440-50-8	Copper, Total	0.0022	J	0.1		mg/L	0.002 - 0.0121	0.1		0.150	1.3	MCL	N	SL
	7439-89-6	Iron, Total	0.032	J	680		mg/L	0.023 - 0.186	680		1.100	0.3	SMCL	N	EN
	7439-92-1	**Lead, Total**	0.0058	J	0.06		mg/L	0.001 - 0.02	**0.06**		0.015	0.015	MCL	Y	SL
	7439-95-4	Magnesium, Total	0.00259		56		mg/L	0.025 - 0.1	56		NA	NA	NA	N	EN
	7439-96-5	**Manganese, Total**	0.0000595		29		mg/L	0.0025 - 0.01	**29**		0.088	0.05	SMCL	Y	SL
	7439-97-6	Mercury, Total	0.00001	J	0.00007	J	mg/L	0.0001 - 0.0005	0.00007		0.001	0.002	MCL	N	SL
	7440-02-0	**Nickel, Total**	0.0008	J	0.08		mg/L	0.0007 - 0.025	**0.08**		0.073	0.1	ORSG	Y	SL
	7440-09-7	Potassium, Total	0.00151		100		mg/L	0.15 - 50	100		NA	NA	NA	N	EN
	7782-49-2	Selenium, Total	0.0021	J	0.012		mg/L	0.0018 - 0.05	0.012		0.018	0.05	MCL	N	SL
	7440-22-4	**Silver, Total**	0.0007	J	0.8		mg/L	0.0004 - 0.007	**0.8**		0.018	0.1	SMCL	Y	SL
	7440-23-5	Sodium, Total	0.00932		310		mg/L	0.15 - 40	**310**		NA	20	ORSG	N	EN
	7440-28-0	**Thallium, Total**	0.00005		0.0048		mg/L	0.00005 - 0.2	**0.0048**		0.0002	0.002	MCL	Y	SL
	7440-62-2	**Vanadium, Total**	0.001	J	0.01		mg/L	0.0008 - 0.01	**0.01**		0.004	NA	NA	Y	SL
	7440-66-6	**Zinc, Total**	0.0041	B	55		mg/L	0.0025 - 0.25	**55**		1.10	5	SMCL	Y	SL
	11097-69-1	**Aroclor 1254**	0.0012	J	0.0012	J	mg/L	0.0002 - 0.001	**0.0012**		0.00003	NA	NA	Y	SL
	319-84-6	**Alpha-BHC**	0.000047	J	0.000047	J	mg/L	0.00001 - 0.00005	**0.000047**		0.00001	NA	NA	Y	SL
	120-82-1	1,2,4-Trichlorobenzene	0.00036	J	0.0004	J	mg/L	0.00075 - 12	0.0004		0.001	0.07	MMCL	N	SL
	95-50-1	1,2-Dichlorobenzene	0.00027	J	0.0012	J	mg/L	0.001 - 12	0.0012		0.037	0.6	MCL	N	SL
	106-46-7	**1,4-Dichlorobenzene**	0.00056	J	0.0032	J	mg/L	0.001 - 12	**0.0032**		0.001	0.005	MCL	Y	SL
	105-67-9	**2,4-Dimethylphenol**	0.00061	J	0.18		mg/L	0.00375 - 2.1	**0.18**		0.073	NA	NA	Y	SL
	95-48-7	**2-Methylphenol**	0.0017	J	1	J	mg/L	0.001 - 1.3	**1**		0.180	NA	NA	Y	SL
	108-39-4/106-44-5	**3-Methylphenol/4-Methylphenol**	0.04		2.1		mg/L	0.0015 - 1.3	**2.1**		0.018	NA	NA	Y	SL
	106-44-5	**4-Methylphenol**	0.0011	J	0.27		mg/L	0.0052 - 0.53	**0.27**		0.018	NA	NA	Y	SL
	65-85-0	Benzoic Acid	0.01	J	5.2	J	mg/L	0.01 - 10	5.2		15.0	NA	NA	N	SL
	100-51-6	Benzyl Alcohol	0.0019	J	0.0019	J	mg/L	0.001 - 2.1	0.0019		1.1	NA	NA	N	SL
	117-81-7	**Bis(2-Ethylhexyl)phthalate**	0.0073		0.61		mg/L	0.00013 - 1	**0.61**		0.005	0.006	MCL	Y	SL
	105-60-2	Caprolactam	0.01	J	0.01	J	mg/L	0.0052 - 0.053	0.01		1.8	NA	NA	N	SL
	84-66-2	Diethyl phthalate	0.0016	J	0.0394		mg/L	0.00125 - 1	0.0394		2.9	NA	NA	N	SL
	131-11-3	Dimethyl phthalate	0.08	J	0.08	J	mg/L	0.00175 - 1	0.08		360	NA	NA	N	SL
	84-74-2	Di-n-butylphthalate	0.001	J	0.011		mg/L	0.00075 - 1	0.011		0.360	NA	NA	N	SL
	91-20-3	**Naphthalene**	0.00049	J	0.011	J	mg/L	0.00075 - 12	**0.011**		0.001	0.14	ORSG	Y	SL
	108-95-2	**Phenol**	0.000559		9.4		mg/L	0.00025 - 1.5	**9.4**		1.100	2	EPA Health Advisory - Lifetime	Y	SL
Group 3-6 Groundwater	71-55-6	**1,1,1-Trichloroethane**	0.00058		0.49	J	mg/L	0.0005 - 2.5	**0.49**		0.320	0.2	MCL	Y	SL
	79-00-5	**1,1,2-Trichloroethane**	0.003	J	0.00692		mg/L	0.00075 - 3.8	**0.00692**		0.0002	0.005	MCL	Y	SL
	75-34-3	**1,1-Dichloroethane**	0.00023	J	3.6	J	mg/L	0.00075 - 3.8	**3.6**		0.081	0.07	ORSG	Y	SL
	75-35-4	**1,1-Dichloroethene**	0.0004	J	0.13	J	mg/L	0.0005 - 2.5	**0.13**		0.034	0.007	MCL	Y	SL
	95-63-6	**1,2,4-Trimethylbenzene**	0.00009	J	1.4		mg/L	0.001 - 12	**1.4**		0.001	NA	NA	Y	SL
	107-06-2	**1,2-Dichloroethane**	0.00029	J	0.0444		mg/L	0.0005 - 2.5	**0.0444**		0.0001	0.005	MCL	Y	SL
	540-59-0	**1,2-Dichloroethene (Total)**	0.002	J	0.13		mg/L	0.01 - 0.01	**0.13**		0.006	0.07	MCL	Y	SL
	78-87-5	**1,2-Dichloropropane**	0.00035	J	0.0036	J	mg/L	0.001 - 8.8	**0.0036**		0.0002	0.005	MCL	Y	SL
	108-67-8	**1,3,5-Trimethylbenzene**	0.0017	J	1.2	J	mg/L	0.001 - 12	**1.2**		0.001	NA	NA	Y	SL
	123-91-1	**1,4-Dioxane**	0.0016	J	3	J	mg/L	0.005 - 10	**3**		0.006	0.003	ORSG	Y	SL
	78-93-3	**2-Butanone**	0.022	J	77		mg/L	0.005 - 25	**77**		0.700	4	ORSG	Y	SL
	108-10-1	**4-Methyl-2-pentanone**	0.001	J	190		mg/L	0.005 - 25	**190**		0.200	0.35	ORSG	Y	SL
	67-64-1	**Acetone**	0.0021	J	73		mg/L	0.005 - 25	**73**		0.550	6.3	ORSG	Y	SL
	71-43-2	**Benzene**	0.00012	J	0.045		mg/L	0.0005 - 2.5	**0.045**		0.0004	0.005	MCL	Y	SL
	75-27-4	Bromodichloromethane	0.00015	J	0.00015	J	mg/L	0.0005 - 2.5	0.00015		0.0002	0.08	MCL	N	SL
	75-15-0	Carbon disulfide	0.00006	J	0.00065	J	mg/L	0.004 - 25	0.00065		0.100	NA	NA	N	SL

TABLE 3-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPC)

Group 3-6 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)		Maximum Concentration (1)		Units	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (5)	COPC Flag (Y/N)	Rationale for Selection or Deletion (6)
	56-23-5	**Carbon tetrachloride**	0.052		0.052		mg/L	0.0005 - 2.5	**0.052**		0.0002	0.005	MCL	Y	SL
	108-90-7	Chlorobenzene	0.0002	J	0.0042		mg/L	0.0005 - 2.5	0.0042	(N/C)	0.011	0.1	MCL	N	SL
	75-00-3	**Chloroethane**	0.00049	J	2.5	J	mg/L	0.001 - 5	**2.5**		0.005	NA	NA	Y	SL
	67-66-3	**Chloroform**	0.00028	J	0.0057		mg/L	0.00075 - 3.8	**0.0057**		0.0002	0.07	ORSG	Y	SL
	74-87-3	Chloromethane	0.0005		0.006		mg/L	0.001 - 12	0.006		0.016	0.03	Health Advisory (Lifetime)	N	SL
	540-59-0	**cis-1,2-Dichloroethene**	0.00018	J	0.22	J	mg/L	0.0005 - 2.5	**0.22**		0.006	0.07	MCL	Y	SL
	75-71-8	Dichlorodifluoromethane	0.00043	J	0.036	J	mg/L	0.001 - 25	0.036		0.039	1.4	ORSG	N	SL
	60-29-7	Ethyl ether	0.00041	J	0.076		mg/L	0.0025 - 12	0.076		0.120	NA	NA	N	SL
	100-41-4	**Ethylbenzene**	0.00004	J	8.4		mg/L	0.0005 - 2.5	**8.4**		0.130	0.7	MCL	Y	SL
	98-82-8	**Isopropylbenzene**	0.00011	J	0.082		mg/L	0.0005 - 2.5	**0.082**		0.066	NA	NA	Y	SL
	1634-04-4	Methyl tert butyl ether	0.00019	J	0.005		mg/L	0.001 - 5	0.005		0.011	0.07	ORSG	N	SL
	75-09-2	**Methylene chloride**	0.00055	J	2.2		mg/L	0.001 - 25	**2.2**		0.004	0.005	MCL	Y	SL
	104-51-8	**n-Butylbenzene**	0.0022		0.0899		mg/L	0.0005 - 2.5	**0.0899**		0.024	NA	NA	Y	SL
	103-65-1	**n-Propylbenzene**	0.00039	J	0.092	J	mg/L	0.0005 - 2.5	**0.092**		0.024	NA	NA	Y	SL
	99-87-6	p-Isopropyltoluene	0.0003	J	0.096	J	mg/L	0.0005 - 2.5	**0.096**		0.066	NA	NA	Y	SL
	135-98-8	sec-Butylbenzene	0.00007	J	0.00066	J	mg/L	0.0005 - 2.5	0.00066		0.024	NA	NA	N	SL
	100-42-5	Styrene	0.00005	J	0.00005	J	mg/L	0.0005 - 2.5	0.00005		0.160	0.1	MMCL	N	SL
	98-06-6	**tert-Butylbenzene**	0.015		0.0668		mg/L	0.001 - 12	**0.0668**		0.024	NA	NA	Y	SL
	127-18-4	**Tetrachloroethene**	0.00022	J	0.006		mg/L	0.0005 - 2.5	**0.006**		0.0001	0.005	MCL	Y	SL
	109-99-9	**Tetrahydrofuran**	0.0019	J	20	J	mg/L	0.01 - 50	**20**		0.002	1.3	ORSG	Y	SL
	108-88-3	**Toluene**	0.00032	J	78		mg/L	0.00075 - 3.8	**78**		0.072	1	MCL	Y	SL
	79-01-6	**Trichloroethene**	0.0001	J	0.006		mg/L	0.0005 - 2.5	**0.006**		0.000028	0.005	MCL	Y	SL
	75-69-4	Trichlorofluoromethane	0.00033	J	0.0345		mg/L	0.001 - 12	0.0345		0.130	2	EPA Health Advisory - Lifetime	N	SL
	75-01-4	**Vinyl chloride**	0.00031	J	0.071	J	mg/L	0.001 - 5	**0.071**		0.00002	0.002	MCL	Y	SL
	1330-20-7	**Xylenes (total)**	0.0001	J	28.2		mg/L	0.001 - 1	**28.2**		0.021	10	MCL	Y	SL
	107-13-1	**Acrylonitrile**	0.8		1.3	J	mg/L	0.005 - 25	**1.3**		0.00004	NA	NA	Y	SL
	97-63-2	**Ethyl Methacrylate**	4		4	J	mg/L	0.005 - 25	**4**		0.055	NA	NA	Y	SL
	87-68-3	Hexachlorobutadiene	0.00049		0.00049	J	mg/L	0.0001 - 12	0.00049		0.001	NA	NA	N	SL
	156-60-5	trans-1,2-Dichloroethene	0.00097		0.00097		mg/L	0.001 - 3.8	0.00097		0.012	0.1	MCL	N	SL

Footnotes:

(1) Summary statistics were calculated from groundwater samples from monitoring wells in Groups 3-6 of the site. See Appendix C for wells and sampling events used in risk assessment.

(2) Maximum detected concentration in groundwater was chosen as the concentration used for screening. **Bold** = concentration exceeds screening level and constituent retained as COPC.

(3) We conducted a statistical evaluation of site conditions relative to background/reference conditions. See Appendix D for details.

(4) EPA Region 9 Preliminary Remediation Goals (PRGs; October 2004) for tapwater were used as screening toxicity values. PRGs based on noncancer effects were adjusted downward by a factor of 0.1 to reflect a hazard quotient of 0.1

(5) For compounds without MCLs, we used federal health advisories or MADEP Office of Research and Standards Guidelines (OSRG). TBC = To be considered. ARAR =Applicable or relevant and appropriate requirements. MCL = Maximum contaminant level.

(6) SL = Constituent was selected / not selected as a COPC based on whether the detected concentration exceeds the screening level or if no screening level is available. EN = Constituent was not selected as a COPC because it is considered to be an essential nutrient. NTX = no toxicity information available.

TABLE 3-15
HUMAN HEALTH RISK ASSESSMENT
SUMMARY OF THE CHEMICALS OF POTENTIAL CONCERN
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Chemical of Potential Concern	Groups 1 & 2		Group 3		Group 4		Group 5				Group 6		
	Groundwater	Ambient Air	Upland Soil	Groundwater	Upland Soil	Groundwater	Surface Water	Groundwater	Wetland Soil	Sediment	Surface Water	Groundwater	Sediment
Organics													
Acetone	X			X				X					
Acetophenone	X												
Acrylonitrile				X									
Alpha-BHC								X					
Aroclor 1254				X									
Benzene	X	X		X				X				X	
Benzo(a)anthracene			X		X				X				
Benzo(a)pyrene			X		X				X	X			X
Benzo(e)pyrene			X		X								
Benzo(b)fluoranthene			X		X				X				
Benzo(k)fluoranthene					X								
Bis(2-Chloroethoxy)methane					X								
Bis(2-ethylhexyl)phthalate			X	X		X		X					
2-Butanone	X			X				X					
n-Butylbenzene								X					
t-Butylbenzene								X					
C11-C22 Aromatics					X								
Carbazole					X								
Carbon tetrachloride								X					
Chlorobenzene	X												
Chloroethane	X			X				X				X	
Chloroform	X							X				X	
4-Chloro-3-methylphenol					X								
Dibenzo(a,h)anthracene					X								
Dibenzofuran					X								
Dichlorodifluoromethane	X												
1,1-Dichloroethane	X							X					
1,2-Dichloroethane	X			X				X				X	
1,1-Dichloroethene								X					
cis-1,2-Dichloroethene	X							X				X	
1,2-Dichloroethene	X							X					
1,4-Dichlorobenzene	X			X				X					
1,2-Dichloropropane	X			X				X					
2,4-Dimethylphenol				X									
Di-n-octylphthalate			X										
1,4-Dioxane	X			X			X	X				X	
Ethylbenzene	X			X				X				X	
Ethyl ether	X												
Ethyl methacrylate				X									
2-Hexanone	X												
Indeno(1,2,3-cd)Pyrene			X		X				X				
Isopropylbenzene								X					
p-Isopropyltoluene				X									
Methylene Chloride	X			X			X	X					
1-Methylnaphthalene					X								
2-Methylnaphthalene	X				X								
4-Methyl-2-pentanone	X			X				X					
2-Methylphenol				X				X					
3-Methylphenol/4-Methylphenol	X			X				X					
4-Methylphenol	X							X					
Naphthalene	X		X	X	X			X					
N-Nitrosodi-n-butylamine	X												
N-Nitrosopyrrolidine	X												
Perylene									X				
Phenol	X			X									
n-Propylbenzene	X			X				X				X	
Pyridine	X												
Styrene	X												
Tetrachloroethene	X		X	X		X		X					
Tetrahydrofuran	X			X				X				X	
Toluene	X		X	X				X					
o-Toluidine	X												
1,1,1-Trichloroethane								X					
1,1,2-Trichloroethane								X					
Trichloroethene	X			X		X		X		X			
Trichlorofluoromethane	X												
1,2,4-Trimethylbenzene	X	X	X	X			X	X				X	
1,3,5-Trimethylbenzene	X	X	X	X			X	X		X		X	
Vinyl Chloride	X			X				X					
Xylenes	X	X	X	X				X				X	
Inorganics													
Antimony	X			X				X					
Arsenic	X		X	X	X	X	X	X	X	X		X	X
Barium	X			X				X				X	
Beryllium	X					X		X				X	
Cadmium	X		X	X		X	X	X				X	
Chromium							X						
Cobalt	X			X									
Copper	X												
Lead	X		X		X	X	X	X	X	X	X		X
Manganese	X			X	X	X	X	X	X	X	X	X	X
Nickel	X					X							
Selenium	X												
Silver						X		X					
Thallium	X							X					
Vanadium	X		X	X	X	X	X	X	X	X		X	X
Zinc							X	X				X	

An **X** indicates that constituent was detected in medium and selected as a chemical of potential concern (COPC).

TABLE 3-16A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Upland Soil
Exposure Medium:	Upland Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact	Facility Worker	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil	50	mg/event	USEPA, 1999	2
			Group 4	AF	Skin-soil adherence factor	0.2	mg/cm² - event	USEPA, 2004	3
				SA	Skin surface area	3300	cm²	USEPA, 2004	4
				EF	Exposure Frequency	150	events/year	USEPA, 1994	5
				ED	Exposure Duration	6.6	years	USEPA, 1999	6
				BW	Body weight	70	kg	USEPA, 1994	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	6.6	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA, 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Construction Worker	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil	100	mg/event	USEPA, 2002a	11
			Group 4	AF	Skin-soil adherence factor	0.3	mg/cm² - event	USEPA, 2004	12
				SA	Skin surface area	2479	cm²	USEPA, 2004	4
				EF	Exposure Frequency	130	events/year	Professional judgement	13
				ED	Exposure Duration	1	year	Professional judgement	13
				BW	Body weight	70	kg	USEPA, 1994	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	1	year	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA, 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Resident	Child (1-6 years) (noncancer effects)	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil-child, 1-6 years	100	mg/event	USEPA, 2002b	14
			Group 4	IR_s	Ingestion rate of soil-older child, 7-9 years	50	mg/event	USEPA, 1999	2
		Older Child (1-9, Cancer effects)		AF	Skin-soil adherence factor-child, 1-6 years	0.2	mg/cm² - event	USEPA, 2004	15
				AF	Skin-soil adherence factor-older child, 7-9 yrs	0.07	mg/cm² - event	USEPA, 2004	15
				SA	Skin surface area-child, 1-6 years	2800	cm²	USEPA, 2004	15
				SA	Skin surface area-older child, 7-9 years	3636	cm²	USEPA, 2004	16
				EF	Exposure Frequency	150	events/year	USEPA, 1994	5
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 2004	17
				ED_c	Exposure Duration-older child	3	years	USEPA, 2004	17
				BW	Body weight, child, 1-6 years	15	kg	USEPA, 1994	18
				BW	Body weight, older child, 7-9 years	28	kg	USEPA, 1999	18
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Trespasser / Recreational User	Youth (8-18 years)	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil	50	mg/event	USEPA, 1999	2
			Group 4	AF	Skin-soil adherence factor	0.09	mg/cm² - event	USEPA, 2004	19
				SA	Skin surface area	3220	cm²	USEPA, 2004	20
				EF	Exposure Frequency	90	events/year	Professional judgement	21
				ED	Exposure Duration	11	years	Professional judgement	22
				BW	Body weight	45	kg	USEPA, 1999	23
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	

TABLE 3-16A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Upland Soil
Exposure Medium:	Upland Soil*

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2

ADI_{dermal} (mg/kg-d) = EPC * SA * AF * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2 * ABS_d

Note: Derivation of area-weighted soil-skin adherence factors is presented below.

Notes:

1. EPCs for soil are based on the 95% upper confidence limit of the mean concentration or maximum detected concentration in soil samples collected from the site.
2. Daily soil ingestion rate (IR_s) is the recommended adult IR_s, from Table 4-23 of USEPA, 1999.
3. Skin-soil adherence factor (AF) is the recommended reasonable maximum exposure (RME) AF for industrial workers, from Exhibit 3-5 of USEPA, 2004. Parts of the body include the face (1/3 of head), hands and forearms.
4. Skin surface area (SA) for the facility worker is based on the default value for industrial scenarios, from Exhibit 3-5 of USEPA, 2004. Parts of the body include the head, hands and forearms. SA for the construction worker is based on the mean SA for industrial scenarios (both males and females), from Exhibit C-1 of USEPA, 2004. Parts of the body include the face (402 cm^2), hands (904 cm^2) and forearms (1,173 cm^2).
5. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. We assumed that facility workers and residents could be exposed to soil 150 days per year as recommended in EPA Region 1 guidance (USEPA, 1994).
6. The exposure duration (ED) for facility workers was assumed to be 6.6 years. This value represents the median occupational tenure for adult workers. Obtained from Table 15-158 of USEPA, 1999.
7. Body weight (BW) is the recommended adult body weight presented in USEPA 1994.
8. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
9. The averaging time for noncancer effects (AT_n) is set equal to the exposure duration.
10. Dermal ABS values were obtained from Exhibit 3-4 of USEPA, 2004.
11. Daily soil ingestion rate (IR_s) for outdoor workers is from Exhibit 1-2 of USEPA, 2002a.
12. The 95th percentile AF is based on the "construction workers" study, presented in Exhibit C-2 of USEPA, 2004. The AF for body parts assumed exposed hands (0.518), forearms (0.215), and head (0.071).
13. It was assumed that construction workers would be exposed to contaminants in soil for 5 days per week for six months, during a one-year period of site redevelopment work.
14. Recommended soil ingestion rate for children, central tendency exposures, presented in Table 5-19 of USEPA, 2002b.
15. Default dermal exposure values for RME residential scenarios. Exhibit 3-5, USEPA, 2004.
16. Skin surface area for 7-9 year old based on face, forearms, hands, lower legs and feet. From Exhibit C-1, USEPA 2004.
17. We evaluated a continuous nine year exposure duration, which is the EPA-recommended ED for central tendency residential scenarios (USEPA, 2004). The ED is divided into two age groups: child, ages 1-6, which we use to evaluate noncancer effects; and child, ages 7-9. Both age groups are considered collectively to evaluate cancer effects over the entire ED of 9 years.
18. Body weight (BW) for the child is the default value provided in USEPA, 1994. For the older child (7-9 years), body weight is the mean body weight for boys and girls within that age range (Table 7-3 of USEPA 1999).
19. The 95th percentile AF is based on the "soccer players" study, presented in Exhibit C-2 of USEPA, 2004. The AF for body parts assumed exposed hands (0.166), forearms (0.014), and lower legs (0.097).
20. Skin surface area (SA) is based on the body part-specific surface area calculations for males and females from from US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004, Exhibit C-1. Parts of the body assumed to be exposed include hands, forearms, and lower legs.
21. The trespasser was assumed to be exposed to contaminants in soil for 3 days per week during the seven non-winter months when the ground is not frozen.
22. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.
23. Body weight (BW) is based on the mean body weights for boys and girls (8 through 18 years) from US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999, Table 7-3. The mean body weight for each age category was averaged to calculate the body weight.

* Please refer to Tables 32 M & N and Tables 33 M & N for additional exposure parameters necessary to calculate risks associated with carcinogenic PAHs.

References:

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 2002a. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.

USEPA, 2002b. US EPA Child-Specific Exposure Factors Handbook. EPA/600/P00/002B, September 2002.

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 1994. Risk Updates: No 2. USEPA Region 1, Waste Management Division, August 1994.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

TABLE 3-16A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Upland Soil
Exposure Medium:	Upland Soil*

CALCULATION OF SITE-SPECIFIC SOIL-SKIN ADHERENCE FACTORS

Construction Worker Scenario (CT/RME)
Upland Soil Exposures

		Hands	Forearms	Face*			
Adherence Factor:	AF	0.518	0.215	0.071			
Skin Surface Area:	SA	904	1173	402	cm^2		
			Total SA	**=**	***2479***	***cm^2***	

Weighted adherence factor: WAF = $\frac{(0.518 * 904) + (0.215 * 1173) + (0.071 * 402)}{(904 + 1173 + 402)}$ = **0.30 mg/cm^2 - event**

Based on "Construction Worker" Scenario, Exhibit C-2 of USEPA 2004. AF values are 95th percentile values.
SA values for adult are mean values for males/females, presented in Exhibit C-1 of USEPA 2004.

Youth Trespasser Scenario (CT/RME)
Upland Soil Exposures

	Hands	Forearms	Lower legs	
AF	0.166	0.014	0.097	mg/cm^2
SA-7<18	700	787	1610	cm^2
SA-adult	904	1173	2370	cm^2

Age-weighted SA:	Hands	((700 * 10)/11) + ((904 * 1/11))	=	719	cm^2
	Forearms	((787 * 10)/11) + ((1173 * 1)/11)	=	822	cm^2
	Lower Legs	((1610 * 10)/11) + ((2370 * 1)/11)	=	1679	cm^2
			Total SA =		***3220 cm^2***

WAF = $\frac{(0.166 * 719) + (0.014 * 822) + (0.097 * 1679)}{(719 + 822 + 1679)}$ = **0.09 mg/cm^2 - event**

Based on "Soccer Players Nos. 2 & 3" Scenario, Exhibit C-2 of USEPA 2004. AF values are 95th percentile values.
SA values for children are from Exhibit C-1 of USEPA 2004.
SA values for adult are mean values for males/females, presented in Exhibit C-1 of USEPA 2004.

TABLE 3-16B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Upland Soil
Exposure Medium:	Upland Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact	Facility Worker	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil	100	mg/event	USEPA, 2002a	2
			Group 4	AF	Skin-soil adherence factor	0.2	mg/cm^2 - event	USEPA, 2004	3
				SA	Skin surface area	3300	cm^2	USEPA, 2004	4
				EF	Exposure Frequency	150	events/year	USEPA, 1994	5
				ED	Exposure Duration	25	years	USEPA, 2004	6
				BW	Body weight	70	kg	USEPA, 1994	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	25	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA, 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Construction Worker	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil	330	mg/event	USEPA, 2002a	11
			Group 4	AF	Skin-soil adherence factor	0.3	mg/cm^2 - event	USEPA, 2004	12
				SA	Skin surface area	2479	cm^2	USEPA, 2004	4
				EF	Exposure Frequency	130	events/year	Professional judgement	13
				ED	Exposure Duration	1	year	Professional judgement	13
				BW	Body weight	70	kg	USEPA, 1994	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	1	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA, 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Resident	Child (1-6 years) (noncancer effects)	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil-child, 1-6 yrs	200	mg/event	USEPA, 1994	14
			Group 4	IR_s	Ingestion rate of soil-adult	100	mg/event	USEPA, 1999	2
		Child/Adult (1-31 years) (cancer effects)		AF	Skin-soil adherence factor-child	0.2	mg/cm^2 - event	USEPA, 2004	15
				AF	Skin-soil adherence factor-adult	0.07	mg/cm^2 - event	USEPA, 2004	15
				SA	Skin surface area-child	2800	cm^2	USEPA, 2004	15
				SA	Skin surface area-adult	5700	cm^2	USEPA, 2004	15
				EF	Exposure Frequency	150	events/year	USEPA, 1994	5
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 2004	15
				ED_c	Exposure Duration-adult	24	years	USEPA, 2004	15
				BW	Body weight, child	15	kg	USEPA, 1994	16
				BW	Body weight, adult	70	kg	USEPA, 1994	16
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Trespasser / Recreational User	Youth (8-18 years)	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 3	IR_s	Ingestion rate of soil	100	mg/event	USEPA, 1999	17.
			Group 4	AF	Skin-soil adherence factor	0.09	mg/cm^2 - event	USEPA, 2004	18.
				SA	Skin surface area	3220	cm^2	USEPA, 2004	19.
				EF	Exposure Frequency	90	events/year	Professional judgement	20.
				ED	Exposure Duration	11	years	Professional judgement	21.
				BW	Body weight	45	kg	USEPA, 1999	22.
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	

RME

EXP FACTOR FW-SOIL	
DC-C	**1.38E-06**
DC-NC	**3.87E-06**
II-C	**2.10E-07**
II-NC	**5.87E-07**

RME

EXP FACTOR CW-SOIL	
DC-C	**5.41E-08**
DC-NC	**3.78E-06**
II-C	**2.40E-08**
II-NC	**1.68E-06**

RME

EX FACTOR RES	Child	Child/ Adult
DC-C	--	**2.12E-06**
DC-NC	**1.53E-05**	--
II-C	--	**6.71E-07**
II-NC	**5.48E-06**	--

CHECK NOTE

RME

EX FACTOR Trespasser = TP		
DC-C	**2.52E-07**	
DC-NC	**1.61E-06**	Upper percer
II-C	**8.61E-08**	
II-NC	**5.48E-07**	

body wt for l

TABLE 3-16B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2

ADI_{dermal} (mg/kg-d) = EPC * SA * AF * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2 * ABS_d

Note: Derivation of area-weighted soil-skin adherence factors is presented on Table 3-16A.

Notes:

1. EPCs for soil are based on the 95% upper confidence limit of the mean concentration or maximum detected concentration in soil samples collected from the site.
2. Daily soil ingestion rate (IR_s) is the default IR_s from USEPA, 1994.
3. Skin-soil adherence factor (AF) is the recommended reasonable maximum exposure (RME) AF for industrial workers, from Exhibit 3-5 of USEPA, 2004. Parts of the body include the face (1/3 of head), hands and forearms.
4. Skin surface area (SA) for the facility worker is based on the default value for industrial scenarios, from Exhibit 3-5 of USEPA, 2004. Parts of the body include the head, hands and forearms. SA for the construction worker is based on the mean SA for industrial scenarios (both males and females), from Exhibit C-1 of USEPA, 2004. Parts of the body include the face (402 cm^2), hands (904 cm^2) and forearms (1,173 cm^2).
5. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. We assumed that facility workers and residents would be exposed to soil 150 days per year, in accordance with EPA Region 1 guidance (USEPA, 1994).
6. The exposure duration (ED) for facility workers was assumed to be 25 years, which is the RME value in Exhibit 3-5, USEPA, 2004.
7. Body weight (BW) is the recommended adult body weight presented in USEPA 1994.
8. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
9. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
10. Dermal ABS values were obtained from Exhibit 3-4 of USEPA, 2004.
11. This is the default soil IR_s recommended in USEPA, 2002a for construction worker scenarios.
12. The 95th percentile AF is based on the "construction workers" study, presented in Exhibit C-2 of USEPA, 2004. The AF for body parts assumed exposed hands (0.518), forearms (0.215), and head (0.071).
13. Assumed a construction worker would be present at the site 5 days per week for six months of a one-year construction period.
14. Recommended soil ingestion rate for children, RME scenarios, presented in Table 5-19 of USEPA, 2002b.
15. Default dermal exposure values for RME residential scenarios. Exhibit 3-5, USEPA, 2004.
16. Body weight (BW) is the default value provided in USEPA, 1994.
17. Daily soil ingestion rate is the recommended ingestion rate for children, from Table 4-23 of USEPA, 1999.
18. The 95th percentile AF is based on the "soccer players" study, presented in Exhibit C-2 of USEPA, 2004. The AF for body parts assumed exposed hands (0.166), forearms (0.014), and lower legs (0.097).
19. Skin surface area (SA) is based on the body part-specific surface area calculations for males and females. From Exhibit C-1 of USEPA , 2004. Parts of the body assumed to be exposed include hands, forearms, and lower legs.
20. It was assumed that a trespasser would be exposed to contaminants in soil for 3 days per week during the 7 non-winter months of the year, or 90 days per year, when the ground is not frozen.
21. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.
22. Body weight (BW) is based on the mean body weights for boys and girls (8 through 18 years). From Table 7-3, USEPA, 1999. The mean body weight for each age category was averaged to calculate the body weight for this age range.

* Please refer to Tables 32 M & N and Tables 33 M & N for additional exposure parameters necessary to calculate risks associated with carcinogenic PAHs.

References:

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 2002a. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.

USEPA, 2002b. US EPA Child-Specific Exposure Factors Handbook. EPA/600/P00/002B, September 2002.

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 1994. Risk Updates: No 2. USEPA Region 1, Waste Management Division, August 1994.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

TABLE 3-17A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Wetland Soil
Exposure Medium:	Wetland Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact	Resident	Child (1-6 years) (noncancer effects)	Wetland Soil: Group 5	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
				IR_s	Ingestion rate of soil-child, 1-6 years	100	mg/event	USEPA, 2002b	2
				IR_s	Ingestion rate of soil-older child, 7-9 years	50	mg/event	USEPA, 1999	3
		Older child (1-9 years) (Cancer effects)		AF	Skin-soil adherence factor-child, 1-6 years	0.15	mg/cm² - event	USEPA, 2004	4
				AF	Skin-soil adherence factor-older child 7-9 years	0.15	mg/cm² - event	USEPA, 2004	4
				SA	Skin surface area-child, 1-6 years	2027	cm²	USEPA, 2004	5
				SA	Skin surface area-older child 7-9 years	3522	cm²	USEPA, 2004	5
				EF	Exposure Frequency	90	events/year	Professional judgement	6
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 2004	7
				ED_c	Exposure Duration-older child	3	years	USEPA, 2004	7
				BW	Body weight, child, 1-6 years	15	kg	USEPA, 1994	8
				BW	Body weight, older child 7-9 years	28	kg	USEPA, 1999	8
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	9
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	10
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	11
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Trespasser / Recreational User	Youth (8-18 years)	Wetland Soil: Group 5	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
				IR_s	Ingestion rate of soil	50	mg/event	USEPA, 1999	3
				AF	Skin-soil adherence factor	0.15	mg/cm² - event	USEPA, 2004	4
				SA	Skin surface area	3643	cm²	USEPA, 2004	5
				EF	Exposure Frequency	90	events/year	Professional judgement	6
				ED	Exposure Duration	11	years	Professional judgement	12
				BW	Body weight	45	kg	USEPA, 1999	13
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	9
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	10
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	11
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2

ADI_{dermal} (mg/kg-d) = EPC * SA * AF * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2 * ABS_d

Note: Derivation of area-weighted soil-skin adherence factors is presented below.

Notes:

1. EPCs for soil are based on the 95% upper confidence limit of the mean concentration or maximum detected concentration in wetland soil samples collected from the site.
2. Recommended soil ingestion rate for children, central tendency exposures, presented in Table 5-19 of USEPA, 2002b.
3. Daily soil ingestion rate (IR_s) is the recommended adult IR_s, from Table 4-23 of USEPA, 1999 .
4. The wetland soil AF is the geometric mean AF from the "children playing (wet soil)" study presented in USEPA, 2004 (Exhibit C-2). The AF for body parts assumed exposed hands, forearms, face and lower legs.
5. Skin surface area (SA) is an age-weighted factor based on the surface area of males and females within each age category. SA values for specific body parts were obtained from Exhibit C-1 of USEPA 2004. Parts of the body assumed exposed to wetland soil included hands, forearms, lower legs and face.
6. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. We assumed that trespassers or residents could be exposed to wetland soil 3 days per week, 7 months per year, or 90 days per year.
7. We evaluated a nine year exposure duration, which is the EPA-recommended ED for central tendency residential scenarios (USEPA, 2004). The ED is divided into two age groups: child, ages 1-6, which we use to evaluate noncancer effects; and older child, ages 7-9. Both age groups are considered collectively to evaluate cancer effects over the entire ED of 9 years.
8. Body weights (BW) for the residents are the default values provided in USEPA, 1994. Body weight for the trespasser is the mean body weight of boys and girls 8-18 years, from Table 7-3 of USEPA 1999.
9. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
10. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
11. Dermal ABS values were obtained from Exhibit 3-4 of USEPA, 2004.
12. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.
13. Body weight (BW) is based on the mean body weights for boys and girls (8 through 18 years) from US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999, Table 7-3. The mean body weight for each age category was averaged to calculate the body weight.

* Please refer to Tables 32 M & N and Tables 33 M & N for additional exposure parameters necessary to calculate risks associated with carcinogenic PAHs.

References:

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 2002a. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002

USEPA, 2002b. US EPA Child-Specific Exposure Factors Handbook. EPA/600/P00/002B, September 2002.

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 1994. Risk Updates: No 2. USEPA Region 1, Waste Management Division, August 1994.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

TABLE 3-17A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Wetland Soil
Exposure Medium:	Wetland Soil*

CALCULATION OF SITE-SPECIFIC SOIL-SKIN ADHERENCE FACTORS

Youth Trespasser Scenario (CT/RME)
Wetland Soil Exposures

	Hands	Forearms	Face	Lower legs	
AF	0.656	0.015	0.004	0.026	mg/cm^2
SA-7<18	700	787	425	1610	cm^2
SA-adult	904	1173	402	2370	cm^2

Age-Weighted SA:

Hands	((700 * 10)/11) + ((904 * 1)/11)	=	719	cm^2
Forearms	((787 * 10)/11) + ((1173 * 1)/11)	=	822	cm^2
Face	((425 * 10)/11) + ((402 * 1)/11)	=	423	cm^2
Lower legs	((1610 * 10)/11) + ((2370 * 1)/11)	=	1679	cm^2
	Total SA	**=**	***3643***	***cm^2***

WAF = $\frac{(719 * 0.656) + (822 * 0.015) + (423 * 0.004) + (1679 * 0.026)}{(719 + 822 + 423 + 1679)}$ = **0.15 mg/cm**

Based on "Children Playing (wet soil)" Scenario, Exhibit C-2 of USEPA 2004. AF values are geometric mean values.
SA values for children are from Exhibit C-1 of USEPA 2004.
SA values for adult are mean values for males/females, presented in Exhibit C-1 of USEPA 2004.

Residential Scenario
Wetland Soil Exposures

	Hands	Forearms	Face	Lower legs	
AF	0.656	0.015	0.004	0.026	mg/cm^2
SA-<1 to <6	358	393	326	650	cm^2
SA <7 - <18	700	787	425	1610	cm^2
SA-adult (18+)	904	1173	402	2370	cm^2

Total SA = ***3522*** ***cm^2***

Age-Weighted SA:

Child	Hands	((700 * 1)/6) + ((358 * 5)/6)	=	415	cm^2
(<7)	Forearms	((787 * 1)/6) + ((393 * 5)/6)	=	459	cm^2
	Face	((425 * 1)/6) + ((326 * 5)/6)	=	343	cm^2
	Lower legs	((1610 * 1)/6) + ((650 * 5)/6)	=	810	cm^2
		Total SA	**=**	***2026***	***cm^2***
Adult	Hands	((700 * 11)/24) + ((904 * 13)/24)	=	811	cm^2
(7-31)	Forearms	((787 * 11)/24) + ((1173 * 13)/24)	=	996	cm^2
	Face	((425 * 11)/24) + ((402 * 13)/24)	=	413	cm^2
	Lower legs	((1610 * 11)/24) + ((2370 * 13)/24)	=	2022	cm^2
		Total SA	**=**	***4241***	***cm^2***

CT & Ri
Child WAF = $\frac{(415 * 0.656) + (459 * 0.015) + (343 * 0.004) + (810 * 0.026)}{(415 + 459 + 343 + 810)}$ = **0.15 mg/cm**

CT
Adult WAF = $\frac{(700 * 0.656) + (787 * 0.015) + (425 * 0.004) + (1610 * 0.026)}{(700 + 787 + 425 + 1610)}$ = **0.15 mg/cm**

Note: Used SA for <7 - <18 year age range (not age-weighted) to evaluate 7-9 year ED

RME
Adult WAF = $\frac{(811 * 0.656) + (996 * 0.015) + (413 * 0.004) + (2022 * 0.026)}{(811+ 996 + 413 + 2022)}$ = **0.14 mg/cm**

Based on "Children Playing (wet soil)" Scenario, Exhibit C-2 of USEPA 2004. AF values are geometric mean values.
SA values for children are from Exhibit C-1 of USEPA 2004.
SA values for adult are mean values for males/females, presented in Exhibit C-1 of USEPA 2004.

TABLE 3-17B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Wetland Soil
Exposure Medium:	Wetland Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact	Resident	Child (1-6 years) (noncancer effects) Child/Adult (cancer effects)	Wetland Soil: Group 5	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1.
				IR_s	Ingestion rate of soil-child, 1-6 yrs	200	mg/event	USEPA, 1994	2
				IR_s	Ingestion rate of soil-adult	100	mg/event	USEPA, 1999	2
				AF	Skin-soil adherence factor-child	0.15	mg/cm² - event	USEPA, 2004	3.
				AF	Skin-soil adherence factor-adult	0.14	mg/cm² - event	USEPA, 2004	3.
				SA	Skin surface area-child	2027	cm²	USEPA, 2004	4.
				SA	Skin surface area-adult	4242	cm²	USEPA, 2004	4.
				EF	Exposure Frequency	90	events/year	Professional judgement	5
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 2004	6.
				ED_c	Exposure Duration-adult	24	years	USEPA, 2004	6.
				BW	Body weight, child	15	kg	USEPA, 1994	7.
				BW	Body weight, adult	70	kg	USEPA, 1994	7.
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA, 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Trespasser / Recreational User	Youth (8-18 years)	Wetland Soil: Group 5	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
				IR_s	Ingestion rate of soil	100	mg/event	USEPA, 1999	11.
				AF	Skin-soil adherence factor	0.15	mg/cm^2 - event	USEPA, 2004	3.
				SA	Skin surface area	3643	cm^2	USEPA, 2004	4.
				EF	Exposure Frequency	90	events/year	Professional judgement	5
				ED	Exposure Duration	11	years	Professional judgement	6.
				BW	Body weight	45	kg	USEPA, 1999	7.
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA, 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	

RME

EX FACTOR	Child	Child/ Adult
DC-C	--	**1.15E-06**
DC-NC	**4.96E-06**	--
II-C	--	**4.03E-07**
II-NC	**3.29E-06**	--

RME

EX FACTOR Trespasser	
DC-C	**4.55E-07**
DC-NC	**2.90E-06**
II-C	**8.61E-08**
II-NC	**5.48E-07**

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2

ADI_{dermal} (mg/kg-d) = EPC * SA * AF * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2 * ABS_d

Note: Derivation of area-weighted soil-skin adherence factors is presented in Table 3-17a.

Notes:

1. EPCs for soil are based on the 95% upper confidence limit of the mean concentration or maximum detected concentration in wetland soil samples collected from the site.
2. Daily soil ingestion rates (IR_s) for adult and child are the default residential IR_s from USEPA, 1994.
3. The wetland soil AF is the geometric mean AF from the "children playing (wet soil)" study presented in USEPA, 2004 (Exhibit C-2). The AF for body parts assumed exposed hands, forearms, face and lower legs.
4. Skin surface area (SA) is an age-weighted factor based on the surface area of males and females within each age category. SA values for specific body parts are geometric mean values obtained from Exhibit C-2 of USEPA 2004. Parts of the body assumed exposed to wetland soil included hands, forearms, lower legs and face. Skin Surface areas are age-weighted to reflect age ranges of each receptor.
5. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. We assumed that residents and trespassers/recreational users would be exposed to wetland soil three days per week during the seven non-winter months when the ground is not frozen, or 90 days per year.
6. Exposure duration for the resident is the recommended residential RME ED (EPA, 2004). The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.
7. Body weights for residential exposures are the recommended child and adult body weights presented in USEPA, 1989. Body weight for the trespasser is based on the mean body weights for boys and girls (8 through 18 years). From Table 7-3, USEPA, 1999.
8. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
9. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
10. Dermal ABS values were obtained from Exhibit 3-4 of USEPA, 2004.
11. Daily adult soil ingestion rate is from Table 4-23 of USEPA, 1999.

* Please refer to Tables 32 M & N and Tables 33 M & N for additional exposure parameters necessary to calculate risks associated with carcinogenic PAHs.

References:

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 1994. Risk Updates: No 2. USEPA Region 1, Waste Management Division, August 1994.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

TABLE 3-18A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Soil (upland)
Exposure Medium:	Fugitive Dust

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation	Facility	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Chemical-specific	1
	Worker		Group 3	EF	Exposure Frequency	150	events/year	USPEPA, 1994	2
			Group 4	ET	Exposure Time	8	hours/event	Professional judgement	3
				ED	Exposure Duration	6.6	years	USEPA, 1999	4
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6.6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation	Construction	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Chemical-specific	1
	Worker		Group 3	EF	Exposure Frequency	130	events/year	Professional judgement	7
			Group 4	ET	Exposure Time	8	hours/event	Professional judgement	3
				ED	Exposure Duration	1	year	Professional judgement	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	1	year	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	

Average Daily Exposure (ADE) Equations:

$ADI_{inhalation}$ (mg/m^3) = EPC * EF * ET * ED * 1/AT * 1/C1 * 1/C2

Where : EPC = Soil EPC (mg/kg) * (1/PEF (m^3/kg) + 1/VF (m^3/kg))

PEF = Particulate Emission Factor, EPA default of 1.36 x 10^9 m^3/kg (EPA 1996).

VF = Volatilization Factor. Chemical-specific.

Notes:

1. EPCs for outdoor particulates were estimated from soil EPCs using the default particulate emission factor (PEF) provided in USEPA, 2002. Additionally, volatile emissions from soil were estimated using a chemical-specific volatilization factor.
2. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. We assumed that facility workers could be exposed to soil 150 days per year, in accordance with USEPA Region 1 guidance (USEPA 1994).
3. The exposure time (ET) describes how long each individual exposure event might last. For inhalation of outdoor particulates and volatiles, exposure time is assumed to be 8 hours/day (a typical work day).
4. The exposure duration (ED) for facility workers was assumed to be 6.6 years. This value represents the median occupational tenure for adult workers. Obtained from Table 15-158 of USEPA, 1999.
5. The averaging time (AT) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
6. The averaging time for noncancer effects is set equal to the exposure duration.
7. It was assumed that construction workers would be exposed to contaminants in soil for 5 days per week for six months, during a one-year period of site redevelopment work.

References:

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.
USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.
USEPA, 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response: Washington, D.C. (EPA/540/R-95/128).
USEPA, 1994. Risk Updates: No 2. USEPA Region 1, Waste Management Division, August 1994.
USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

TABLE 3-18B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Soil (upland)
Exposure Medium:	Fugitive Dust

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation	Facility	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Chemical-specific	1
	Worker		Group 3	EF	Exposure Frequency	150	events/year	USEPA, 1994	2
			Group 4	ET	Exposure Time	8	hours/event	USEPA, 2004	3
				ED	Exposure Duration	25	years	USEPA, 2004	4
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	25	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation	Construction	Adult	Soil:	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Chemical-specific	1
	Worker		Group 3	EF	Exposure Frequency	130	events/year	Professional judgement	7
			Group 4	ET	Exposure Time	8	hours/event	Professional judgement	3
				ED	Exposure Duration	1	years	Professional judgement	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	1	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	

Average Daily Exposure (ADE) Equations:

$ADI_{inhalation}$ (mg/m^3) = EPC * EF * ET * ED * 1/AT * 1/C1 * 1/C2

Where : EPC = Soil EPC (mg/kg) * (1/PEF (m^3/kg) + 1/VF (m^3/kg))

PEF = Particulate Emission Factor, EPA default of 1.36 x 10^9 m^3/kg (EPA 1996).

VF = Volatilization Factor. Chemical-specific.

Notes:

1. EPCs for outdoor particulates were estimated from soil EPCs using the default particulate emission factor (PEF) provided in USEPA, 2002. Additionally, volatile emissions from soil were estimated using a chemical-specific volatilization factor.
2. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. We assumed that facility workers could be exposed to soil 150 days per year, in accordance with USEPA Region 1 guidance (USEPA 1994).
3. The exposure time (ET) describes how long each individual exposure event might last. For inhalation of outdoor particulates and volatiles, exposure time is 8 hours/day (a typical work day).
4. The exposure duration (ED) for facility workers was assumed to be 25 years, which is the RME value in Exhibit 3-5, USEPA, 2004.
5. The averaging time (AT) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
6. The averaging time for noncancer effects is set equal to the exposure duration.
7. It was assumed that construction workers would be exposed to contaminants in soil for 5 days per week for six months, during a one-year period of site redevelopment work.

References:

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.
USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.
USEPA, 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response: Washington, D.C. (EPA/540/R-95/128).
USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).
USEPA, 1994. Risk Updates: No 2. USEPA Region 1, Waste Management Division, August 1994.

TABLE 3-19A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater/Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion of potable water	Facility Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Group 4	IR_s	Ingestion rate of drinking water	0.7	L/day	Professional judgement	2
				EF	Exposure Frequency	219	days/year	USEPA, 2004	3
				ED	Exposure Duration	6.6	years	USEPA, 1999	4
				BW	Body weight	70	kg	USEPA, 1994	5
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	6.6	years	USEPA, 1989	7
				C1	Units Conversion Factor	365	days/year	Constant	
Dermal contact with Potable Water	Facility Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Group 4	DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight	70	kg	USEPA, 1994	5
				SA	Skin surface area	2077	cm^2	USEPA, 2004	9
				EV	Event Frequency	8	events/day	Professional judgement	10
				EF	Exposure Frequency	219	days/year	USEPA, 2004	3
				ED	Exposure Duration	6.6	years	USEPA, 1999	4
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	0.003	hours/event	Professional judgement	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1989	6
				AT_{nc}	Averaging Time-noncancer	6.6	years	USEPA, 1989	7
Dermal contact with Groundwater	Construction Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Group 4	DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight	70	kg	USEPA, 1994	5
				SA	Skin surface area	2077	cm^2	USEPA, 2004	9
				EV	Event Frequency	1	events/day	Professional judgement	11
				EF	Exposure Frequency	52	days/year	Professional judgement	11
				ED	Exposure Duration	1	years	Professional judgement	11
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	0.5	hours/event	Professional judgement	11
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1989	6
				AT_{nc}	Averaging Time-noncancer	1	years	USEPA, 1989	7
Ingestion of potable water	Resident	Child (1-6 years) (noncancer effects)	Groups 1-2	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Groups 3-6	IR_s	Ingestion rate of drinking water, 1-9 years	0.7	L/day	USEPA, 1999	12
				EF	Exposure Frequency	350	days/year	USEPA, 2004	13
		Child (1-9 years) (cancer effects)		ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	14
				ED_c	Exposure Duration-adult	3	years	USEPA, 1999	14
				BW	Body weight, 1-6 years	15	kg	USEPA, 1999	15
				BW	Body weight, 7-9 years	28	kg	USEPA, 1999	15
				AT_c	Averaging Time-cancer	70	years	USEPA, 1989	6
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	7
				C1	Units Conversion Factor	365	days/year	Constant	

TABLE 3-19A Continued

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater/Surfacewater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact with potable water (i.e., showering)	Resident	Child (1-6 years) (noncancer effects)	Groups 1-2 Groups 3-6	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
				DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA, 2004	8
		Older child (1-9 years) (cancer effects)		FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight, 1-6 years	15	kg	USEPA, 1999	15
				BW	Body weight, 7-9 years	28	kg	USEPA, 1999	15
				SA	Skin surface area, 1-6 years	6600	cm^2	USEPA, 2004	16
				SA	Skin surface area, 7-9 years	9972	cm^2	USEPA, 2004	16
				EV	Event Frequency	1	events/day	USEPA, 2004	13
				EF	Exposure Frequency	350	days/year	USEPA, 2004	13
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	14
				ED_c	Exposure Duration-older child	3	years	USEPA, 1999	14
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	0.33	hours/event	USEPA, 2004	13
				B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA, 2004	8
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1989	6
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	7
Dermal contact (surface water)	Trespasser/ Future Site Recreational User	Youth (Ages 8-18 years)	Groups 5 & 6	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	17
				DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight	45	kg	USEPA, 1999	18
				SA	Skin surface area	4194	cm^2	USEPA, 2004	19
				EV	Event Frequency	1	events/day	Professional judgement	20
				EF	Exposure Frequency	90	days/year	Professional judgement	20
				ED	Exposure Duration	11	years	Professional judgement	21
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	1	hours/event	Professional judgement	22
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1989	6
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	7
Dermal contact (surface water)	Future Site Resident	Child (1-6 years) (noncancer effects) Older child (1-9 years) (cancer effects)	Groups 5 & 6	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	17
				DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight, child	15	kg	USEPA, 1999	15
				BW	Body weight, older child	28	kg	USEPA, 1999	15
				SA	Skin surface area, child	2218	cm^2	USEPA, 2004	19
				SA	Skin surface area, older child	4046	cm^2	USEPA, 1999	19
				EV	Event Frequency	1	events/day	Professional judgement	20
				EF	Exposure Frequency	90	days/year	Professional judgement	20
				ED	Exposure Duration-child	6	years	USEPA, 1999	14
				ED	Exposure Duration-older child	3		USEPA, 1999	14
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	1	hours/event	Professional judgement	22
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1989	6
				AT_{nc}	Averaging Time-noncancer	13	years	USEPA, 1989	7

TABLE 3-19A Continued

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1

ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

where for inorganics: DA_{event} (mg/cm^2-event)= EPC * Kp * t$_e$ * CF2

where for organics: DA_{event} = EPC * 2 FA * Kp * C2 * SQRT{(6 * tau-event * t-e)/pi}

(short-duration exposures)

and DA_{event} = EPC * FA * Kp * C2 * [(t-event/1 + B) + 2 tau-event {(1 + 3 B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Note: The DA "exposure factor" (DA_{event} not including the EPC) is presented on Table 3-22c.

Notes:

1. EPCs are the maximum groundwater concentration in each exposure point.
2. Since the facility worker represents a non-residential, adult exposure, we used one-half of the 50th percentile drinking water ingestion rate for adults (1.4 L/day; Table 3-30; USEPA, 1999) for this exposure scenario, assuming that a facility worker spends only a portion of the day at the site and, accordingly, would not ingest the full daily allotment for adults.
3. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency is the recommended central tendency (CT) value for industrial scenarios, from Exhibit 3-5, USEPA, 2004.
4. The exposure duration (ED) for facility workers was assumed to be 6.6 years. This value represents the median occupational tenure for adult workers, as recommended in Table 15-158 of USEPA, 1999.
5. Body weight (BW) is the adult body weight presented in USEPA, 1994.
6. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
7. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
8. Chemical-specific absorption coefficients/factors were obtained from USEPA, 2004.
9. Skin surface area (SA) for both the facility and construction worker scenarios was based on the mean SA for hands and forearms, from USEPA, 2004.
10. Handwashing frequency and event duration values were based on information provided by the Centers for Disease Control (CDC) and Prevention (CDC, 2002) and USEPA, 1999. USEPA (1999) also provides statistics on handwashing frequency in the United States. We assumed that a facility worker would wash his hands once per hour (or 8 times per day) under the CT scenario. Information provided by the CDC indicates an average observed handwashing time of 7-10 seconds among hospital workers, which we assumed would also reflect average handwashing habits among United States residents. The CDC recommends washing hands a minimum of 15 seconds (CDC, 2002). For the central tendency exposure scenario, we assumed that a facility worker spent 10 seconds per hand washing event.
11. It was assumed that construction workers would be present at the site during a one-year period of site redevelopment work. Because OSHA mandates dewatering in excavation pits or trenches, construction workers were assumed to contact groundwater only while setting up or dismantling dewatering equipment at the beginning and ending of a work week (or 52 events per year, for six months of one year), for one-half hour per exposure event.
12. Drinking water ingestion rate is based on the 50th percentile tapwater intake rate for males and females within the 1-10 year age category. From Ershow and Cantor, 1989, as cited in Table 3-30, USEPA, 1999).
13. These are the recommended exposure values for central tendency residential scenarios, as indicated in Exhibit 3-2, USEPA 2004.
14. We evaluated a nine year exposure duration, which is the EPA-recommended ED for central tendency residential scenarios (USEPA, 1999). The ED is divided into two age groups: child, ages 1-6, which we use to evaluate noncancer effects; and child, ages 7-9. Both age groups are considered collectively to evaluate cancer effects over the entire ED.
15. Body weight (BW) for the young child is the default value provided in USEPA, 1994. Body weight for the older child is the mean body weight for males and females ages 7-9 years, from Table 7-3 of USEPA 1999.
16. Skin surface area for the child (1-6 years) is the recommended SA for central tendency residential scenarios, as indicated in Exhibit 3-2 of USEPA, 2004. SA for the 7-9 year old was calculated based on the 50th percentile total SA for both sexes within the age range, in USEPA 1999.
17. Surface water exposure point concentration is either the maximum detected concentration or 95% UCL concentration.
18. Body weight (BW) is based on the mean body weights for boys and girls (8 through 18 years) from US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999, Table 7-3. The mean body weight for each age category was averaged to calculate the body weight.
19. Skin surface areas for the trespasser and resident are based on the body part-specific surface area calculations for males and females within each age range, from US EPA, 2004. Parts of the body assumed to be exposed include hands, forearms, feet and lower legs.
20. It was assumed that a trespasser or area resident would be exposed to contaminants in surface water for 3 days per week during the 7 non-winter months.
21. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.
22. We assumed that a trespasser or resident would be present at the site for only one hour per exposure event.

References:

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.

Center for Disease Control (CDC). 2002. *Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee* and the ICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Morbidity and Mortality Weekly Report. October 25, 2002 / Vol. 51 / No. RR-16.

TABLE 3-19B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater/Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion of potable water	Facility Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Group 4	IR_s	Ingestion rate of drinking water	1.15	L/day	Professional judgment	2
				EF	Exposure Frequency	250	days/year	USEPA, 2004	3
				ED	Exposure Duration	25	years	USEPA, 2004	4
				BW	Body weight	70	kg	USEPA, 1994	5
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	25	years	USEPA, 1989	7
				C1	Units Conversion Factor	365	days/year	Constant	
Dermal contact with Potable Water	Facility Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Group 4	DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coefficient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight	70	kg	USEPA, 1994	5
				SA	Skin surface area	2077	cm^2	USEPA, 2004	9
				EV	Event Frequency	16	events/day	Professional judgment	10
				EF	Exposure Frequency	250	days/year	USEPA, 1999	3
				ED	Exposure Duration	25	years	USEPA, 1999	4
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	0.01	hours/event	Professional judgment	10
				C1	Units Conversion Factor	365.00	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	25	years	USEPA, 1989	7
Dermal contact with Groundwater	Construction Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Group 4	DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coefficient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight	70	kg	USEPA, 1994	5
				SA	Skin surface area	2077	cm^2	USEPA, 2004	9
				EV	Event Frequency	1	events/day	Professional judgment	11
				EF	Exposure Frequency	130	days/year	Professional judgment	11
				ED	Exposure Duration	1	years	Professional judgment	11
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	0.5	hours/event	Professional judgment	11
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	1	years	USEPA, 1989	7
Ingestion of potable water	Resident	Child (1-6 years) (noncancer effects)	Groups 1-2	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
			Groups 3-6	IR_s	Ingestion rate of drinking water, 1-6 years	1.3	L/day	USEPA, 1999	12
				IR_s	Ingestion rate of drinking water, 7-31 years	1.98	L/day	USEPA, 1994	13
		Child/adult (1-31 years) (cancer effects)		EF	Exposure Frequency	350	days/year	USEPA, 2004	14
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	15
				ED_c	Exposure Duration-adult	24	years	USEPA, 1999	15
				BW	Body weight, child	15	kg	USEPA, 1994	16
				BW	Body weight, adult	70	kg	USEPA, 1994	16
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	7
				C1	Units Conversion Factor	365	days/year	Constant	

RME
EXP FACTOR
FW-ING
DWI-C **4.02E-03**
DWI-NC **1.13E-02**

note dermal units!!! Need to calc DA sep
RME
EXP FACTOR
FW-DCW
DC-C **1.16E+02** ev-cm2 /d-kg
DC-NC **3.25E+02**

hands and lower arms, adult
Assumed 3 times/hour

assumed 20 seconds per han

note dermal units!!! Need to calc DA sep
RME
EXP FACTOR
CW-DCW
DC-C **1.51E-01** ev-cm2 /d-kg
DC-NC **1.06E+01**

hands and lower arms, adult

RME
EXP FACTOR
RES-DWI
DWI NC **0.08310502** **child**
DWI C **0.01639922** **child/adult**

TABLE 3-19B Continued

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater/Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact with potable water (i.e., showering)	Resident	Child (1-6 years) (noncancer effects)	Groups 1-2 Groups 3-6	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	1
				DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coefficient	Chemical-specific	cm/h	USEPA, 2004	8
		Child/adult (cancer effects)		FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight, child	15	kg	USEPA, 1999	16
				BW	Body weight, adult	70	kg	USEPA, 1994	16
				SA	Skin surface area, 1-6 years	6600	cm^2	USEPA, 2004	17
				SA	Skin surface area, 7-31 years	18000	cm^2	USEPA, 2004	17
				EV	Event Frequency	1	events/day	USEPA, 2004	14
				EF	Exposure Frequency	350	days/year	USEPA, 2004	14
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	15
				ED_c	Exposure Duration-adult	24	years	USEPA, 1999	15
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration, 1-6 years	1	hours/event	USEPA, 2004	14
				t_e	Event duration, 7-31 years	0.58	hours/event	USEPA, 2004	14
				B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA, 2004	8
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	7
Dermal contact (surface water)	Trespasser/ Future Site Recreational User	Youth (Ages 8-18 years)	Groups 5 & 6	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	18
				DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coefficient	Chemical-specific	cm/h	USEPA, 2004	8
				FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight	45	kg	USEPA, 1999	19
				SA	Skin surface area	4194	cm^2	USEPA, 2004	20
				EV	Event Frequency	1	events/day	Professional judgment	21
				EF	Exposure Frequency	90	days/year	Professional judgment	21
				ED	Exposure Duration	11	years	Professional judgment	22
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	1	hours/event	Professional judgment	23
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	7
Dermal contact (surface water)	Future Site Resident	Child (1-6 years) (noncancer effects)	Groups 5 & 6	EPC	Exposure Point Concentration	Chemical-specific	mg/L	Chemical-specific	18
				DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	
				Kp	Permeability coefficient	Chemical-specific	cm/h	USEPA, 2004	8
		Child/adult (cancer effects)		FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA, 2004	8
				BW	Body weight, child	15	kg	USEPA, 1994	16
				BW	Body weight, adult	70	kg	USEPA, 1994	16
				SA	Skin surface area, child	2218	cm^2	USEPA, 2004	20
				SA	Skin surface area, adult	4927	cm^2	USEPA, 2004	20
				EV	Event Frequency	1	events/day	Professional judgment	21
				EF	Exposure Frequency	90	days/year	Professional judgment	21
				ED	Exposure Duration-child	6	years	USEPA, 1999	15
				ED	Exposure Duration-adult	24	years	USEPA, 1999	15
				tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA, 2004	8
				t_e	Event duration	1	hours/event	Professional judgment	23
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	0.001	L/cm^3	Constant	
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	6
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	7

note dermal units!!! Need to calc DA sep
RME
EXP FACTOR
RES-DCW
DC-C 120.704501
DC-NC 421.917808

note dermal units!!! Need to calc DA sep
RME
EXP FACTOR
TRES-DC_SW
DC-C 3.61E+00 ev-cm2 /d-kg
DC-NC 2.30E+01

note dermal units!!! Need to calc DA sep
RME
EXP FACTOR
RES-DC_SW
DC-C 9.07558289
DC-NC 36.460274

TABLE 3-19B Continued

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1

ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

where for inorganics: DA_{event} (mg/cm^2-event)= EPC * Kp * t_e * C2

where for organics: DA_{event} = EPC * 2 FA * Kp * C2 * SQRT{(6 * tau-event * t-e)/pi}

(short-duration exposures)

and DA_{event} = EPC * FA * Kp * C2 * [(t-event/1 + B) + 2 tau-event {(1 + 3 B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Note: The DA "exposure factor" (DA_{event} not including the EPC) is presented on Table 3-22c.

Notes:

hands, lower arms, feet, low

1. EPCs are the maximum groundwater concentration in each exposure point.
2. Since the facility worker represents a non-residential, adult exposure, we used one-half of the RME drinking water ingestion rate (2.3 L/day), which is the 90th percentile ingestion rate for adults (Table 3-30; USEPA, 1999), for this exposure scenario, assuming that a facility worker spends only a portion of the day at the site and, accordingly, would not ingest the full daily allotment for adults.
3. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency is the default EF for industrial RME scenarios, in USEPA, 2004.
4. The exposure duration (ED) for facility workers was assumed to be 25 years, which is the RME value in Exhibit 3-5, USEPA, 2004.
5. Body weight (BW) is the adult body weight presented in USEPA, 1994.
6. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
7. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
8. Chemical-specific dermal absorption coefficients/factors were obtained from USEPA, 2004.
9. Skin surface area (SA) for both the facility and construction worker scenarios was based on the mean SA for hands and forearms, from USEPA, 2004.
10. Handwashing frequency and event duration values were based on information provided by the Centers for Disease Control (CDC) and Prevention (CDC, 2002) and USEPA, 1999. USEPA (1999) also provides statistics on handwashing frequency in the United States. We assumed that a facility would wash his hands twice per hour (or 16 times per day) under the RME scenario. Information provided by the CDC indicates an average observed handwashing time of 7-10 seconds among hospital workers, which we assumed would also reflect average handwashing habits among United States residents. The CDC recommends washing hands a minimum of 15 seconds (CDC, 2002). For the RME scenario, we assumed that a facility worker spent 20 seconds per hand washing event.
11. It was assumed that construction workers would be present at the site during a one-year period of site redevelopment work. Because OSHA mandates dewatering in excavation pits or trenches, construction workers were assumed to contact groundwater only while setting up or dismantling dewatering equipment at the beginning and ending of a work week (or 52 events per year, for six months of one year), for one-half hour per exposure event.
12. Drinking water ingestion rate is based on the 90th percentile ingestion rate for children ages 1-10 yrs (Ershow and Cantor, 1989, as cited in Table 3-30, USEPA, 1999).
13. Daily drinking water ingestion rate is based on the 90th percential tapwater intake rate for males and females within age categories 11-19 (conservatively used for the 7-19 age range) and 20 through 30 years. From Ershow and Cantor, 1989, as cited in Table 3-30, EPA 1999.
14. These are the recommended exposure values for RME residential scenarios, as indicated in Exhibit 3-2, USEPA 2004.
15. We evaluated a thirty year exposure duration, which is the EPA-recommended ED for RME residential scenarios (USEPA, 1999). The ED is divided into two age groups: child, ages 1-6, which we use to evaluate noncancer effects; and child/adult, ages 7-31. Both age groups are considered collectively to evaluate cancer effects over the entire ED.
16. Body weight (BW) is the default value provided in USEPA, 1994.
17. Skin surface areas are the recommended SAs for RME residential scenarios, as indicated in Exhibit 3-2 of USEPA, 2004.
18. Surface water exposure point concentration is either the maximum detected concentration or 95% UCL concentration.
19. Body weight (BW) is based on the mean body weights for boys and girls (8 through 18 years) from US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999, Table 7-3. The mean body weight for each age category was averaged to calculate the body weight.
20. Skin surface areas for the resident and trespasser are based on the body part-specific surface area calculations for males and females within each age range, from US EPA, 2004. Parts of the body assumed to be exposed include hands, forearms, feet and lower legs.
21. We assumed that a trespasser or area resident would be exposed to contaminants in surface water for 3 days per week during the 7 non-winter months.
22. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.
23. We assumed that a trespasser or resident would be present at the site for only one hour per exposure event.

References:

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.

Center for Disease Control (CDC). 2002. *Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee* and the ICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Morbidity and Mortality Weekly Report. October 25, 2002 / Vol. 51 / No. RR-16.

TABLE 3-20A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/future
Source Medium:	Groundwater
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation of Indoor Air	Facility Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	219	days/year	USEPA, 2004	2
				ET	Exposure Time	8	hours/day	Professional judgement	3
				ED	Exposure Duration	6.6	years	USEPA, 1999	4
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6.6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Ambient Air	Construction Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	130	days/year	Professional judgement	2
				ET	Exposure Time	8	hours/day	Professional judgement	3
				ED	Exposure Duration	1	years	Professional judgement	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	1	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Volatiles while Showering/Bathing	Resident	Child (1-6 years) (noncancer effects) Older child (1-9 years) (cancer effects)	Groups 1-2 Groups 3-6	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
				EF	Exposure Frequency	350	days/year	USEPA, 2004	2
				ET	Exposure Time, child, 1-6 yrs.	0.33	hours/day	USEPA, 2004	3
				ET	Exposure Time, child, 7-9 yrs.	0.25	hours/day	USEPA, 2004	3
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	8
				ED_c	Exposure Duration-older child	3	years	USEPA, 1999	8
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Indoor Air	Resident	Child (1-6 years) (noncancer effects) Older child (1-9 years) (cancer effects)	Group 3 Group 4	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
				EF	Exposure Frequency	350	days/year	USEPA, 2004	2
				ET	Exposure Time	24	hours/day	USEPA, 1999	3
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	8
				ED_c	Exposure Duration-young/older child	9	years	USEPA, 1999	8
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Ambient Air	Resident	Child (1-6 years) (noncancer effects) Older child (1-9 years) (cancer effects)	Groups 3 & 4 and adjacent neighborhoods	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
				EF	Exposure Frequency	350	days/year	USEPA, 2004	2
				ET	Exposure Time	4	hours/day	USEPA, 1999	3
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	8
				ED_c	Exposure Duration-young/older child	9	years	USEPA, 1999	8
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	

TABLE 3-20A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/future
Source Medium:	Groundwater
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation of Ambient Air	Trespassers/ Recreational Users	Youth (8-18 years)	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	90	days/year	Professional judgement	2
				ET	Exposure Time	2	hours/day	Professional judgement	3
				ED	Exposure Duration	11	years	Professional judgement	9
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	

Average Daily Exposure (ADE) Equation:

$ADI_{inhalation}$ (mg/m^3) = EPC * EF * ET * ED * 1/AT * 1/C1 * 1/C2

1. Indoor air concentrations resulting from vapor intrusion were estimated from groundwater EPCs using the USEPA Johnson & Ettinger Vapor Intrusion Model, 2003. EPCs for ambient air were estimated from groundwater EPCs using a USEPA emissions model (USEPA, 1990). Indoor air concentrations resulting from bathing/showering exposures were estimated from groundwater EPCs using the Foster and Chrowstowski (1989) model.
2. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequencies for the facility worker and the resident are the recommended central tendency (CT) value for industrial and residential scenarios, from USEPA, 2004. The EF for construction workers assumes presence at the site 5 days per week for 6 months of a one-year construction period. The EF for the trespasser assumes a presence at the site 3 days per week during the 7 non-winter months.
3. The exposure time (ET) describes how long each individual exposure event might last. For industrial scenarios, we assumed an exposure time of 8 hours/day, a typical work day. The ET for the resident is the recommended value in Exhibit 3-2, EPA 1999 (and assumes 24 hour/day exposure for indoor air exposures). We assumed an ET of 2 hours per day for the trespasser scenario.
4. The exposure duration (ED) for facility workers was assumed to be 6.6 years. This value represents the median occupational tenure for adult workers. Obtained from Table 15-158 of USEPA, 1999.
5. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
6. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
7. It was assumed that construction workers would be present at the site 5 days per week during a one-year period of site redevelopment work.
8. We evaluated a nine year exposure duration, which is the EPA-recommended ED for central tendency residential scenarios (USEPA, 1999). The ED is divided into two age groups: child, ages 1-6, which we use to evaluate noncancer effects; and older child, ages 7-9. Both age groups are considered collectively to evaluate cancer effects over the entire ED.
9. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.

References:

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.
USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

TABLE 3-20B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/future
Source Medium:	Groundwater
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation of Indoor Air	Facility Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	250	days/year	USEPA, 2004	2
				ET	Exposure Time	8	hours/day	Professional judgement	3
				ED	Exposure Duration	25	years	USEPA, 2004	4
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	25	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Ambient Air	Construction Worker	Adult	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	130	days/year	Professional judgement	2
				ET	Exposure Time	8	hours/day	Professional judgement	3
				ED	Exposure Duration	1	years	Professional judgement	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	1	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Volatiles while Showering/Bathing	Resident	Child (1-6 years) (noncancer effects)	Groups 1-2	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Groups 3-6	EF	Exposure Frequency	350	days/year	USEPA, 2004	2
				ET	Exposure Time, child, 1-6 yrs.	1	hours/day	USEPA, 2004	3
		Child/Adult (cancer effects)		ET	Exposure Time, child/adult, 7-31 yrs.	0.58	hours/day	USEPA, 2004	3
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	8
				ED_c	Exposure Duration-adult	24	years	USEPA, 1999	9
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Indoor Air	Resident	Child (1-6 years) (noncancer effects)	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	350	days/year	USEPA, 2004	2
				ET	Exposure Time	24	hours/day	Professional judgement	3
		Child/Adult (cancer effects)		ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	8
				ED_c	Exposure Duration-adult	24	years	USEPA, 1999	8
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Ambient Air	Resident	Child (1-6 years) (noncancer effects)	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	350	days/year	USEPA, 2004	2
			Neighboring	ET	Exposure Time	4	hours/day	Professional judgement	3
		Child/Adult (cancer effects)	Residences	ED_{nc}	Exposure Duration-child	6	years	USEPA, 1999	8
				ED_c	Exposure Duration-adult	24	years	USEPA, 1999	8
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	

TABLE 3-20B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/future
Source Medium:	Groundwater
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation of Ambient Air	Trespassers/ Recreational Users	Youth (8-18 years)	Group 3	EPC	Exposure Point Concentration	Chemical-specific	mg/m³	Chemical-specific	1
			Group 4	EF	Exposure Frequency	90	days/year	Professional judgement	2
				ET	Exposure Time	2	hours/day	Professional judgement	3
				ED	Exposure Duration	11	years	Professional judgement	9
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	5
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	6
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	24	hours/day	Constant	

TABLE 3-20B continued

Average Daily Exposure (ADE) Equation:

$ADI_{inhalation}$ (mg/m^3) = EPC * EF * ET * ED * 1/AT * 1/C1 * 1/C2

Notes:

1. Indoor air concentrations resulting from vapor intrusion were estimated from groundwater EPCs using the USEPA Johnson & Ettinger Vapor Intrusion Model, 2003. EPCs for ambient air were estimated from groundwater EPCs using a USEPA emissions model (USEPA, 1990). Indoor air concentrations resulting from bathing/showering exposures were estimated from groundwater EPCs using the Foster and Chrowstowski (1989) model.
2. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency for the facility worker and resident is the recommended reasonable maximum exposure (RME) value for industrial and residential scenarios, from USEPA, 2004. The EF for construction workers assumes presence at the site 5 days per week for 6 months of a one-year construction period. The EF for the trespasser assumes a presence at the site 3 days per week during the 7 non-winter months.
3. The exposure time (ET) describes how long each individual exposure event might last. For industrial scenarios, we assumed an exposure time of 8 hours/day, a typical work day. We conservatively assumed that residents were exposed to COPCs in indoor air 24 hours per day, in accordance with USEPA guidance. Trespassers were assumed to be at the site 2 hours per day.
4. The exposure duration (ED) for facility workers was assumed to be 25 years, which is the RME value in Exhibit 3-5, USEPA, 2004.
5. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
6. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
7. It was assumed that construction workers would be present at the site 5 days per week during a one-year period of site redevelopment work.
8. We evaluated a thirty year exposure duration, which is the EPA-recommended ED for RME residential scenarios (USEPA, 1999). The ED is divided into two age groups: child, ages 1-6, which we use to evaluate noncancer effects; and child/adult, ages 7-31. Both age groups are considered collectively to evaluate cancer effects over the entire ED.
9. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected.

References:

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.
USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

TABLE 3-21A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact	Trespasser / Recreational User	Youth (8-18 years)	Group 5 Group 6	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
				IR_{sed}	Ingestion rate of sediment	50	mg/day	USEPA, 1999	2
				AF	Sediment adherence factor	0.33	mg/cm² - d	USEPA, 2004	3
				SA	Skin surface area	4194	cm²	USEPA, 2004	4
				EF	Exposure Frequency	90	days/year	Professional judgement	5
				ED	Exposure Duration	11	years	Professional judgement	6
				BW	Body weight	45	kg	USEPA, 1999	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	9
				ABSd	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1000000	mg/kg	Constant	
Incidental ingestion and dermal contact	Resident	Child (1-6 years) (noncancer effects) Older child (1-9 years) (Cancer effects)	Group 5 Group 6	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
				IR_s	Ingestion rate of soil-child, 1-6 years	100	mg/event	USEPA, 2002b	2
				IR_s	Ingestion rate of soil-older child, 7-9 years	50	mg/event	USEPA, 1999	2
				AF	Sediment adherence factor-child	0.34	mg/cm² - event	USEPA, 2004	3
				AF	Sediment adherence factor-adult	0.33	mg/cm² - event	USEPA, 2004	3
				SA	Skin surface area-child, 1-6 years	2218	cm²	USEPA, 2004	4
				SA	Skin surface area-older child, 7-9 years	4046	cm²	USEPA, 2004	4
				EF	Exposure Frequency	90	events/year	Professional judgement	5
				ED_{nc}	Exposure Duration-child	6	years	USEPA, 2004	6
				ED_c	Exposure Duration-older child	3	years	USEPA, 2004	6
				BW	Body weight, child, 1-6 years	15	kg	USEPA, 1994	7
				BW	Body weight, older child, 7-9 years	28	kg	USEPA, 1999	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	

Sediment Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2

ADI_{dermal} (mg/kg-d) = EPC * SA * AF * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2 * ABS_d

Note: Derivation of area-weighted sediment-skin adherence factors is presented in below.

Notes:

1. EPCs for sediment are based on the maximum detected concentration or 95% UCL among sediment samples collected at the site.
2. Daily soil ingestion rate (IR_{sed}) values are the recommended CT values from Table 4-23 of USEPA, 1999 (used the adult value for the trespasser scenario).
3. The AF is the geometric mean AF from the "Reed Gatherers" study presented in Exhibit C-2, USEPA, 2004. The body parts assumed to be exposed included hands, forearms, lower legs and feet. The "Reed Gatherer" scenario is considered a high-end activity for sediment contact and is, per EPA guidance, a central tendency estimate (i.e., geometric mean) of a high-end activity. The streams, wetlands and pond at the site are shallow and generally not navigable by boats and there is limited potential for exposure to sediments. Furthermore, the sediment samples were collected from locations typically inundated and thus, if actually contacted, will likely wash off.
4. Skin surface area (SA) is an age-weighted factor based on the surface area of males and females within each age category. SA values for specific body parts were obtained from Exhibit C-1 of USEPA 2004. Parts of the body assumed exposed to wetland soil included hands, forearms, lower legs and feet.
5. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. It was assumed that trespassers or area residents would be exposed to contaminants in sediment 3 times per week during the 7 non-winter months.
6. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected. The residential ED values are the recommended CT values from USEPA 2004.
7. Body weights (BW) for the older child and trespasser are based on the mean body weights for males and females for each applicable age group, from Table 7-3, USEPA, 1999. The mean body weight for each age category was averaged to calculate the body weight for this age range. Body weight (BW) for the young child is the default value provided in USEPA, 2004.
8. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
9. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
10. Dermal ABS values were obtained from Exhibit 3-4 of USEPA, 2004.

* Please refer to Tables 32 M & N and Tables 33 M & N for additional exposure parameters necessary to calculate risks associated with carcinogenic PAHs.

References:

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.

TABLE 3-21A

VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment*

Youth Trespasser Scenario (CT/RME)
Sediment Exposures

	Hands	Forearms	Feet	Lower legs	
AF	0.658	0.036	0.633	0.159	mg/cm^2
SA-7-<18	700	787	949	1610	cm^2
SA-adult	904	1173	1225	2370	cm^2

Age-Weighted SA:

Hands	((700 * 10)/11) + ((904 * 1)/11)	=	719	cm^2
Forearms	((787 * 10)/11) + ((1173 * 1)/11)	=	822	cm^2
Feet	((949 * 10)/11) + ((1225 * 1)/11)	=	974	cm^2
Lower legs	((1610 * 10)/11) + ((2370 * 1)/11)	=	1679	cm^2
	Total SA	**=**	***4194***	***cm^2***

$$WAF = \frac{(885 * 9.66) + (1138 * 0.115) + (1200 * 9.66) + (2301 * 3.4)}{(885 + 1138 + 1200 + 2301)} = \mathbf{0.33}\ \mathbf{mg/cm}$$

Based on "Reed Gatherer" Scenario, Exhibit C-2 of USEPA 2004. AF values are geometric mean values.
SA values for children are from Exhibit C-1 of USEPA 2004.
SA values for adult are mean values for males/females, presented in Exhibit C-1 of USEPA 2004.

Residential Scenario
Sediment Exposures

	Hands	Forearms	Feet	Lower legs	
AF	0.658	0.036	0.633	0.159	mg/cm^2
SA-<1 to <6	358	393	451	650	cm^2
SA <7 - <18	700	787	949	1610	cm^2
SA-adult	904	1173	1225	2370	cm^2

Total SA = **4046** ***cm^2***

Age-Weighted SA:

Child	Hands	((700 * 1)/6) + ((358 * 5)/6)	=	415	cm^2
(<7)	Lower ams	((787 * 1)/6) + ((393 * 5)/6)	=	459	cm^2
	Feet	((949 * 1)/6) + ((451 * 5)/6)	=	534	cm^2
	Lower legs	((1610 * 1)/6) + ((650 * 5)/6)	=	810	cm^2
		Total SA	**=**	***2218***	***cm^2***
Adult	Hands	((700 * 11)/24) + ((904 * 13)/24)	=	811	cm^2
(7-31)	Lower ams	((787 * 11)/24) + ((1173 * 13)/24)	=	996	cm^2
	Feet	((949 * 11)/24) + ((1225 * 13)/24)	=	1099	cm^2
	Lower legs	((1610 * 11)/24) + ((2370 * 13)/24)	=	2022	cm^2
		Total SA	**=**	***4927***	***cm^2***

CT

$$\text{Child WAF} = \frac{(415 * 9.66) + (459 * 0.115) + (534 * 9.66) + (810 * 3.4)}{(415 + 459 + 534 + 810)} = 0.34\ mg/cm$$

CT

$$\text{Adult WAF} = \frac{(700 * 9.66) + (787 * 0.115) + (949 * 9.66) + (1610 * 3.4)}{(700 + 787 + 949 + 1610)} = 0.33\ mg/cm$$

Note: Used SA for <7 - <18 year age range (not age-weighted)

RMI

$$\text{Adult WAF} = \frac{(811 * 9.66) + (996 * 0.115) + (1099 * 9.66) + (2022 * 3.4)}{(811 + 996 + 1099 + 2022)} = 0.32\ mg/cm$$

Based on "Reed Gatherer" Scenario, Exhibit C-2 of USEPA 2004. AF values are geometric mean values.
SA values for children are from Exhibit C-1 of USEPA 2004.
SA values for adult are mean values for males/females, presented in Exhibit C-1 of USEPA 2004.

TABLE 3-21B

VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact	Trespasser / Recreational User	Youth (8-18 years)	Group 5	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 6	IR_{sed}	Ingestion rate of sediment	100	mg/day	USEPA, 1999	2
				AF	Sediment adherence factor	0.33	mg/cm² - d	USEPA, 2004	3.
				SA	Skin surface area	4194	cm²	USEPA, 2004	4
				EF	Exposure Frequency	90	days/year	Professional judgement	5
				ED	Exposure Duration	11	years	Professional judgement	6
				BW	Body weight	45	kg	USEPA, 1999	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	11	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	
Incidental ingestion and dermal contact	Resident	Child (1-6 years)	Group 5	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	Chemical-specific	1
			Group 6	IR_s	Ingestion rate of soil-child	200	mg/event	USEPA, 1994	2
				IR_s	Ingestion rate of soil-adult	100	mg/event	USEPA, 1999	2
				AF	Sediment adherence factor, child	0.34	mg/cm² - d	USEPA, 2004	3.
		Adult (1-31 years)		AF	Sediment adherence factor, adult	0.32	mg/cm² - d	USEPA, 2004	3.
				SA	Skin surface area, 1-6 years	2218	cm²	USEPA, 2004	4
				SA	Skin surface area, 7-31 years	4927	cm²	USEPA, 2004	4
				EF	Exposure Frequency	90	days/year	Professional judgement	5
				ED	Exposure Duration-child	6	years	USEPA, 2004	6
				ED	Exposure Duration-adult	24	years	USEPA, 2004	6
				BW	Body weight, 1-6 years	15	kg	USEPA, 1994	7
				BW	Body weight, 7-31 years	70	kg	USEPA, 1994	7
				AT_c	Averaging Time-cancer	70	years	USEPA, 1999	8
				AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	9
				ABS_d	Dermal Absorption Fraction	Chemical-specific	unitless	USEPA 2004	10
				C1	Units Conversion Factor	365	days/year	Constant	
				C2	Units Conversion Factor	1,000,000	mg/kg	Constant	

Sediment Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2

ADI_{dermal} (mg/kg-d) = EPC * SA * AF * EF * ED * 1/BW * 1/AT * 1/C1 * 1/C2 * ABS_d
Note: Derivation of area-weighted soil-skin adherence factors is presented in Table 3-21a

Notes:

1. EPCs for sediment were based on the maximum detected or 95% UCL of the mean concentration from sediment samples collected at the site.
2. Daily soil ingestion rate (IR_{sed}) values are the recommended RME values from Table 4-23 of USEPA, 1999 (used the adult value for the trespasser scenario).
3. The AF is the geometric mean AF from the "Reed Gatherers" study presented in Exhibit C-2, USEPA, 2004. The body parts assumed to be exposed included hands, forearms, lower legs and feet. The "Reed Gatherer" scenario is considered a high-end activity for sediment contact and is, per EPA guidance, a central tendency estimate (i.e., geometric mean) of a high-end activity. The streams, wetlands and pond at the site are shallow and generally not navigable by boats and there is limited potential for exposure to sediments. Furthermore, the sediment samples were collected from locations typically inundated and thus, if actually contacted, will likely wash off.
4. Skin surface area (SA) is an age-weighted factor based on the surface area of males and females within each age category. SA values for specific body parts were obtained from Exhibit C-1 of USEPA 2004. Parts of the body assumed exposed to wetland soil included hands, forearms, lower legs and feet.
5. Exposure frequency (EF) describes how often the exposure event occurs over a given period of time. It was assumed that trespassers or area residents would be exposed to contaminants in sediment 3 times per week during the 7 non-winter months.
6. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The trespasser was assumed to be 8 through 18 years old, so an exposure period of 11 years was selected. Residential ED values are the recommended values for RME scenarios, EPA 2004.
7. Body weight (BW) for the trespasser is based on the mean body weights for both sexes (8 through 18 years) from Table 7-3 of USEPA 1999. The mean body weight for each age category was averaged to calculate the body weight for each age group. Body weights for the residential child and adult are the default values provided in USEPA, 1994.
8. The averaging time (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1999.
9. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration.
10. Dermal ABS values were obtained from Exhibit 3-4 of USEPA, 2004.

* Please refer to Tables 32 M & N and Tables 33 M & N for additional exposure parameters necessary to calculate risks associated with carcinogenic PAHs.

References:

USEPA, 1999. US EPA Exposure Factors Handbook EPA/600/C-99/001, February 1999.

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

USEPA, 2002. US EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.

TABLE 3-22a

DERMAL ABSORPTION FRACTIONS FOR SOIL

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Dermal Absorption Fraction from Soil	Source*
Organics		
1,1,1-Trichloroethane		Not available*
1,1,2-Trichloroethane		Not available*
1,1-Dichloroethane		Not available*
1,1-Dichloroethene		Not available*
1,2,4-Trimethylbenzene		Not available*
1,2-Dichloroethane		Not available*
1,2-Dichloroethene		Not available*
1,2-Dichloropropane		Not available*
1,3,5-Trimethylbenzene		Not available*
1,4-Dichlorobenzene		Not available*
1,4-Dioxane		Not available*
1-Methylnaphthalene	1.30E-01	Default for PAHs; USEPA 2004
2,4-Dimethylphenol	1.00E-01	Default for SVOCs; USEPA 2004
2-Butanone		Not available*
2-Methylnaphthalene	1.30E-01	Default for PAHs; USEPA 2004
2-Methylphenol	1.00E-01	Default for SVOCs; USEPA 2004
3-Methylphenol/4-Methylphenol	1.00E-01	Default for SVOCs; USEPA 2004
4-Chloro-3-methylphenol	1.00E-01	Default for SVOCs; USEPA 2004
4-Methyl-2-pentanone		Not available*
4-Methylphenol	1.00E-01	Default for SVOCs; USEPA 2004
Acetone		Not available*
Alpha-BHC	1.00E-01	Default for SVOCs; USEPA 2004
Aroclor 1254	1.40E-01	Value from USEPA 2004
Benzene		Not available*
Benzo(a)anthracene	1.30E-01	Default for PAHs; USEPA 2004
Benzo(a)pyrene	1.30E-01	Default for PAHs; USEPA 2004
Benzo(b)fluoranthene	1.30E-01	Default for PAHs; USEPA 2004
Benzo(e)pyrene	1.30E-01	Default for PAHs; USEPA 2004
Benzo(k)fluoranthene	1.30E-01	Default for PAHs; USEPA 2004
Bis(2-Chloroethoxy)methane	1.00E-01	Default for SVOCs; USEPA 2004
Bis(2-ethylhexyl)phthalate	1.00E-01	Default for SVOCs; USEPA 2004
C11-C22 Aromatics	1.00E-01	Default for SVOCs; USEPA 2004
Carbazole	1.00E-01	Default for SVOCs; USEPA 2004
Carbon tetrachloride		Not available*
Chloroethane		Not available*
Chloroform		Not available*
cis-1,2-Dichloroethene		Not available*
Dibenzo(a,h)anthracene	1.30E-01	Default for PAHs; USEPA 2004
Dibenzofuran	1.00E-01	Default for SVOCs; USEPA 2004
Di-n-octylphthalate	1.00E-01	Default for SVOCs; USEPA 2004
Ethylbenzene		Not available*
Indeno(1,2,3-cd)pyrene	1.30E-01	Default for PAHs; USEPA 2004
Isopropylbenzene		Not available*
Methylene Chloride		Not available*
Naphthalene	1.30E-01	Default for PAHs; USEPA 2004

TABLE 3-22a

DERMAL ABSORPTION FRACTIONS FOR SOIL

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Dermal Absorption Fraction from Soil	Source*
n-Butylbenzene		Not available*
n-Propylbenzene		Not available*
Perylene	1.30E-01	Default for PAHs; USEPA 2004
Phenanthrene	1.30E-01	Default for PAHs; USEPA 2004
Phenol	1.00E-01	Default for SVOCs; USEPA 2004
Styrene		Not available*
tert-Butylbenzene		Not available*
Tetrachloroethene		Not available*
Tetrahydrofuran	1.00E-01	Default for SVOCs; USEPA 2004
Toluene		Not available*
Trichloroethene		Not available*
Trichlorofluoromethane		Not available*
Vinyl Chloride		Not available*
Xylenes (total)		Not available*
Inorganics		
Antimony		Not available*
Arsenic	3.00E-02	Value from USEPA 2004
Barium		Not available*
Beryllium		Not available*
Cadmium	1.00E-03	Value from USEPA 2004
Chromium		Not available*
Cobalt		Not available*
Copper		Not available*
Lead		Not available*
Manganese		Not available*
Nickel		Not available*
Selenium		Not available*
Silver		Not available*
Thallium		Not available*
Vanadium		Not available*
Zinc		Not available*

Footnotes:

*Unless otherwise noted, values are from USEPA 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. EPA/540/R/99/005.

Risks associated with dermal exposure to volatile organic compounds and inorganics are qualitatively evaluated in the uncertainty analysis.

TABLE 3-22b
CONSTITUENT-SPECIFIC PARAMETERS USED IN ESTIMATING DERMAL ABSORPTION FROM WATER
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)		Tau (hour/event)		Fraction Absorbed (FA) (unitless)	
Antimony	1.0E-03	c	Not Applicable		Not Applicable	
Arsenic	1.0E-03	c	Not Applicable		Not Applicable	
Barium	1.0E-03	c	Not Applicable		Not Applicable	
Beryllium	1.0E-03	c	Not Applicable		Not Applicable	
Cadmium	1.0E-03	b	Not Applicable		Not Applicable	
Chromium	1.0E-03	b	Not Applicable		Not Applicable	
Cobalt	4.0E-04	b	Not Applicable		Not Applicable	
Copper	1.0E-03	c	Not Applicable		Not Applicable	
Lead	1.0E-04	b	Not Applicable		Not Applicable	
Manganese	1.0E-03	c	Not Applicable		Not Applicable	
Nickel	2.0E-04	b	Not Applicable		Not Applicable	
Selenium	1.0E-03	c	Not Applicable		Not Applicable	
Silver	6.0E-04	b	Not Applicable		Not Applicable	
Thallium	1.0E-03	c	Not Applicable		Not Applicable	
Vanadium	1.0E-03	c	Not Applicable		Not Applicable	
Zinc	6.0E-04	b	Not Applicable		Not Applicable	
Aroclor 1254		i		i		i
Alpha-BHC	1.6E-02	f	1	h	1	h
C11-C22 Aromatic Hydrocarbons	4.6E-01	f	1	h	1	h
2-Methylphenol	1.0E-02	g	1	h	1	h
3-Methylphenol/4-Methylphenol	8.0E-03	f	1	h	1	h
4-Methylphenol	8.0E-03	f	1	h	1	h
Acenaphthene	8.4E-02	f	1	h	1	h
Acetophenone	4.7E-03	g	1	h	1	h
Acrylonitrile	1.2E-03	a	0.21	d	1	d
Bis(2-Ethylhexyl)phthalate	2.4E-02	f	16.64	d	0.8	d
Naphthalene	4.7E-02	a	0.56	d	1	d
N-Nitrosodi-n-butylamine	3.8E-03	a	0.82	d	1	d
N-Nitrosopyrrolidine	3.4E-04	g	1	h	1	h
o-Toluidine	3.0E-03	a	0.42	d	1	d
Phenol	8.1E-03	a	0.36	d	1	d
Pyridine	1.8E-03	g	1	h	1	h
1,1,1-Trichloroethane	1.3E-02	a	0.6	d	1	d
1,1,2-Trichloroethane	6.4E-03	a	0.6	d	1	d
1,1-Dichloroethane	6.7E-03	a	0.38	d	1	d
1,1-Dichloroethene	1.2E-02	a	0.37	d	1	d
1,2,4-Trichlorobenzene	6.6E-02	a	1.11	d	1	d
1,2,4-Trimethylbenzene	1.1E-01	f	1	h	1	h
1,2-Dichloroethane	4.2E-03	a	0.38	d	1	d
1,2-Dichloroethene (Total)	7.7E-03	a	0.37	d	1	d
cis-1,2-Dichloroethene	7.7E-03	f	0.37	d	1	d
1,2-Dichloropropane	7.8E-03	a	0.46	d	1	d
1,3,5-Trimethylbenzene	6.1E-02	f	1	h	1	h
1,4-Dioxane	3.3E-04	a	0.33	d	1	d
2-Butanone	1.1E-03	g	0.27	d	1	d
2-Hexanone	4.5E-03	f	1	h	1	h
4-Methyl-2-pentanone	4.0E-03	g	0.39	d	1	d
Acetone	5.2E-04	f	1	h	1	h
Benzene	1.5E-02	a	0.29	d	1	d
Carbon tetrachloride	1.6E-02	a	0.78	d	1	d
Chlorobenzene	2.8E-02	a	0.46	d	1	d
Chloroethane	6.1E-03	a	0.24	d	1	d
Chloroform	6.8E-03	a	0.5	d	1	d
Dichlorodifluoromethane	9.0E-03	a	0.51	d	1	d
Ethyl Ether	2.3E-03	a	0.28	d	1	d
Ethylbenzene	4.9E-02	a	0.42	d	1	d
Ethyl methacrylate	9.1E-03	g	1	h	1	h
Isopropylbenzene	7.0E-02	f	1	h	1	h
Methyl tert butyl ether	2.1E-03	f	1	h	1	h
Methylene Chloride	3.5E-03	a	0.32	d	1	d
2-Methylnaphthalene	4.7E-02	d	0.56	d	1	d
n-Propylbenzene	9.2E-02	f	1	h	1	h

TABLE 3-22b
CONSTITUENT-SPECIFIC PARAMETERS USED IN ESTIMATING DERMAL ABSORPTION FROM WATER
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)		Tau (hour/event)		Fraction Absorbed (FA) (unitless)	
p-Isopropyltoluene	1.4E-01	f	1	h	1	h
Styrene	3.7E-02	a	0.41	d	1	d
n-Butylbenzene	1.8E-01	f	1	h	1	h
tert-Butylbenzene	1.4E-01	f	1	h	1	h
Tetrachloroethene	3.3E-02	a	0.91	d	1	d
Tetrahydrofuran	1.3E-03	f	1	h	1	h
Toluene	3.1E-02	a	0.35	d	1	d
Trichloroethene	1.2E-02	a	0.58	d	1	d
Trichlorofluoromethane	1.3E-02	a	0.63	d	1	d
Vinyl chloride	5.6E-03	a	0.24	d	1	d
Xylenes (total)	7.0E-02	g	0.42	d	1	d

NOTES:

a Kp value obtained from US EPA, RAGS Part E, Supplemental Guidance for Dermal Risk Assessment Final, EPA/540/R/99/005, July 2004. Exhibit B-2.

b Kp value obtained from US EPA, RAGS Part E, Supplemental Guidance for Dermal Risk Assessment Final, EPA/540/R/99/005, July 2004. Exhibit 3-1.

c A default value of 0.001 cm/hr was used to represent the Kp for inorganic compounds not tested, as recommended in US EPA, RAGS Part E, Supplemental Guidance for Dermal Risk Assessment Final, EPA/540/R/99/005, July 2004. Exhibit 3-1.

d Tau and FA obtained from US EPA, RAGS Part E, Supplemental Guidance for Dermal Risk Assessment Final, EPA/540/R/99/005, July 2004. Exhibit B-3.

e Versar Inc., PCB Risk Assessment Review Guidance Document, June 1998.

f Compound-specific molecular weight (MW) and Kow values obtained from U.S. EPA Office of Health and Environment and Hampshire Research Institute, Risk Assistant, 1991, unless otherwise noted.

Log Kow value obtained from Illustrated Handbook of Physical-Chemical Properties and Environmental Fate of Organic Compounds, Volume II, Mackay, Donald, Shiu, Wan Ying, and Ma, Kuo Ching, 1992.
Molecular weight and log Kow value obtained from Howard, 1989.
Molecular weight and log Kow value obtained from Groundwater Chemical Desk Reference, J.H. Montgomery; L.M. Welkon, 1990
Molecular weight and log Kow value obtained from Montgomery, John H., Groundwater Chemical Desk Reference Volume 2, 1991
Equation 5.8 from U.S. EPA, "Dermal Exposure Assessment: Principles and Applications," Interim Report, Office of Reasearch and Development, EPA 600/8-91/001B, January 1992, was used to calculate estimated Kp value.
$\log Kp = -2.72 + 0.71 \log Kow - 0.0061 MW$

g Values obtained from the Risk Assessment Information System (RAIS), April 2006, which were calculated using USEPAs DERMWIN (The Dermal Permeability Coefficient) Program, which utilizes the equation listed above.

h A default value of 1 hr/event, and 1 (unitless) was used to represent the Tau and FA, respectively, for compounds not tested.

i Kp is outside the effective prediction domain of the model; therefore, aqueous dermal risks not quantified for Aroclor 1254.

TABLE 3-22c
CALCULATION OF THE DERMAL ABSORBED (DA) FACTOR
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)	Tau (hour/event)	Absorbed (FA) (unitless)	Constants C2 L/cm3	Constants 2FA	Group 3-4, Facility Worker, CT te (hr/event)	Group 3-4, Facility Worker, CT pi	Group 3-4, Facility Worker, CT SQRT(6tau*t/pi)	Group 3-4, Facility Worker, CT DAfactor grp 3-4 FW	Group 3-4, Facility Worker, RME te (hr/event)	Group 3-4, Facility Worker, RME pi	Group 3-4, Facility Worker, RME SQRT(6tau*t/pi)	Group 3-4, Facility Worker, RME DAfactor grp 3-4 FW
			Fraction										
Antimony	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Arsenic	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Barium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Beryllium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Cadmium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Chromium	2.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**5.6E-09**	5.6E-03	3.1E+00		**1.1E-08**
Cobalt	4.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**1.1E-09**	5.6E-03	3.1E+00		**2.2E-09**
Copper	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Lead	1.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-10**	5.6E-03	3.1E+00		**5.6E-10**
Manganese	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Nickel	2.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**5.6E-10**	5.6E-03	3.1E+00		**1.1E-09**
Selenium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Silver	6.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**1.7E-09**	5.6E-03	3.1E+00		**3.3E-09**
Thallium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Vanadium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**2.8E-09**	5.6E-03	3.1E+00		**5.6E-09**
Zinc	6.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00		**1.7E-09**	5.6E-03	3.1E+00		**3.3E-09**
Aroclor 1254	0.0E+00	4.6E+00	6.0E-01	1.0E-03	2.0E+00	2.8E-03	3.1E+00	1.6E-01	**0.0E+00**	5.6E-03	3.1E+00	2.2E-01	**0.0E+00**
Alpha-BHC	1.6E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**2.3E-06**	5.6E-03	3.1E+00	1.0E-01	**3.3E-06**
2,4-Dimethylphenol	1.1E-02	5.2E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.3E-02	**1.2E-06**	5.6E-03	3.1E+00	7.4E-02	**1.6E-06**
3-Methylphenol/4-Methylphenol	8.0E-03	4.3E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.8E-02	**7.6E-07**	5.6E-03	3.1E+00	6.8E-02	**1.1E-06**
4-Methylphenol	8.0E-03	4.3E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.8E-02	**7.6E-07**	5.6E-03	3.1E+00	6.8E-02	**1.1E-06**
Acetophenone	4.7E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**6.8E-07**	5.6E-03	3.1E+00	1.0E-01	**9.6E-07**
Acrylonitrile	1.2E-03	2.1E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.3E-02	**8.0E-08**	5.6E-03	3.1E+00	4.7E-02	**1.1E-07**
Bis(2-Ethylhexyl)phthalate	2.4E-02	1.7E+01	8.0E-01	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.0E-01	**1.1E-05**	5.6E-03	3.1E+00	4.2E-01	**1.6E-05**
Ethyl methacrylate	9.1E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**1.3E-06**	5.6E-03	3.1E+00	1.0E-01	**1.9E-06**
Naphthalene	4.7E-02	5.6E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.5E-02	**5.1E-06**	5.6E-03	3.1E+00	7.7E-02	**7.2E-06**
N-Nitrosodi-n-butylamine	3.8E-03	8.2E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	6.6E-02	**5.0E-07**	5.6E-03	3.1E+00	9.3E-02	**7.1E-07**
N-Nitrosopyrrolidine	3.4E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**5.0E-08**	5.6E-03	3.1E+00	1.0E-01	**7.0E-08**
o-Toluidine	3.0E-03	4.2E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.7E-02	**2.8E-07**	5.6E-03	3.1E+00	6.7E-02	**4.0E-07**
Phenol	8.1E-03	3.6E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.4E-02	**7.1E-07**	5.6E-03	3.1E+00	6.2E-02	**1.0E-06**
Pyridine	1.8E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**2.7E-07**	5.6E-03	3.1E+00	1.0E-01	**3.8E-07**
1,1,1-Trichloroethane	1.3E-02	6.0E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.6E-02	**1.5E-06**	5.6E-03	3.1E+00	8.0E-02	**2.1E-06**
1,1,2-Trichloroethane	6.4E-03	6.0E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.6E-02	**7.2E-07**	5.6E-03	3.1E+00	8.0E-02	**1.0E-06**
1,1-Dichloroethane	6.7E-03	3.8E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.5E-02	**6.0E-07**	5.6E-03	3.1E+00	6.4E-02	**8.5E-07**
1,1-Dichloroethene	1.2E-02	3.7E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.4E-02	**1.1E-06**	5.6E-03	3.1E+00	6.3E-02	**1.5E-06**
1,2,4-Trichlorobenzene	6.6E-02	1.1E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.7E-02	**1.0E-05**	5.6E-03	3.1E+00	1.1E-01	**1.4E-05**
1,2,4-Trimethylbenzene	1.1E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**1.6E-05**	5.6E-03	3.1E+00	1.0E-01	**2.3E-05**
1,4-Dichlorobenzene	4.2E-02	7.1E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	6.1E-02	**5.2E-06**	5.6E-03	3.1E+00	8.7E-02	**7.3E-06**
1,2-Dichloroethane	4.2E-03	3.8E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.5E-02	**3.8E-07**	5.6E-03	3.1E+00	6.4E-02	**5.3E-07**
1,2-Dichloroethene	7.7E-03	3.7E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.4E-02	**6.8E-07**	5.6E-03	3.1E+00	6.3E-02	**9.7E-07**
cis-1,2-Dichloroethene	7.7E-03	3.7E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.4E-02	**6.8E-07**	5.6E-03	3.1E+00	6.3E-02	**9.7E-07**
1,2-Dichloropropane	7.8E-03	4.6E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.9E-02	**7.7E-07**	5.6E-03	3.1E+00	7.0E-02	**1.1E-06**
1,3,5-Trimethylbenzene	6.1E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**8.9E-06**	5.6E-03	3.1E+00	1.0E-01	**1.3E-05**
1,4-Dioxane	3.3E-04	3.3E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.2E-02	**2.8E-08**	5.6E-03	3.1E+00	5.9E-02	**3.9E-08**
2-Butanone	1.1E-03	2.7E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.8E-02	**8.4E-08**	5.6E-03	3.1E+00	5.4E-02	**1.2E-07**
2-Hexanone	4.5E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**6.6E-07**	5.6E-03	3.1E+00	1.0E-01	**9.3E-07**
4-Methyl-2-pentanone	4.0E-03	3.9E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.5E-02	**3.6E-07**	5.6E-03	3.1E+00	6.4E-02	**5.1E-07**
Acetone	5.2E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**7.6E-08**	5.6E-03	3.1E+00	1.0E-01	**1.1E-07**
Benzene	1.5E-02	2.9E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.9E-02	**1.2E-06**	5.6E-03	3.1E+00	5.5E-02	**1.7E-06**
Carbon tetrachloride	1.6E-02	7.8E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	6.4E-02	**2.1E-06**	5.6E-03	3.1E+00	9.1E-02	**2.9E-06**
Chlorobenzene	2.8E-02	4.6E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.9E-02	**2.8E-06**	5.6E-03	3.1E+00	7.0E-02	**3.9E-06**
Chloroethane	6.1E-03	2.4E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.6E-02	**4.4E-07**	5.6E-03	3.1E+00	5.0E-02	**6.2E-07**

TABLE 3-22c
CALCULATION OF THE DERMAL ABSORBED (DA) FACTOR
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)	Tau (hour/event)	Absorbed (FA) (unitless)	Constants C2 L/cm3	2FA	Group 3-4, Facility Worker, CT te (hr/event)	pi	SQRT(6tau*t/pi)	DAfactor grp 3-4 FW	Group 3-4, Facility Worker, RME te (hr/event)	pi	SQRT(6tau*t/pi)	DAfactor grp 3-4 FW
Chloroform	6.8E-03	5.0E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.2E-02	**7.0E-07**	5.6E-03	3.1E+00	7.3E-02	**9.9E-07**
Dichlorodifluoromethane	9.0E-03	5.1E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.2E-02	**9.4E-07**	5.6E-03	3.1E+00	7.4E-02	**1.3E-06**
Ethyl Ether	2.3E-03	2.8E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.9E-02	**1.8E-07**	5.6E-03	3.1E+00	5.5E-02	**2.5E-07**
Ethylbenzene	4.9E-02	4.2E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.7E-02	**4.6E-06**	5.6E-03	3.1E+00	6.7E-02	**6.5E-06**
Isopropylbenzene	7.0E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**1.0E-05**	5.6E-03	3.1E+00	1.0E-01	**1.4E-05**
Methylene Chloride	3.5E-03	3.2E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.1E-02	**2.9E-07**	5.6E-03	3.1E+00	5.8E-02	**4.1E-07**
2-Methylnaphthalene	4.7E-02	5.6E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.5E-02	**5.1E-06**	5.6E-03	3.1E+00	7.7E-02	**7.2E-06**
n-Propylbenzene	9.2E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**1.3E-05**	5.6E-03	3.1E+00	1.0E-01	**1.9E-05**
p-Isopropyltoluene	1.4E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**2.0E-05**	5.6E-03	3.1E+00	1.0E-01	**2.9E-05**
Styrene	3.7E-02	4.1E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.7E-02	**3.5E-06**	5.6E-03	3.1E+00	6.6E-02	**4.9E-06**
n-Butylbenzene	1.8E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**2.6E-05**	5.6E-03	3.1E+00	1.0E-01	**3.7E-05**
tert-Butylbenzene	1.4E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**2.0E-05**	5.6E-03	3.1E+00	1.0E-01	**2.9E-05**
Tetrachloroethene	3.3E-02	9.1E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	6.9E-02	**4.6E-06**	5.6E-03	3.1E+00	9.8E-02	**6.5E-06**
Tetrahydrofuran	1.3E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	7.3E-02	**1.9E-07**	5.6E-03	3.1E+00	1.0E-01	**2.7E-07**
Toluene	3.1E-02	3.5E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.3E-02	**2.7E-06**	5.6E-03	3.1E+00	6.1E-02	**3.8E-06**
Trichloroethene	1.2E-02	5.8E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.5E-02	**1.3E-06**	5.6E-03	3.1E+00	7.8E-02	**1.9E-06**
Trichlorofluoromethane	1.3E-02	6.3E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	5.8E-02	**1.5E-06**	5.6E-03	3.1E+00	8.2E-02	**2.1E-06**
Vinyl chloride	5.6E-03	2.4E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	3.6E-02	**4.0E-07**	5.6E-03	3.1E+00	5.0E-02	**5.7E-07**
Xylenes (total)	7.0E-02	4.2E-01	1.0E+00	1.0E-03	2.0E+00	2.8E-03	3.1E+00	4.7E-02	**6.6E-06**	5.6E-03	3.1E+00	6.7E-02	**9.4E-06**

Notes:

1. ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

Where for inorganics: DA_{event} = EPC * Kp * C2 * t-e

Where for organics: DA_{event} = EPC * 2 FA * Kp * C2 * SQRT{(6 * tau-event * t-e)/pi}

(short-duration exposures)

and DA_{event} = EPC * FA * Kp * C2 * [(t-event/1 + B) + 2 tau-event {(1 + 3 B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

2. DA_{factor} includes all above variables except for the groundwater EPC. (DA_{factor} = DA_{event} / EPC)

3. CT = Central Tendency; RME = Reasonable Maximum Exposure; EPC = groundwater exposure point concentration

TABLE 3-22c
CALCULATION OF THE DERMAL ABSORBED (DA) FACTOR
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)	Tau (hour/event)	Absorbed (FA) (unitless)	Constants C2 L/cm3	Constants 2FA	Group 3-4 Construction Worker, CT te (hr/event)	Group 3-4 Construction Worker, CT SQRT(6tau*t/pi)	Group 3-4 Construction Worker, CT DAfactor grp 3-4 CW	Group 3-4 Construction Worker, RME te (hr/event)	Group 3-4 Construction Worker, RME SQRT(6tau*t/pi)	Group 3-4 Construction Worker, RME DAfactor grp 3-4 CW	Group 3-4 Resident, CT te (hr/event)	Group 3-4 Resident, CT SQRT(6tau*t/pi)	Group 3-4 Resident, CT DAfactor grp 3-4 Res	Group 5 Trespasser/Future Resident, CT te (hr/event)	Group 5 Trespasser/Future Resident, CT SQRT(6tau*t/pi)	Group 5 Trespasser/Future Resident, CT DAfactor grp 5 TP/FR
			Fraction														
Antimony	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Arsenic	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Barium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Beryllium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Cadmium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Chromium	2.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**1.0E-06**	5.0E-01		**1.0E-06**	3.3E-01		**6.6E-07**	1.0E+00		**2.0E-06**
Cobalt	4.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**2.0E-07**	5.0E-01		**2.0E-07**	3.3E-01		**1.3E-07**	1.0E+00		**4.0E-07**
Copper	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Lead	1.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-08**	5.0E-01		**5.0E-08**	3.3E-01		**3.3E-08**	1.0E+00		**1.0E-07**
Manganese	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Nickel	2.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**1.0E-07**	5.0E-01		**1.0E-07**	3.3E-01		**6.6E-08**	1.0E+00		**2.0E-07**
Selenium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Silver	6.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**3.0E-07**	5.0E-01		**3.0E-07**	3.3E-01		**2.0E-07**	1.0E+00		**6.0E-07**
Thallium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Vanadium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**5.0E-07**	5.0E-01		**5.0E-07**	3.3E-01		**3.3E-07**	1.0E+00		**1.0E-06**
Zinc	6.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01		**3.0E-07**	5.0E-01		**3.0E-07**	3.3E-01		**2.0E-07**	1.0E+00		**6.0E-07**
Aroclor 1254	0.0E+00	4.6E+00	6.0E-01	1.0E-03	2.0E+00	5.0E-01	2.1E+00	**0.0E+00**	5.0E-01	2.1E+00	**0.0E+00**	3.3E-01	1.7E+00	**0.0E+00**	1.0E+00	3.0E+00	**0.0E+00**
Alpha-BHC	1.6E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**3.1E-05**	5.0E-01	9.8E-01	**3.1E-05**	3.3E-01	7.9E-01	**2.5E-05**	1.0E+00	1.4E+00	**4.4E-05**
2,4-Dimethylphenol	1.1E-02	5.2E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.0E-01	**1.6E-05**	5.0E-01	7.0E-01	**1.6E-05**	3.3E-01	5.7E-01	**1.3E-05**	1.0E+00	1.0E+00	**2.2E-05**
3-Methylphenol/4-Methylphenol	8.0E-03	4.3E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.4E-01	**1.0E-05**	5.0E-01	6.4E-01	**1.0E-05**	3.3E-01	5.2E-01	**8.3E-06**	1.0E+00	9.1E-01	**1.5E-05**
4-Methylphenol	8.0E-03	4.3E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.4E-01	**1.0E-05**	5.0E-01	6.4E-01	**1.0E-05**	3.3E-01	5.2E-01	**8.3E-06**	1.0E+00	9.1E-01	**1.5E-05**
Acetophenone	4.7E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**9.1E-06**	5.0E-01	9.8E-01	**9.1E-06**	3.3E-01	7.9E-01	**7.4E-06**	1.0E+00	1.4E+00	**1.3E-05**
Acrylonitrile	1.2E-03	2.1E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	4.5E-01	**1.1E-06**	5.0E-01	4.5E-01	**1.1E-06**	3.3E-01	3.6E-01	**8.7E-07**	1.0E+00	6.3E-01	**1.5E-06**
Bis(2-Ethylhexyl)phthalate	2.4E-02	1.7E+01	8.0E-01	1.0E-03	2.0E+00	5.0E-01	4.0E+00	**1.5E-04**	5.0E-01	4.0E+00	**1.5E-04**	3.3E-01	3.2E+00	**1.2E-04**	1.0E+00	5.6E+00	**2.2E-04**
Ethyl methacrylate	9.1E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**1.8E-05**	5.0E-01	9.8E-01	**1.8E-05**	3.3E-01	7.9E-01	**1.5E-05**	1.0E+00	1.4E+00	**2.5E-05**
Naphthalene	4.7E-02	5.6E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.3E-01	**6.9E-05**	5.0E-01	7.3E-01	**6.9E-05**	3.3E-01	5.9E-01	**5.6E-05**	1.0E+00	1.0E+00	**9.7E-05**
N-Nitrosodi-n-butylamine	3.8E-03	8.2E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	8.9E-01	**6.7E-06**	5.0E-01	8.9E-01	**6.7E-06**	3.3E-01	7.2E-01	**5.5E-06**	1.0E+00	1.3E+00	**9.5E-06**
N-Nitrosopyrrolidine	3.4E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**6.7E-07**	5.0E-01	9.8E-01	**6.7E-07**	3.3E-01	7.9E-01	**5.4E-07**	1.0E+00	1.4E+00	**9.5E-07**
o-Toluidine	3.0E-03	4.2E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.3E-01	**3.8E-06**	5.0E-01	6.3E-01	**3.8E-06**	3.3E-01	5.1E-01	**3.1E-06**	1.0E+00	9.0E-01	**5.4E-06**
Phenol	8.1E-03	3.6E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.9E-01	**9.5E-06**	5.0E-01	5.9E-01	**9.5E-06**	3.3E-01	4.8E-01	**7.7E-06**	1.0E+00	8.3E-01	**1.3E-05**
Pyridine	1.8E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**3.6E-06**	5.0E-01	9.8E-01	**3.6E-06**	3.3E-01	7.9E-01	**2.9E-06**	1.0E+00	1.4E+00	**5.0E-06**
1,1,1-Trichloroethane	1.3E-02	6.0E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.6E-01	**2.0E-05**	5.0E-01	7.6E-01	**2.0E-05**	3.3E-01	6.2E-01	**1.6E-05**	1.0E+00	1.1E+00	**2.8E-05**
1,1,2-Trichloroethane	6.4E-03	6.0E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.6E-01	**9.7E-06**	5.0E-01	7.6E-01	**9.7E-06**	3.3E-01	6.2E-01	**7.9E-06**	1.0E+00	1.1E+00	**1.4E-05**
1,1-Dichloroethane	6.7E-03	3.8E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.0E-01	**8.1E-06**	5.0E-01	6.0E-01	**8.1E-06**	3.3E-01	4.9E-01	**6.6E-06**	1.0E+00	8.5E-01	**1.1E-05**
1,1-Dichloroethene	1.2E-02	3.7E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.9E-01	**1.4E-05**	5.0E-01	5.9E-01	**1.4E-05**	3.3E-01	4.8E-01	**1.2E-05**	1.0E+00	8.4E-01	**2.0E-05**
1,2,4-Trichlorobenzene	6.6E-02	1.1E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	1.0E+00	**1.4E-04**	5.0E-01	1.0E+00	**1.4E-04**	3.3E-01	8.4E-01	**1.1E-04**	1.0E+00	1.5E+00	**1.9E-04**
1,2,4-Trimethylbenzene	1.1E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**2.2E-04**	5.0E-01	9.8E-01	**2.2E-04**	3.3E-01	7.9E-01	**1.7E-04**	1.0E+00	1.4E+00	**3.0E-04**
1,4-Dichlorobenzene	4.2E-02	7.1E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	8.2E-01	**6.9E-05**	5.0E-01	8.2E-01	**6.9E-05**	3.3E-01	6.7E-01	**5.6E-05**	1.0E+00	1.2E+00	**9.8E-05**
1,2-Dichloroethane	4.2E-03	3.8E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.0E-01	**5.1E-06**	5.0E-01	6.0E-01	**5.1E-06**	3.3E-01	4.9E-01	**4.1E-06**	1.0E+00	8.5E-01	**7.2E-06**
1,2-Dichloroethene	7.7E-03	3.7E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.9E-01	**9.2E-06**	5.0E-01	5.9E-01	**9.2E-06**	3.3E-01	4.8E-01	**7.4E-06**	1.0E+00	8.4E-01	**1.3E-05**
cis-1,2-Dichloroethene	7.7E-03	3.7E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.9E-01	**9.2E-06**	5.0E-01	5.9E-01	**9.2E-06**	3.3E-01	4.8E-01	**7.4E-06**	1.0E+00	8.4E-01	**1.3E-05**
1,2-Dichloropropane	7.8E-03	4.6E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.6E-01	**1.0E-05**	5.0E-01	6.6E-01	**1.0E-05**	3.3E-01	5.4E-01	**8.4E-06**	1.0E+00	9.4E-01	**1.5E-05**
1,3,5-Trimethylbenzene	6.1E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**1.2E-04**	5.0E-01	9.8E-01	**1.2E-04**	3.3E-01	7.9E-01	**9.7E-05**	1.0E+00	1.4E+00	**1.7E-04**
1,4-Dioxane	3.3E-04	3.3E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.6E-01	**3.7E-07**	5.0E-01	5.6E-01	**3.7E-07**	3.3E-01	4.6E-01	**3.0E-07**	1.0E+00	7.9E-01	**5.2E-07**
2-Butanone	1.1E-03	2.7E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.1E-01	**1.1E-06**	5.0E-01	5.1E-01	**1.1E-06**	3.3E-01	4.1E-01	**9.2E-07**	1.0E+00	7.2E-01	**1.6E-06**
2-Hexanone	4.5E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**8.8E-06**	5.0E-01	9.8E-01	**8.8E-06**	3.3E-01	7.9E-01	**7.1E-06**	1.0E+00	1.4E+00	**1.2E-05**
4-Methyl-2-pentanone	4.0E-03	3.9E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.1E-01	**4.8E-06**	5.0E-01	6.1E-01	**4.8E-06**	3.3E-01	5.0E-01	**3.9E-06**	1.0E+00	8.6E-01	**6.9E-06**
Acetone	5.2E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**1.0E-06**	5.0E-01	9.8E-01	**1.0E-06**	3.3E-01	7.9E-01	**8.3E-07**	1.0E+00	1.4E+00	**1.4E-06**
Benzene	1.5E-02	2.9E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.3E-01	**1.6E-05**	5.0E-01	5.3E-01	**1.6E-05**	3.3E-01	4.3E-01	**1.3E-05**	1.0E+00	7.4E-01	**2.2E-05**
Carbon tetrachloride	1.6E-02	7.8E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	8.6E-01	**2.8E-05**	5.0E-01	8.6E-01	**2.8E-05**	3.3E-01	7.0E-01	**2.2E-05**	1.0E+00	1.2E+00	**3.9E-05**
Chlorobenzene	2.8E-02	4.6E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.6E-01	**3.7E-05**	5.0E-01	6.6E-01	**3.7E-05**	3.3E-01	5.4E-01	**3.0E-05**	1.0E+00	9.4E-01	**5.3E-05**
Chloroethane	6.1E-03	2.4E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	4.8E-01	**5.8E-06**	5.0E-01	4.8E-01	**5.8E-06**	3.3E-01	3.9E-01	**4.7E-06**	1.0E+00	6.8E-01	**8.3E-06**

TABLE 3-22c
CALCULATION OF THE DERMAL ABSORBED (DA) FACTOR
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)	Tau (hour/event)	Absorbed (FA) (unitless)	Constants C2 L/cm3	Constants 2FA	Group 3-4 Construction Worker, CT te (hr/event)	Group 3-4 Construction Worker, CT SQRT(6tau*t/pi)	Group 3-4 Construction Worker, CT DAfactor grp 3-4 CW	Group 3-4 Construction Worker, RME te (hr/event)	Group 3-4 Construction Worker, RME SQRT(6tau*t/pi)	Group 3-4 Construction Worker, RME DAfactor grp 3-4 CW	Group 3-4 Resident, CT te (hr/event)	Group 3-4 Resident, CT SQRT(6tau*t/pi)	Group 3-4 Resident, CT DAfactor grp 3-4 Res	Group 5 Trespasser/Future Resident, CT te (hr/event)	Group 5 Trespasser/Future Resident, CT SQRT(6tau*t/pi)	Group 5 Trespasser/Future Resident, CT DAfactor grp 5 TP/FR
Chloroform	6.8E-03	5.0E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.9E-01	**9.4E-06**	5.0E-01	6.9E-01	**9.4E-06**	3.3E-01	5.6E-01	**7.6E-06**	1.0E+00	9.8E-01	**1.3E-05**
Dichlorodifluoromethane	9.0E-03	5.1E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.0E-01	**1.3E-05**	5.0E-01	7.0E-01	**1.3E-05**	3.3E-01	5.7E-01	**1.0E-05**	1.0E+00	9.9E-01	**1.8E-05**
Ethyl Ether	2.3E-03	2.8E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.2E-01	**2.4E-06**	5.0E-01	5.2E-01	**2.4E-06**	3.3E-01	4.2E-01	**1.9E-06**	1.0E+00	7.3E-01	**3.4E-06**
Ethylbenzene	4.9E-02	4.2E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.3E-01	**6.2E-05**	5.0E-01	6.3E-01	**6.2E-05**	3.3E-01	5.1E-01	**5.0E-05**	1.0E+00	9.0E-01	**8.8E-05**
Isopropylbenzene	7.0E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**1.4E-04**	5.0E-01	9.8E-01	**1.4E-04**	3.3E-01	7.9E-01	**1.1E-04**	1.0E+00	1.4E+00	**1.9E-04**
Methylene Chloride	3.5E-03	3.2E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.5E-01	**3.9E-06**	5.0E-01	5.5E-01	**3.9E-06**	3.3E-01	4.5E-01	**3.1E-06**	1.0E+00	7.8E-01	**5.5E-06**
2-Methylnaphthalene	4.7E-02	5.6E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.3E-01	**6.9E-05**	5.0E-01	7.3E-01	**6.9E-05**	3.3E-01	5.9E-01	**5.6E-05**	1.0E+00	1.0E+00	**9.7E-05**
n-Propylbenzene	9.2E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**1.8E-04**	5.0E-01	9.8E-01	**1.8E-04**	3.3E-01	7.9E-01	**1.5E-04**	1.0E+00	1.4E+00	**2.5E-04**
p-Isopropyltoluene	1.4E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**2.7E-04**	5.0E-01	9.8E-01	**2.7E-04**	3.3E-01	7.9E-01	**2.2E-04**	1.0E+00	1.4E+00	**3.9E-04**
Styrene	3.7E-02	4.1E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.3E-01	**4.6E-05**	5.0E-01	6.3E-01	**4.6E-05**	3.3E-01	5.1E-01	**3.8E-05**	1.0E+00	8.9E-01	**6.5E-05**
n-Butylbenzene	1.8E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**3.5E-04**	5.0E-01	9.8E-01	**3.5E-04**	3.3E-01	7.9E-01	**2.9E-04**	1.0E+00	1.4E+00	**5.0E-04**
tert-Butylbenzene	1.4E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**2.7E-04**	5.0E-01	9.8E-01	**2.7E-04**	3.3E-01	7.9E-01	**2.2E-04**	1.0E+00	1.4E+00	**3.9E-04**
Tetrachloroethene	3.3E-02	9.1E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.3E-01	**6.2E-05**	5.0E-01	9.3E-01	**6.2E-05**	3.3E-01	7.6E-01	**5.0E-05**	1.0E+00	1.3E+00	**8.7E-05**
Tetrahydrofuran	1.3E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	5.0E-01	9.8E-01	**2.5E-06**	5.0E-01	9.8E-01	**2.5E-06**	3.3E-01	7.9E-01	**2.1E-06**	1.0E+00	1.4E+00	**3.6E-06**
Toluene	3.1E-02	3.5E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	5.8E-01	**3.6E-05**	5.0E-01	5.8E-01	**3.6E-05**	3.3E-01	4.7E-01	**2.9E-05**	1.0E+00	8.2E-01	**5.1E-05**
Trichloroethene	1.2E-02	5.8E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.4E-01	**1.8E-05**	5.0E-01	7.4E-01	**1.8E-05**	3.3E-01	6.0E-01	**1.5E-05**	1.0E+00	1.1E+00	**2.5E-05**
Trichlorofluoromethane	1.3E-02	6.3E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	7.8E-01	**2.0E-05**	5.0E-01	7.8E-01	**2.0E-05**	3.3E-01	6.3E-01	**1.6E-05**	1.0E+00	1.1E+00	**2.9E-05**
Vinyl chloride	5.6E-03	2.4E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	4.8E-01	**5.4E-06**	5.0E-01	4.8E-01	**5.4E-06**	3.3E-01	3.9E-01	**4.4E-06**	1.0E+00	6.8E-01	**7.6E-06**
Xylenes (total)	7.0E-02	4.2E-01	1.0E+00	1.0E-03	2.0E+00	5.0E-01	6.3E-01	**8.9E-05**	5.0E-01	6.3E-01	**8.9E-05**	3.3E-01	5.1E-01	**7.2E-05**	1.0E+00	9.0E-01	**1.3E-04**

Notes:

1. ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

Where for inorganics: DA_{event} = EPC * Kp * C2 * t-e

Where for organics: DA_{event} = EPC * 2 FA * Kp * C2 * SQRT{(6 * tau-event * t-e)/pi}

(short-duration exposures)

and DA_{event} = EPC * FA * Kp * C2 * [(t-event/1 + B) + 2 tau-event {(1 + 3 B + 3 B^2

(long-duration exposures)

2. DA_{factor} includes all above variables except for the groundwater EPC. (DA_{factor} = DA_{event} / EPC)

3. CT = Central Tendency; RME = Reasonable Maximum Exposure; EPC = groundwater exposure point concentration

TABLE 3-22c
CALCULATION OF THE DERMAL ABSORBED (DA) FACTOR
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)	Tau (hour/event)	Absorbed (FA) (unitless)	Constants C2 L/cm3	Constants 2FA	Group 3-4 Resident, RME te 1-6yr (hr/event)	te 7-31yr (hr/event)	1-6yr SQRT(6tau*t/pi)	7-31yr SQRT(6tau*t/pi)	DAfactor grp 3-4 Res NC	DAfactor grp 3-4 Res C	Group 5 Trespasser/Future Resident, RME te (hr/event)	SQRT(6tau*t/pi)	DAfactor grp 5 TP/FR
			Fraction											
Antimony	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Arsenic	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Barium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Beryllium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Cadmium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Chromium	2.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**2.0E-06**	**1.2E-06**	1.0E+00		**2.0E-06**
Cobalt	4.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**4.0E-07**	**2.3E-07**	1.0E+00		**4.0E-07**
Copper	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Lead	1.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-07**	**5.8E-08**	1.0E+00		**1.0E-07**
Manganese	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Nickel	2.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**2.0E-07**	**1.2E-07**	1.0E+00		**2.0E-07**
Selenium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Silver	6.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**6.0E-07**	**3.5E-07**	1.0E+00		**6.0E-07**
Thallium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Vanadium	1.0E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**1.0E-06**	**5.8E-07**	1.0E+00		**1.0E-06**
Zinc	6.0E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01			**6.0E-07**	**3.5E-07**	1.0E+00		**6.0E-07**
Aroclor 1254	0.0E+00	4.6E+00	6.0E-01	1.0E-03	2.0E+00	1.0E+00	5.8E-01	3.0E+00	2.3E+00	**0.0E+00**	**0.0E+00**	1.0E+00	3.0E+00	**0.0E+00**
Alpha-BHC	1.6E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**4.4E-05**	**3.4E-05**	1.0E+00	1.4E+00	**4.4E-05**
2,4-Dimethylphenol	1.1E-02	5.2E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.0E+00	7.6E-01	**2.2E-05**	**1.7E-05**	1.0E+00	1.0E+00	**2.2E-05**
3-Methylphenol/4-Methylphenol	8.0E-03	4.3E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.1E-01	6.9E-01	**1.5E-05**	**1.1E-05**	1.0E+00	9.1E-01	**1.5E-05**
4-Methylphenol	8.0E-03	4.3E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.1E-01	6.9E-01	**1.5E-05**	**1.1E-05**	1.0E+00	9.1E-01	**1.5E-05**
Acetophenone	4.7E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**1.3E-05**	**9.8E-06**	1.0E+00	1.4E+00	**1.3E-05**
Acrylonitrile	1.2E-03	2.1E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	6.3E-01	4.8E-01	**1.5E-06**	**1.2E-06**	1.0E+00	6.3E-01	**1.5E-06**
Bis(2-Ethylhexyl)phthalate	2.4E-02	1.7E+01	8.0E-01	1.0E-03	2.0E+00	1.0E+00	5.8E-01	5.6E+00	4.3E+00	**2.2E-04**	**1.6E-04**	1.0E+00	5.6E+00	**2.2E-04**
Ethyl methacrylate	9.1E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**2.5E-05**	**1.9E-05**	1.0E+00	1.4E+00	**2.5E-05**
Naphthalene	4.7E-02	5.6E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.0E+00	7.9E-01	**9.7E-05**	**7.4E-05**	1.0E+00	1.0E+00	**9.7E-05**
N-Nitrosodi-n-butylamine	3.8E-03	8.2E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.3E+00	9.5E-01	**9.5E-06**	**7.2E-06**	1.0E+00	1.3E+00	**9.5E-06**
N-Nitrosopyrrolidine	3.4E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**9.5E-07**	**7.2E-07**	1.0E+00	1.4E+00	**9.5E-07**
o-Toluidine	3.0E-03	4.2E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.0E-01	6.8E-01	**5.4E-06**	**4.1E-06**	1.0E+00	9.0E-01	**5.4E-06**
Phenol	8.1E-03	3.6E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.3E-01	6.3E-01	**1.3E-05**	**1.0E-05**	1.0E+00	8.3E-01	**1.3E-05**
Pyridine	1.8E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**5.0E-06**	**3.8E-06**	1.0E+00	1.4E+00	**5.0E-06**
1,1,1-Trichloroethane	1.3E-02	6.0E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.1E+00	8.2E-01	**2.8E-05**	**2.1E-05**	1.0E+00	1.1E+00	**2.8E-05**
1,1,2-Trichloroethane	6.4E-03	6.0E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.1E+00	8.2E-01	**1.4E-05**	**1.0E-05**	1.0E+00	1.1E+00	**1.4E-05**
1,1-Dichloroethane	6.7E-03	3.8E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.5E-01	6.5E-01	**1.1E-05**	**8.7E-06**	1.0E+00	8.5E-01	**1.1E-05**
1,1-Dichloroethene	1.2E-02	3.7E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.4E-01	6.4E-01	**2.0E-05**	**1.5E-05**	1.0E+00	8.4E-01	**2.0E-05**
1,2,4-Trichlorobenzene	6.6E-02	1.1E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.5E+00	1.1E+00	**1.9E-04**	**1.5E-04**	1.0E+00	1.5E+00	**1.9E-04**
1,2,4-Trimethylbenzene	1.1E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**3.0E-04**	**2.3E-04**	1.0E+00	1.4E+00	**3.0E-04**
1,4-Dichlorobenzene	4.2E-02	7.1E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.2E+00	8.9E-01	**9.8E-05**	**7.5E-05**	1.0E+00	1.2E+00	**9.8E-05**
1,2-Dichloroethane	4.2E-03	3.8E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.5E-01	6.5E-01	**7.2E-06**	**5.5E-06**	1.0E+00	8.5E-01	**7.2E-06**
1,2-Dichloroethene	7.7E-03	3.7E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.4E-01	6.4E-01	**1.3E-05**	**9.9E-06**	1.0E+00	8.4E-01	**1.3E-05**
cis-1,2-Dichloroethene	7.7E-03	3.7E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.4E-01	6.4E-01	**1.3E-05**	**9.9E-06**	1.0E+00	8.4E-01	**1.3E-05**
1,2-Dichloropropane	7.8E-03	4.6E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.4E-01	7.1E-01	**1.5E-05**	**1.1E-05**	1.0E+00	9.4E-01	**1.5E-05**
1,3,5-Trimethylbenzene	6.1E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**1.7E-04**	**1.3E-04**	1.0E+00	1.4E+00	**1.7E-04**
1,4-Dioxane	3.3E-04	3.3E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	7.9E-01	6.0E-01	**5.2E-07**	**4.0E-07**	1.0E+00	7.9E-01	**5.2E-07**
2-Butanone	1.1E-03	2.7E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	7.2E-01	5.5E-01	**1.6E-06**	**1.2E-06**	1.0E+00	7.2E-01	**1.6E-06**
2-Hexanone	4.5E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**1.2E-05**	**9.5E-06**	1.0E+00	1.4E+00	**1.2E-05**
4-Methyl-2-pentanone	4.0E-03	3.9E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.6E-01	6.6E-01	**6.9E-06**	**5.2E-06**	1.0E+00	8.6E-01	**6.9E-06**
Acetone	5.2E-04	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**1.4E-06**	**1.1E-06**	1.0E+00	1.4E+00	**1.4E-06**
Benzene	1.5E-02	2.9E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	7.4E-01	5.7E-01	**2.2E-05**	**1.7E-05**	1.0E+00	7.4E-01	**2.2E-05**
Carbon tetrachloride	1.6E-02	7.8E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.2E+00	9.3E-01	**3.9E-05**	**3.0E-05**	1.0E+00	1.2E+00	**3.9E-05**
Chlorobenzene	2.8E-02	4.6E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.4E-01	7.1E-01	**5.3E-05**	**4.0E-05**	1.0E+00	9.4E-01	**5.3E-05**
Chloroethane	6.1E-03	2.4E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	6.8E-01	5.2E-01	**8.3E-06**	**6.3E-06**	1.0E+00	6.8E-01	**8.3E-06**

TABLE 3-22c
CALCULATION OF THE DERMAL ABSORBED (DA) FACTOR
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Permeability Coefficient (Kp) (cm/hour)	Tau (hour/event)	Absorbed (FA) (unitless)	**Constants** C2 L/cm3	2FA	**Group 3-4 Resident, RME** te 1-6yr (hr/event)	te 7-31yr (hr/event)	1-6yr SQRT(6tau*t/pi)	7-31yr SQRT(6tau*t/pi)	**DAfactor grp 3-4 Res NC**	**DAfactor grp 3-4 Res C**	**Group 5 Trespasser/Future Resident, RME** te (hr/event)	SQRT(6tau*t/pi)	**DAfactor grp 5 TP/FR**
Chloroform	6.8E-03	5.0E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.8E-01	7.4E-01	**1.3E-05**	**1.0E-05**	1.0E+00	9.8E-01	**1.3E-05**
Dichlorodifluoromethane	9.0E-03	5.1E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.9E-01	7.5E-01	**1.8E-05**	**1.4E-05**	1.0E+00	9.9E-01	**1.8E-05**
Ethyl Ether	2.3E-03	2.8E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	7.3E-01	5.6E-01	**3.4E-06**	**2.6E-06**	1.0E+00	7.3E-01	**3.4E-06**
Ethylbenzene	4.9E-02	4.2E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.0E-01	6.8E-01	**8.8E-05**	**6.7E-05**	1.0E+00	9.0E-01	**8.8E-05**
Isopropylbenzene	7.0E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**1.9E-04**	**1.5E-04**	1.0E+00	1.4E+00	**1.9E-04**
Methylene Chloride	3.5E-03	3.2E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	7.8E-01	6.0E-01	**5.5E-06**	**4.2E-06**	1.0E+00	7.8E-01	**5.5E-06**
2-Methylnaphthalene	4.7E-02	5.6E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.0E+00	7.9E-01	**9.7E-05**	**7.4E-05**	1.0E+00	1.0E+00	**9.7E-05**
n-Propylbenzene	9.2E-02	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**2.5E-04**	**1.9E-04**	1.0E+00	1.4E+00	**2.5E-04**
p-Isopropyltoluene	1.4E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**3.9E-04**	**2.9E-04**	1.0E+00	1.4E+00	**3.9E-04**
Styrene	3.7E-02	4.1E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.9E-01	6.7E-01	**6.5E-05**	**5.0E-05**	1.0E+00	8.9E-01	**6.5E-05**
n-Butylbenzene	1.8E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**5.0E-04**	**3.8E-04**	1.0E+00	1.4E+00	**5.0E-04**
tert-Butylbenzene	1.4E-01	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**3.9E-04**	**2.9E-04**	1.0E+00	1.4E+00	**3.9E-04**
Tetrachloroethene	3.3E-02	9.1E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.3E+00	1.0E+00	**8.7E-05**	**6.6E-05**	1.0E+00	1.3E+00	**8.7E-05**
Tetrahydrofuran	1.3E-03	1.0E+00	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.4E+00	1.1E+00	**3.6E-06**	**2.7E-06**	1.0E+00	1.4E+00	**3.6E-06**
Toluene	3.1E-02	3.5E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	8.2E-01	6.2E-01	**5.1E-05**	**3.9E-05**	1.0E+00	8.2E-01	**5.1E-05**
Trichloroethene	1.2E-02	5.8E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.1E+00	8.0E-01	**2.5E-05**	**1.9E-05**	1.0E+00	1.1E+00	**2.5E-05**
Trichlorofluoromethane	1.3E-02	6.3E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	1.1E+00	8.4E-01	**2.9E-05**	**2.2E-05**	1.0E+00	1.1E+00	**2.9E-05**
Vinyl chloride	5.6E-03	2.4E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	6.8E-01	5.2E-01	**7.6E-06**	**5.8E-06**	1.0E+00	6.8E-01	**7.6E-06**
Xylenes (total)	7.0E-02	4.2E-01	1.0E+00	1.0E-03	2.0E+00	1.0E+00	5.8E-01	9.0E-01	6.8E-01	**1.3E-04**	**9.6E-05**	1.0E+00	9.0E-01	**1.3E-04**

Notes:

1. ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

Where for inorganics: DA_{event} = EPC * Kp * C2 * t-e

Where for organics: DA_{event} = EPC * 2 FA * Kp * C2 * SQRT{(6 * tau-event * t-e)/pi}

(short-duration exposures)

and DA_{event} = EPC * FA * Kp * C2 * [(t-event/1 + B) + 2 tau-event {(1 + 3 B + 3 B^2

(long-duration exposures)

2. DA_{factor} includes all above variables except for the groundwater EPC. (DA_{factor} = DA_{event} / EPC)

3. CT = Central Tendency; RME = Reasonable Maximum Exposure; EPC = groundwater exposure point concentration

TABLE 3-23A

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Group 3 - Upland Soil (all depths)

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Current and Future Scenarios (trespasser, resident, facility worker, construction worker)

Medium: Upland soil

Exposure Medium: Soil (0-10' bgs)*

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[1]	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
0-10 feet	Benzo(a)anthracene	0.381	1.16	1.10	1.10	(mg/kg)	Minimum between 95% UCL and Maximum	95% UCL of the mean (or maximum) concentration is a conservative, upper-bound estimate of exposure for Group 3 soils.
	Benzo(a)pyrene	0.381	1.16	1.10	1.10	(mg/kg)		
	Benzo(e)pyrene	0.313	0.801	0.760	0.760	(mg/kg)		
	Benzo(b)fluoranthene	0.329	0.886	0.840	0.840	(mg/kg)		
	Bis(2-ethylhexyl)phthalate	312	4905	1500	1500	(mg/kg)		
	Di-n-octylphthalate	294	5646	1600	1600	(mg/kg)		
	Indeno(1,2,3-cd)Pyrene	0.305	0.758	0.720	0.720	(mg/kg)		
	Naphthalene	18.1	217	100	100	(mg/kg)		
	Toluene	139	3209	710	710	(mg/kg)		
	Tetrachloroethene	4.81	109	27.0	27.0	(mg/kg)		
	1,2,4-Trimethylbenzene	139	3075	590	590	(mg/kg)		
	1,3,5-Trimethylbenzene	47.7	1049	200	200	(mg/kg)		
	Xylenes (total)	413	897	1500	897	(mg/kg)		
	Arsenic	5.13	5.89	6.70	5.89	(mg/kg)		
	Cadmium	0.791	6.80	3.80	3.80	(mg/kg)		
	Lead	25.0	283	73.0	73.0	(mg/kg)		
	Vanadium	10.0	13.4	16.0	13.4	(mg/kg)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean and UCL concentrations for samples in which results were reported as not detected (ND).

(1) The mean, maximum and 95% Upper Confidence Level (UCL) value for each COPC were calculated using EPA's ProUCL software (version 3.00.02). Outputs are provided in Appendix F. Selected UCL values are the statistic recommended by the ProUCL model output.

(2) Exposure Point Concentrations (EPCs) represent the minimum value between the 95% UCL and the Maximum Detected Concentration.

*With the exception of soil sample (SB-3(04)), all soil samples in Group 3 were collected from subsurface (>1'bgs) depths up to 12' bgs. Most samples were collected at or near the water table, at approximately 4-6' bgs, where levels of COPCs are generally highest. We have therefore considered all samples collected from 0-10' bgs in the Group 3 soil EPC for both current and future exposure scenarios.

TABLE 3-23B

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Group 4 - Upland Soil (surface, 0-1' bgs)

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Current Scenarios (local resident/youth trespasser)

Medium: Upland soil

Exposure Medium: Surface soil (0-1' bgs)

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[1]	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
0-1 feet	Benzo(a)anthracene	0.376	0.538	0.810	0.538	(mg/kg)	Minimum between 95% UCL and Maximum	95% UCL of the mean (or maximum) concentration is a conservative, upper-bound estimate of exposure for Group 4 soils.
	Benzo(a)pyrene	0.369	0.552	0.990	0.552	(mg/kg)		
	Benzo(b)fluoranthene	0.475	0.676	1.10	0.676	(mg/kg)		
	Indeno(1,2,3-cd)Pyrene	0.355	0.516	0.940	0.516	(mg/kg)		
	Arsenic	5.48	7.02	9.40	7.02	(mg/kg)		
	Lead	99.5	138	233	138	(mg/kg)		
	Manganese	147	173	224	173	(mg/kg)		
	Vanadium	13.9	15.6	18.0	15.6	(mg/kg)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean and UCL concentrations for samples in which results were reported as not detected (ND).

(1) The mean, maximum and 95% Upper Confidence Level (UCL) value for each COPC were calculated using EPA's ProUCL software (version 3.00.02). Outputs are provided in Appendix F.

Selected UCL values are the statistic recommended by the ProUCL model output.

(2) Exposure Point Concentrations (EPCs) represent the minimum value between the 95% UCL and the Maximum Detected Concentration.

TABLE 3-23C

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Group 4 - Upland Soil (0-10' bgs)

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Future Scenarios (resident, trespasser, facility worker, construction worker)

Medium: Upland soil

Exposure Medium: Soil (0-10' bgs)

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[1]	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
0-10 feet	Benzo(a)anthracene	3.82	38.0	45.0	38.0	(mg/kg)	Minimum between 95% UCL and Maximum	95% UCL of the mean (or maximum) concentration is a conservative, upper-bound estimate of exposure for Group 4 soils.
	Benzo(a)pyrene	2.43	22.8	27.0	22.8	(mg/kg)		
	Benzo(e)pyrene	4.50	57.6	17.0	17.0	(mg/kg)		
	Benzo(b)fluoranthene	1.872	16.10	19.0	16.10	(mg/kg)		
	Benzo(k)fluoranthene	2.081	20.27	24.0	20.27	(mg/kg)		
	Bis(2-Chloroethoxy)methane	0.196	1.032	0.490	0.490	(mg/kg)		
	Carbazole	2.15	22	26.0	21.9	(mg/kg)		
	4-Chloro-3-methylphenol	0.185	1.021	0.370	0.370	(mg/kg)		
	Dibenzo(a,h)anthracene	0.552	3.882	4.50	3.882	(mg/kg)		
	Dibenzofuran	1.99	20	24.0	20.2	(mg/kg)		
	Indeno(1,2,3-cd)Pyrene	1.06	8.49	10.0	8.49	(mg/kg)		
	1-Methylnaphthalene	3.15	32.51	12.0	12.0	(mg/kg)		
	2-Methylnaphthalene	1.51	14.4	17.0	14.4	(mg/kg)		
	Naphthalene	1.45	13.2	19.0	13.2	(mg/kg)		
	C11-C22 Aromatics	46.3	71.6	130	71.6	(mg/kg)		
	Arsenic	5.87	7.10	9.40	7.1	(mg/kg)		
	Lead	102	134	233	134	(mg/kg)		
	Manganese	149	170	224	170	(mg/kg)		
	Vanadium	14.3	15.8	19.0	15.8	(mg/kg)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean and UCL concentrations for samples in which results were reported as not detected (ND).

(1) The mean, maximum and 95% Upper Confidence Level (UCL) value for each COPC were calculated using EPA's ProUCL software (version 3.00.02). Outputs are provided in Appendix F.

Selected UCL values are the statistic recommended by the ProUCL model output.

(2) Exposure Point Concentrations (EPCs) represent the minimum value between the 95% UCL and the Maximum Detected Concentration.

N/R = UCL not calculated due to low number of datapoints.

TABLE 3-24

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Group 5 - Wetland Soil

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Current/Future Scenarios (resident, trespasser)

Medium: Wetland soil

Exposure Medium: Wetland soil (0-1')

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[1]	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
Surface soils in wetland Group 5	Benzo(a)anthracene	0.41	0.64	1.2	0.64	(mg/kg)	Minimum between 95% UCL and Maximum	95% UCL of the mean (or maximum) concentration is a conservative, upper-bound estimate of exposure for Group 5 soils.
	Benzo(a)pyrene	0.41	0.64	1.2	0.64	(mg/kg)		
	Benzo(b)fluoranthene	0.47	0.80	1.7	0.80	(mg/kg)		
	Indeno(1,2,3-cd)Pyrene	0.39	0.56	0.96	0.56	(mg/kg)		
	Perylene	0.30	0.39	0.25	0.25	(mg/kg)		
	Arsenic	9.7	15	30	15	(mg/kg)		
	Lead	34	63	104	63	(mg/kg)		
	Manganese	259	578	1000	578	(mg/kg)		
	Vanadium	9.2	12	16	12	(mg/kg)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean and UCL concentrations for samples in which results were reported as not detected (ND).
(1) The mean, maximum and 95% Upper Confidence Level (UCL) value for each COPC were calculated using EPA's ProUCL software (version 3.00.02). Outputs are provided in Appendix F
Selected UCL values are the statistic recommended by the ProUCL model output.
(2) Exposure Point Concentrations (EPCs) represent the minimum value between the 95% UCL and the Maximum Detected Concentration

TABLE 3-25A

CALCULATION OF FUGITIVE DUST EXPOSURE POINT CONCENTRATIONS (EPCS): GROUP 3

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point	Chemical of Potential Concern	Soil EPC (1)		1/PEF (2) ($1/m^3/kg$)	1/VF (3) ($1/m^3/kg$)	Fugitive Dust EPC (4)	
		Value	Units			Value	Units
Group 3 Soils 0-10 feet	Benzo(a)anthracene	1.10	mg/kg	7.4E-10	NC	8E-10	mg/m^3
	Benzo(a)pyrene	1.10	mg/kg	7.4E-10	NC	8E-10	mg/m^3
	Benzo(e)pyrene	0.760	mg/kg	7.4E-10	NC	6E-10	mg/m^3
	Benzo(b)fluoranthene	0.840	mg/kg	7.4E-10	NC	6E-10	mg/m^3
	Bis(2-ethylhexyl)phthalate	1500	mg/kg	7.4E-10	NC	1E-06	mg/m^3
	Di-n-octylphthalate	1600	mg/kg	7.4E-10	NC	1E-06	mg/m^3
	Indeno(1,2,3-cd)Pyrene	0.720	mg/kg	7.4E-10	NC	5E-10	mg/m^3
	Naphthalene	100	mg/kg	7.4E-10	2.5E-05	3E-03	mg/m^3
	Toluene	710	mg/kg	7.4E-10	3.5E-04	3E-01	mg/m^3
	Tetrachloroethene	27.0	mg/kg	7.4E-10	6.3E-04	2E-02	mg/m^3
	1,2,4-Trimethylbenzene	590	mg/kg	7.4E-10	1.1E-04	7E-02	mg/m^3
	1,3,5-Trimethylbenzene	200	mg/kg	7.4E-10	1.1E-04	2E-02	mg/m^3
	Xylenes (total)	897	mg/kg	7.4E-10	2.3E-04	2E-01	mg/m^3
	Arsenic	5.89	mg/kg	7.4E-10	NC	4E-09	mg/m^3
	Cadmium	3.80	mg/kg	7.4E-10	NC	3E-09	mg/m^3
	Lead	73.0	mg/kg	7.4E-10	NC	5E-08	mg/m^3
	Vanadium	13.4	mg/kg	7.4E-10	NC	1E-08	mg/m^3

Notes:

1. The soil EPC is the lowest value between the maximum detected concentration and the 95% upper confidence limit of the mean concentration in Group 3 soil (0-10' bgs).
2. The EPA default Particulate Emission Factor (PEF), 1.36×10^9 mg^3/kg, was obtained from the USEPA Soil Screening Guidance (2002).
3. The volatilization factor was derived as shown in Appendix G.
4. Fugitive dust EPC = Soil EPC * (1/PEF + 1/VF).

NC = not calculated as the volatility is negligible.

TABLE 3-25B

CALCULATION OF FUGITIVE DUST EXPOSURE POINT CONCENTRATIONS (EPCS): GROUP 4 SURFACE / SUBSURFACE SOILS

Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point	Chemical of Potential Concern	Soil EPC (1)		1/PEF (2) ($1/m^3/kg$)	1/VF (3) ($1/m^3/kg$)	Fugitive Dust EPC (4)	
		Value	Units			Value	Units
Group 4 Soil 0-10 feet	Benzo(a)anthracene	37.97	mg/kg	7.35E-10	NC	3E-08	mg/m^3
	Benzo(a)pyrene	22.8	mg/kg	7.35E-10	NC	2E-08	mg/m^3
	Benzo(e)pyrene	17.0	mg/kg	7.35E-10	NC	1E-08	mg/m^3
	Benzo(b)fluoranthene	16.10	mg/kg	7.35E-10	NC	1E-08	mg/m^3
	Benzo(k)fluoranthene	20.27	mg/kg	7.35E-10	NC	1E-08	mg/m^3
	Bis(2-Chloroethoxy)methane	0.490	mg/kg	7.35E-10	NC	4E-10	mg/m^3
	Carbazole	21.9	mg/kg	7.35E-10	NC	2E-08	mg/m^3
	4-Chloro-3-methylphenol	0.370	mg/kg	7.35E-10	NC	3E-10	mg/m^3
	Dibenzo(a,h)anthracene	3.882	mg/kg	7.35E-10	NC	3E-09	mg/m^3
	Dibenzofuran	20.2	mg/kg	7.35E-10	NC	1E-08	mg/m^3
	Indeno(1,2,3-cd)Pyrene	8.49	mg/kg	7.35E-10	NC	6E-09	mg/m^3
	1-Methylnaphthalene	12.0	mg/kg	7.35E-10	6.0E-05	7E-04	mg/m^3
	2-Methylnaphthalene	14.4	mg/kg	7.35E-10	2.1E-05	3E-04	mg/m^3
	Naphthalene	13.2	mg/kg	7.35E-10	2.5E-05	3E-04	mg/m^3
	C11-C22 Aromatics	71.6	mg/kg	7.35E-10	2.0E-05	1E-03	mg/m^3
	Arsenic	7.10	mg/kg	7.35E-10	NC	5E-09	mg/m^3
	Lead	134	mg/kg	7.35E-10	NC	1E-07	mg/m^3
	Manganese	170	mg/kg	7.35E-10	NC	1E-07	mg/m^3
	Vanadium	15.8	mg/kg	7.35E-10	NC	1E-08	mg/m^3

Notes:
1. The soil EPC is the lowest value between the maximum detected concentration and the 95% upper confidence limit of the mean concentration in Group 4 soil (0-10' bgs).
2. The EPA default Particulate Emission Factor (PEF), 1.36×10^9 mg^3/kg, was obtained from the USEPA Soil Screening Guidance (2002).
3. The volatilization factor was derived as shown in Appendix G.
4. Fugitive dust EPC = Soil EPC * (1/PEF + 1/VF).
NC = not calculated as the volatility is negligible.

TABLE 3-26A
EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURE
Group 1-2 - Groundwater
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Future (Resident/Facility Worker)
Medium: Groundwater
Exposure Medium: Group 1-2*

Exposure Point	Chemical of Potential Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[2]	Exposure Point Concentration	Units	Statistical Measure	Rationale
Group 1-2 Groundwater	1,4-Dichlorobenzene			0.0110	0.011	mg/L	Maximum	The maximum detected concentration was chosen as a conservative estimate of exposure.
	2-Methylnaphthalene			0.000830	0.001	mg/L		
	3-Methylphenol/4-Methylphenol			10.0	10.00	mg/L		
	4-Methylphenol			11.0	11.00	mg/L		
	Acetophenone			0.0308	0.03	mg/L		
	Naphthalene			0.240	0.24	mg/L		
	N-Nitrosodi-n-butylamine			0.00108	0.001	mg/L		
	N-Nitrosopyrrolidine			0.00968	0.010	mg/L		
	o-Toluidine			0.00316	0.003	mg/L		
	Phenol			2.60	2.60	mg/L		
	Pyridine			0.0420	0.04	mg/L		
	1,1-Dichloroethane			0.530	0.530	mg/L		
	1,2,4-Trichlorobenzene			0.00250	0.00250	mg/L		
	1,2,4-Trimethylbenzene			2.60	2.60	mg/L		
	1,2-Dichloroethane			0.00690	0.01	mg/L		
	1,2-Dichloroethene			0.150	0.15	mg/L		
	cis-1,2-Dichloroethene			0.450	0.45	mg/L		
	1,2-Dichloropropane			0.00340	0.003	mg/L		
	1,3,5-Trimethylbenzene			0.640	0.64	mg/L		
	1,4-Dioxane			0.830	0.83	mg/L		
	2-Butanone			27.0	27.00	mg/L		
	2-Hexanone			0.450	0.45	mg/L		
	4-Methyl-2-pentanone			13.0	13.00	mg/L		
	Acetone			21.0	21.00	mg/L		
	Benzene			0.0380	0.04	mg/L		
	Chlorobenzene			0.0280	0.03	mg/L		
	Chloroethane			4.30	4.30	mg/L		
	Chloroform			0.00170	0.002	mg/L		
	Dichlorodifluoromethane			0.0950	0.10	mg/L		
	Ethyl Ether			0.300	0.30	mg/L		
	Ethylbenzene			2.00	2.00	mg/L		
	Methylene Chloride			2.14	2.14	mg/L		
	n-Propylbenzene			0.260	0.26	mg/L		
	Styrene			0.240	0.24	mg/L		
	Tetrachloroethene			0.0170	0.02	mg/L		
	Tetrahydrofuran			10.0	10.00	mg/L		
	Toluene			21.0	21.00	mg/L		
	Trichloroethene			0.0760	0.08	mg/L		
	Trichlorofluoromethane			0.410	0.41	mg/L		
	Vinyl chloride			0.0350	0.04	mg/L		
	Xylenes (total)			0.490	0.49	mg/L		
	Antimony			0.00520	0.005	mg/L		
	Arsenic			2.00	2.00	mg/L		
	Barium			1.59	1.59	mg/L		
	Beryllium			0.0300	0.03	mg/L		
	Cadmium			0.360	0.36	mg/L		
	Cobalt			0.0763	0.08	mg/L		
	Copper			0.179	0.18	mg/L		
	Lead			0.240	0.24	mg/L		
	Manganese			20.2	20.20	mg/L		
	Nickel			0.210	0.21	mg/L		
	Selenium			0.0700	0.07	mg/L		
	Thallium			0.00470	0.005	mg/L		
	Vanadium			0.0300	0.03	mg/L		

Footnotes:

(1) The arithmetic mean and 95% Upper Confidence Level (UCL) was not calculated for groundwater COPCs, as the maximum was used as the EP(
(2) Maximum Concentration represents the maximum detected concentration of each COPC sample within both Group 1 and Group :

*We used groundwater data from Groups 1 and 2, collectively, to evaluate potential risks associated with future potable water use at the Site.

TABLE 3-26B

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURE

Group 3-6 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Future (resident, facility worker)

Medium: Groundwater

Exposure Medium: Groups 3, 4, 5 and 6*

Exposure Point	Chemical of Potential Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[2]	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure	Rationale
Groups 3, 4, 5, 6 Groundwater	1,4-Dichlorobenzene			0.00320	0.00320	mg/L	Maximum	The maximum detected concentration was chosen as a conservative estimate of exposure.
	2,4-Dimethylphenol			0.180	0.180	mg/L		
	2-Methylphenol			1.00	1.00	mg/L		
	3-Methylphenol/4-Methylphenol			2.10	2.10	mg/L		
	4-Methylphenol			0.270	0.270	mg/L		
	Aroclor 1254			0.00120	0.00120	mg/L		
	Alpha-BHC			0.0000470	0.0000470	mg/L		
	Bis(2-Ethylhexyl)phthalate			0.610	0.610	mg/L		
	Naphthalene			0.0110	0.0110	mg/L		
	Phenol			9.40	9.40	mg/L		
	1,1,1-Trichloroethane			0.490	0.490	mg/L		
	1,1,2-Trichloroethane			0.00692	0.00692	mg/L		
	1,1-Dichloroethane			3.60	3.60	mg/L		
	1,1-Dichloroethene			0.130	0.130	mg/L		
	1,2,4-Trimethylbenzene			1.40	1.40	mg/L		
	1,2-Dichloroethane			0.0444	0.0444	mg/L		
	1,2-Dichloroethene			0.130	0.130	mg/L		
	1,2-Dichloropropane			0.00360	0.00360	mg/L		
	1,3,5-Trimethylbenzene			1.20	1.20	mg/L		
	1,4-Dioxane			3.00	3.00	mg/L		
	2-Butanone			77.0	77.0	mg/L		
	4-Methyl-2-pentanone			190	190	mg/L		
	Acetone			73.0	73.0	mg/L		
	Acrylonitrile			1.30	1.30	mg/L		
	Benzene			0.0450	0.0450	mg/L		
	Carbon tetrachloride			0.0520	0.0520	mg/L		
	Chloroethane			2.50	2.50	mg/L		
	Chloroform			0.00570	0.00570	mg/L		
	cis-1,2-Dichloroethene			0.220	0.220	mg/L		
	Ethylbenzene			8.40	8.40	mg/L		
	Ethyl methacrylate			4.00	4.00	mg/L		
	Isopropylbenzene			0.0820	0.0820	mg/L		
	Methylene Chloride			2.20	2.20	mg/L		
	n-Propylbenzene			0.0920	0.0920	mg/L		
	n-Butylbenzene			0.0899	0.0899	mg/L		
	p-Isopropyltoluene			0.0960	0.0960	mg/L		
	tert-Butylbenzene			0.0668	0.0668	mg/L		
	Tetrachloroethene			0.00600	0.00600	mg/L		
	Tetrahydrofuran			20.0	20.0	mg/L		
	Toluene			78.0	78.0	mg/L		
	Trichloroethene			0.00600	0.00600	mg/L		
	Vinyl chloride			0.0710	0.0710	mg/L		
	Xylenes (total)			28.2	28.2	mg/L		
	Antimony			0.100	0.100	mg/L		
	Arsenic			2.32	2.32	mg/L		
	Barium			0.370	0.370	mg/L		
	Beryllium			0.560	0.560	mg/L		
	Cadmium			0.0600	0.0600	mg/L		
	Chromium			0.0300	0.0300	mg/L		
	Cobalt			0.140	0.140	mg/L		
	Lead			0.0600	0.0600	mg/L		
	Manganese			29.0	29.0	mg/L		
	Nickel			0.0800	0.0800	mg/L		
	Silver			0.800	0.800	mg/L		
	Thallium			0.00480	0.00480	mg/L		
	Vanadium			0.0100	0.0100	mg/L		
	Zinc			55.0	55.0	mg/L		

Footnotes:

(1) The arithmetic mean and 95% Upper Confidence Level (UCL) was not calculated for groundwater COPCs, as the maximum was used as the EPC.

(2) Maximum Concentration represents the maximum detected concentration of each COPC sample within the Group.

*We used groundwater data from Groups 3, 4, 5 and 6, collectively, to evaluate potential risks associated with future potable water use at the Site.

TABLE 3-26C

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURE

Group 3 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Future (Resident, Facility Worker, Construction Worker)

Medium: Groundwater

Exposure Medium: Group 3*

Exposure Point	Chemical of Potential Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[2]	Exposure Point Concentration	Units	Statistical Measure	Rationale
Group 3 Groundwater	1,2,4-Trimethylbenzene			1.40	1.40	mg/L	Maximum	The maximum detected concentration was chosen as a conservative estimate of exposure.
	1,2-Dichloroethane			0.00038	0.00038	mg/L		
	1,2-Dichloropropane			0.00035	0.00035	mg/L		
	1,3,5-Trimethylbenzene			0.420	0.420	mg/L		
	1,4-Dichlorobenzene			0.0012	0.0012	mg/L		
	1,4-Dioxane			3.00	3.00	mg/L		
	2,4-Dimethylphenol			0.18	0.18	mg/L		
	2-Butanone			77	77	mg/L		
	2-Methylphenol			1	1	mg/L		
	3-Methylphenol/4-Methylphenol			2.10	2.10	mg/L		
	4-Methyl-2-pentanone			190	190	mg/L		
	Acetone			73	73	mg/L		
	Acrylonitrile			1.3	1.3	mg/L		
	Aroclor 1254			0.0012	0.0012	mg/L		
	Benzene			0.0036	0.0036	mg/L		
	Bis(2-Ethylhexyl)phthalate			0.610	0.610	mg/L		
	Chloroethane			2.30	2.30	mg/L		
	Ethylbenzene			8.40	8.40	mg/L		
	Ethyl methacrylate			4.00	4.00	mg/L		
	Methylene Chloride			2.20	2.20	mg/L		
	Naphthalene			0.011	0.011	mg/L		
	n-Propylbenzene			0.082	0.082	mg/L		
	p-Isopropyltoluene			0.096	0.096	mg/L		
	Phenol			9.40	9.40	mg/L		
	Tetrachloroethene			0.00022	0.00022	mg/L		
	Tetrahydrofuran			20	20	mg/L		
	Toluene			78	78	mg/L		
	Trichloroethene			0.00039	0.00039	mg/L		
	Vinyl chloride			0.00044	0.00044	mg/L		
	Xylenes (total)			28.2	28.2	mg/L		
	Antimony			0.0038	0.0038	mg/L		
	Arsenic			0.58	0.58	mg/L		
	Barium			0.30	0.30	mg/L		
	Cadmium			0.002	0.002	mg/L		
	Cobalt			0.140	0.140	mg/L		
	Lead			0.0058	0.0058	mg/L		
	Manganese			29	29	mg/L		
	Nickel			0.0580	0.0580	mg/L		
	Thallium			0.00005	0.00005	mg/L		
	Vanadium			0.010	0.010	mg/L		

Footnotes:

(1) The arithmetic mean and 95% Upper Confidence Level (UCL) was not calculated for groundwater COPCs, as the maximum was used as the EP
(2) Maximum Concentration represents the maximum detected concentration of each COPC sample within the Grou
(3) ND = Constituent not detected in groundwater samples collected from this grou
*Groundwater data for Group 3 were used to evaluate potential health risks associated with vapor intrusion to indoor air (for the future facility worker and resident) and ambient air (for the future construction worker) at the Site (volatile COPCs only), as well as dermal contact for the future construction worker (all COPCs).

TABLE 3-26D

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURE

Group 4 - Groundwater

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Future (Resident, Facility Worker, Construction Worker)

Medium: Groundwater

Exposure Medium: Group 4*

Exposure Point	Chemical of Potential Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[2]	Exposure Point Concentration	Units	Statistical Measure	Rationale
Group 4 Groundwater	Bis(2-Ethylhexyl)phthalate			0.00730	0.00730	mg/L	Maximum	The maximum detected concentration was chosen as a conservative estimate of exposure.
	Tetrachloroethene			0.000340	0.000340	mg/L		
	Trichloroethene			0.000340	0.000340	mg/L		
	Arsenic			0.430	0.430	mg/L		
	Beryllium			0.560	0.560	mg/L		
	Cadmium			0.0250	0.0250	mg/L		
	Lead			0.0600	0.0600	mg/L		
	Manganese			3.71	3.71	mg/L		
	Nickel			0.0800	0.0800	mg/L		
	Silver			0.800	0.800	mg/L		
	Vanadium			0.00440	0.00440	mg/L		

Footnotes:

(1) The arithmetic mean and 95% Upper Confidence Level (UCL) was not calculated for groundwater COPCs, as the maximum was used as the EPC.

(2) Maximum Concentration represents the maximum detected concentration of each COPC sample within the Group.

*Groundwater data for Group 4 were used to evaluate potential health risks associated with vapor intrusion to indoor air (for the future facility worker and resident) and ambient air (for the future construction worker) at the Site (volatile COPCs only), as well as dermal contact for the future construction worker (all COPCs).

TABLE 3-27A

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Ambient Air

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Current/Future Scenarios (all receptors)

Medium: Air

Exposure Medium: Ambient Air

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[2]	Maximum Concentration	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
Site	1,2,4-Trimethylbenzene	0.00260	NC	0.00300	0.00300	(mg/m^3)	Maximum	The maximum detected concentration was chosen as a conservative estimate of exposure.
	1,3,5-Trimethylbenzene	0.00472	NC	0.00990	0.00990	(mg/m^3)		
	Benzene	0.00210	NC	0.00400	0.00400	(mg/m^3)		
	Xylenes (total)	0.0266	NC	0.0920	0.0920	(mg/m^3)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean concentrations for samples in which results were reported as not detected (ND).
(1) NC: 95% UCLs were not calculated for ambient air due to limited dataset.
(2) Exposure Point Concentrations (EPCs) represent the Maximum Detected Concentration.

TABLE 3-27B

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Ambient Air in a Trench: Group 3

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future (Construction Workers)
Medium:	Groundwater
Exposure Medium:	Ambient Air in a Trench

Exposure Point	Chemical of Potential Concern	Estimated Ambient Air Concentration[1]	Units	Basis
Group 3	1,4-Dichlorobenzene	1.8E-07	mg/m^3	Calculated from maximum detected concentration in Group 3 groundwater.
	Naphthalene	1.3E-06	mg/m^3	
	1,2,4-Trimethylbenzene	2.5E-04	mg/m^3	
	1,2-Dichloroethane	6.1E-08	mg/m^3	
	1,2-Dichloropropane	6.1E-08	mg/m^3	
	1,3,5-Trimethylbenzene	7.5E-05	mg/m^3	
	2-Butanone	1.8E-03	mg/m^3	
	4-Methyl-2-pentanone	1.3E-02	mg/m^3	
	Acetone	2.6E-03	mg/m^3	
	Acrylonitrile	9.3E-05	mg/m^3	
	Benzene	7.9E-07	mg/m^3	
	Chloroethane	5.6E-04	mg/m^3	
	Ethylbenzene	1.6E-03	mg/m^3	
	Ethyl methacrylate	7.6E-04	mg/m^3	
	Methylene Chloride	4.3E-04	mg/m^3	
	n-Propylbenzene	1.2E-05	mg/m^3	
	p-Isopropyltoluene	1.6E-05	mg/m^3	
	Tetrachloroethene	3.4E-08	mg/m^3	
	Tetrahydrofuran	1.0E-03	mg/m^3	
	Toluene	1.6E-02	mg/m^3	
	Trichloroethene	6.7E-08	mg/m^3	
	Vinyl chloride	1.1E-07	mg/m^3	
	Xylenes (total)	5.3E-03	mg/m^3	

Footnotes:

(1) Ambient air concentrations were estimated from maximum groundwater concentrations using an EPA emissions model (EPA 1990). Please see Appendix H for model description and supporting calculations.

TABLE 3-27C

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Ambient Air in a Trench: Group 4

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future (Construction Workers)
Medium:	Air
Exposure Medium:	Ambient Air in a Trench

Exposure Point	Chemical of Concern	Estimated Ambient Air Concentration[1]	Units	Basis
Group 4	Tetrachloroethene	5.3E-08	mg/m^3	Calculated from maximum detected concentration in Group 4 groundwater.
	Trichloroethene	5.9E-08	mg/m^3	

Footnotes:

(1) Ambient air concentrations were estimated from maximum groundwater concentrations using an EPA emissions model (EPA 1990). Please see Appendix H for model description and supporting calculations.

TABLE 3-28A
EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES
Group 3 - Vapor Intrusion Pathway, Predicted Indoor Air Concentrations
Sutton Brook Disposal Area

Scenario Timeframe: Future (Resident, Facility Worker)
Medium: Groundwater
Exposure Medium: Indoor Air/ Vapor Intrusion from Groundwater

Exposure Point	Chemical of Potential Concern	Groundwater Exposure Point Concentration	Exposure Point Concentration Units	Predicted Indoor Air Exposure Point Concentration	Exposure Point Concentration Units
Group 3 Groundwater	1,4-Dichlorobenzene	1.2E+00	ug/L	3.2E-05	mg/m^3
	Naphthalene	1.1E+01	ug/L	5.1E-05	mg/m^3
	1,2,4-Trimethylbenzene	1.4E+03	ug/L	8.3E-02	mg/m^3
	1,2-Dichloroethane	3.8E-01	ug/L	7.3E-06	mg/m^3
	1,2-Dichloropropane	3.5E-01	ug/L	1.5E-05	mg/m^3
	1,3,5-Trimethylbenzene	4.2E+02	ug/L	2.4E-02	mg/m^3
	2-Butanone	7.7E+04	ug/L	1.1E-01	mg/m^3
	4-Methyl-2-pentanone	1.9E+05	ug/L	4.4E-01	mg/m^3
	Acetone	7.3E+04	ug/L	9.6E-02	mg/m^3
	Acrylonitrile	1.3E+03	ug/L	3.5E-03	mg/m^3
	Benzene	3.6E+00	ug/L	3.5E-04	mg/m^3
	Chloroethane	2.3E+03	ug/L	8.7E-01	mg/m^3
	Ethylbenzene	8.4E+03	ug/L	8.6E-01	mg/m^3
	Ethyl methacrylate	4.0E+03	ug/L	3.3E-02	mg/m^3
	Methylene Chloride	2.2E+03	ug/L	1.0E-01	mg/m^3
	n-Propylbenzene	8.2E+01	ug/L	8.6E-03	mg/m^3
	p-Isopropyltoluene	9.6E+01	ug/L	1.0E-02	mg/m^3
	Tetrachloroethene	2.2E-01	ug/L	5.4E-05	mg/m^3
	Tetrahydrofuran	2.0E+04	ug/L	1.2E-01	mg/m^3
	Toluene	7.8E+04	ug/L	8.3E+00	mg/m^3
	Trichloroethene	3.9E-01	ug/L	6.3E-05	mg/m^3
	Vinyl chloride	4.4E-01	ug/L	3.2E-04	mg/m^3
	Xylenes (total)	2.8E+04	ug/L	2.5E+00	mg/m^3

Notes:
1. Groundwater exposure point concentration is the maximum detected concentration in Group 3 groundwater.
2. Predicted indoor air concentrations were estimated from groundwater EPCs using the EPA Johnson & Ettinger Vapor Intrusion Model (2004). Please see Appendix H-2 for supporting calculations.

TABLE 3-28B
EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES
Group 4 - Vapor Intrusion Pathway, Predicted Indoor Air Concentrations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Future (Resident, Facility Worker)
Medium: Groundwater
Exposure Medium: Indoor Air/ Vapor Intrusion from Groundwater

Exposure Point	Chemical of Potential Concern	Groundwater Exposure Point Concentration	Exposure Point Concentration Units	Predicted Indoor Air Exposure Point Concentration	Exposure Point Concentration Units
Group 4	Tetrachloroethene	3.4E-01	ug/L	4.1E-06	mg/m^3
	Trichloroethene	3.4E-01	ug/L	2.8E-06	mg/m^3

Notes:
1. Groundwater exposure point concentration is the maximum detected concentration in Group 4 groundwater.
2. Predicted indoor air concentrations estimated from groundwater EPCs using the EPA Johnson & Ettinger Vapor Intrusion Model (2004). Please see Appendix H-2 for supporting calculations.

TABLE 3-29

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Remedial Investigation and Feasibility Study Group 5 & 6 Sediment

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Current/Future Scenarios (resident, trespasser)

Medium: Sediment

Exposure Medium: Sediment

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[1]	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
Sediment in Groups 5 & 6 Wetlands	Benzo(a)pyrene	1.29	5.76	0.53	0.53	(mg/kg)	Minimum between 95% UCL and Maximum	95% UCL of the mean (or maximum) concentration is a conservative, upper-bound estimate of exposure for Group 5/6 sediments.
	Trichloroethene	0.389	2.29	0.062	0.06	(mg/kg)		
	1,3,5-Trimethylbenzene	2.07	11.6	16	11.6	(mg/kg)		
	Arsenic	54.5	158	767	158	(mg/kg)		
	Lead	15.4	20.5	120	20.5	(mg/kg)		
	Manganese	120	147	550	147	(mg/kg)		
	Vanadium	7.46	8.7	28	8.69	(mg/kg)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean and UCL concentrations for samples in which results were reported as not detected (ND).
(1) The mean, maximum and 95% Upper Confidence Level (UCL) value for each COPC were calculated using EPA's ProUCL software (version 3.00.02). Outputs are provided in Appendix F
Selected UCL values are the statistic recommended by the ProUCL model output.
(2) Exposure Point Concentrations (EPCs) represent the minimum value between the 95% UCL and the Maximum Detected Concentration

TABLE 3-30

EXPOSURE POINT CONCENTRATION SUMMARY: CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURES

Groups 5 & 6 - Surface Water

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe: Current/Future Scenarios (resident, trespasser)

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Point	Chemical of Concern	Arithmetic Mean Concentration[1]	95% UCL of Mean[1]	Maximum Concentration[1]	Exposure Point Concentration[2]	Units	Statistical Measure	Rationale
Surface Water in Groups 5 and 6	1,4-Dioxane	0.0125	0.0490	0.110	0.0490	(mg/L)	Minimum between 95% UCL and Maximum	95% UCL of the mean (or maximum) concentration is a conservative, upper-bound estimate of exposure for Group 5/6 surface water
	Methylene Chloride	0.00343	0.00517	0.0134	0.00517	(mg/L)		
	1,2,4-Trimethylbenzene	0.00218	0.00428	0.0140	0.00428	(mg/L)		
	1,3,5-Trimethylbenzene	0.00133	0.00187	0.00340	0.00187	(mg/L)		
	Arsenic	0.0231	0.0696	0.147	0.0696	(mg/L)		
	Cadmium	0.00237	0.00664	0.0300	0.00664	(mg/L)		
	Lead	0.00907	0.0150	0.0500	0.0150	(mg/L)		
	Manganese	0.465	0.581	1.48	0.581	(mg/L)		
	Vanadium	0.00312	0.00548	0.0200	0.00548	(mg/L)		
	Zinc	0.268	2.44	9.44	2.44	(mg/L)		

Footnotes:

One-half the detection limit value was used in the calculation of arithmetic mean and UCL concentrations for samples in which results were reported as not detected (ND).

(1) The mean, maximum and 95% Upper Confidence Level (UCL) value for each COPC were calculated using EPA's ProUCL software (version 3.00.02). Outputs are provided in Appendix F. Selected UCL values are the statistic recommended by the ProUCL model output.

(2) Exposure Point Concentrations (EPCs) represent the minimum value between the 95% UCL and the Maximum Detected Concentration.

TABLE 3-31A
NON-CANCER TOXICITY DATA - ORAL/DERMAL
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Basis of Study (Chronic/ Subchronic)	Oral RfD		Oral Absorption Efficiency for Dermal (ABS_{gi}) (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Source	
		Value	Units		Value	Units			Source	Date
Organics										
1,1,1-Trichloroethane	Chronic	7.00E-01	mg/kg/day	--	7.00E-01	mg/kg/day	Nervous system	100	ATSDR MRL (intermediate)/STSC	5/23/2006
1,1,2-Trichloroethane	Chronic	4.00E-03	mg/kg/day	--	4.00E-03	mg/kg/day	Blood	1000 x 1	IRIS	3/7/2007
1,1-Dichloroethane	Chronic	2.00E-01	mg/kg/day	--	2.00E-01	mg/kg/day	Nervous system		PPRTV	1/27/2005
1,1-Dichloroethene	Chronic	5.00E-02	mg/kg/day	--	5.00E-02	mg/kg/day	Liver	100 x 1	IRIS	3/7/2007
1,2,4-Trimethylbenzene		--	--	--	--	--				
1,2-Dichloroethane	Chronic	2.00E-01	mg/kg/day	--	2.00E-01	mg/kg/day	Kidney	300 x 1	ATSDR MRL (intermediate)	9/1/2001
1,2-Dichloroethene	Chronic	9.00E-03	mg/kg/day	--	9.00E-03	mg/kg/day	Liver		HEAST	1997
1,2-Dichloropropane		--	--	--	--	--				
1,3,5-Trimethylbenzene		--	--	--	--	--				
1,4-Dichlorobenzene	Chronic	9.00E-02	mg/kg/day	--	9.00E-02	mg/kg/day	None observed	1000 x 1	IRIS (4)	3/7/2007
1,4-Dioxane	Chronic	1.00E-01	mg/kg/day	--	1.00E-01	mg/kg/day	Liver	100 x 1	ATSDR MRL	10/1/2004
1-Methylnaphthalene	Chronic	4.00E-03	mg/kg/day	--	4.00E-03	mg/kg/day	Lungs	1000 x 1	IRIS (value for 2-methylnaphthalene)	4/13/2006
2,4-Dimethylphenol	Chronic	2.00E-02	mg/kg/day	--	2.00E-02	mg/kg/day	Blood; whole body	3000 x 1	IRIS	3/7/2007
2,4-Dinitrotoluene	Chronic	2.00E-03	mg/kg/day	--	2.00E-03	mg/kg/day	Nervous system; liver	100 x 1	IRIS	3/7/2007
2-Butanone	Chronic	6.00E-01	mg/kg/day	--	6.00E-01	mg/kg/day	Whole body	1000 x 1	IRIS	3/7/2007
2-Hexanone		--	--	--	--	--				
2-Methylnaphthalene	Chronic	4.00E-03	mg/kg/day	--	4.00E-03	mg/kg/day	Lungs	1000 x 1	IRIS	3/7/2007
2-Methylphenol	Chronic	5.00E-02	mg/kg/day	--	5.00E-02	mg/kg/day	Whole body; nervous system	1000 x 1	IRIS	3/7/2007
3-Methylphenol/4-Methylphenol	Chronic	5.00E-02	mg/kg/day	--	5.00E-02	mg/kg/day	Whole body; nervous system	1000 x 1	IRIS (value for 3-methylphenol)	3/7/2007
4-Chloro-3-methylphenol	Chronic	7.00E-02	mg/kg/day	--	7.00E-02	mg/kg/day	Whole body		PPRTV**	4/14/2005
4-Methyl-2-pentanone	Chronic	8.00E-02	mg/kg/day	--	8.00E-02	mg/kg/day	Whole body	3000	HEAST	1997
4-Methylphenol	Chronic	5.00E-02	mg/kg/day	--	5.00E-02	mg/kg/day	Whole body; nervous system	1000 x 1	IRIS (value for 3-methylphenol)	3/7/2007
Acetone	Chronic	9.00E-01	mg/kg/day	--	9.00E-01	mg/kg/day	Kidney	1000 x 1	IRIS	3/7/2007
Acetophenone	Chronic	1.00E-01	mg/kg/day	--	1.00E-01	mg/kg/day	Whole body	3000 x 1	IRIS	3/7/2007
Acrylonitrile	Chronic	1.00E-03	mg/kg/day		1.00E-03	mg/kg/day	Reproductive	1000	HEAST	1997
Alpha-BHC		--	--	--	--	--				
Aroclor 1254	Chronic	2.00E-05	mg/kg/day	--	2.00E-05	mg/kg/day	Eyes; immune system	300 x 1	IRIS	3/7/2007
Benzene	Chronic	4.00E-03	mg/kg/day	--	4.00E-03	mg/kg/day	Blood; immune system	300 x 1	IRIS	3/7/2007
Benzo(a)anthracene		--	--	--	--	--				
Benzo(a)pyrene		--	--	--	--	--				
Benzo(b)fluoranthene		--	--	--	--	--				
Benzo(e)pyrene		--	--	--	--	--				
Benzo(k)fluoranthene		--	--	--	--	--				
Benzyl alcohol	Chronic	5.00E-01	mg/kg/day	--	5.00E-01	mg/kg/day	None observed		PPRTV	9/29/2005
Bis(2-Chloroethoxy)methane		--	--	--	--	--				
Bis(2-ethylhexyl)phthalate	Chronic	2.00E-02	mg/kg/day	--	2.00E-02	mg/kg/day	Liver	1000 x 1	IRIS	3/7/2007
C11-C22 Aromatics	Chronic	3.00E-02	mg/kg/day	--	3.00E-02	mg/kg/day	Kidney		MADEP	2003

TABLE 3-31A
NON-CANCER TOXICITY DATA - ORAL/DERMAL
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Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Basis of Study (Chronic/ Subchronic)	Oral RfD		Oral Absorption Efficiency for Dermal (ABS_{gi}) (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Source	
		Value	Units		Value	Units			Source	Date
Carbazole		--	--	--	--	--				
Carbon tetrachloride	Chronic	7.00E-04	mg/kg/day	--	7.00E-04	mg/kg/day	Liver	1000 x 1	IRIS	3/7/2007
Chlorobenzene	Chronic	2.00E-02	mg/kg/day	--	2.00E-02	mg/kg/day	Liver	1000 x 1	IRIS	3/7/2007
Chloroethane		--	--	--	--	--				
Chloroform	Chronic	1.00E-02	mg/kg/day	--	1.00E-02	mg/kg/day	Liver	100 x 1	IRIS	3/7/2007
Chloromethane		--	--	--	--	--				
cis-1,2-Dichloroethene	Chronic	1.00E-02	mg/kg/day	--	1.00E-02	mg/kg/day	Blood		PPRTV	3/1/2006
Dibenzo(a,h)anthracene		--	--	--	--	--				
Dibenzofuran	Chronic	2.00E-03	mg/kg/day	--	2.00E-03	mg/kg/day	Not available		EPA Region 9	2004
Dichlorodifluoromethane	Chronic	2.00E-01	mg/kg/day	--	2.00E-01	mg/kg/day	Whole body	100 x 1	IRIS	3/7/2007
Di-n-octylphthalate	Chronic	4.00E-02	mg/kg/day	--	4.00E-02	mg/kg/day	Not available		EPA Region 9	2004
Ethyl ether	Chronic	2.00E-01	mg/kg/day	--	2.00E-01	mg/kg/day	Whole body	3000 x 1	IRIS	3/7/2007
Ethylbenzene	Chronic	1.00E-01	mg/kg/day	--	1.00E-01	mg/kg/day	Liver; kidney	1000 x 1	IRIS	3/7/2007
Ethyl methacrylate	Chronic	9.00E-02	mg/kg/day	--	9.00E-02	mg/kg/day	Kidney	100	HEAST	1997
Indeno(1,2,3-cd)pyrene		--	--	--	--	--				
Isopropylbenzene	Chronic	1.00E-01	mg/kg/day	--	1.00E-01	mg/kg/day	Kidney	1000 x 1	IRIS	3/7/2007
Methylene Chloride	Chronic	6.00E-02	mg/kg/day	--	6.00E-02	mg/kg/day	Liver	100 x 1	IRIS	3/7/2007
Naphthalene	Chronic	2.00E-02	mg/kg/day	--	2.00E-02	mg/kg/day	Whole body	3000 x 1	IRIS	3/7/2007
n-Butylbenzene		--	--	--	--	--				
n-Nitrosodi-n-butylamine		--	--	--	--	--				
n-Nitrosopyrrolidine		--	--	--	--	--				
n-Propylbenzene		--	--	--	--	--				
o-Chlorotoluene	Chronic	2.00E-02	mg/kg/day	--	2.00E-02	mg/kg/day	Whole body	1000 x 1	IRIS	3/7/2007
o-Toluidine		--	--	--	--	--				
p-Isopropyltoluene	Chronic	1.00E-01	mg/kg/day	--	1.00E-01	mg/kg/day	Kidney	1000 x 1	IRIS (value for isopropylbenzene)	3/7/2007
Perylene		--	--	--	--	--				
Phenanthrene		--	--	--	--	--				
Phenol	Chronic	3.00E-01	mg/kg/day	--	3.00E-01	mg/kg/day	Development/Fetus	300 x 1	IRIS	3/7/2007
Pyridine	Chronic	1.00E-03	mg/kg/day	--	1.00E-03	mg/kg/day	Liver	1000 x 1	IRIS	3/7/2007
Styrene	Chronic	2.00E-01	mg/kg/day	--	2.00E-01	mg/kg/day	Blood; liver	1000 x 1	IRIS	3/7/2007
tert-Butylbenzene		--	--	--	--	--				
Tetrachloroethene	Chronic	1.00E-02	mg/kg/day	--	1.00E-02	mg/kg/day	Liver	1000 x 1	IRIS	3/7/2007
Tetrahydrofuran		--	--	--	--	--				
Toluene	Chronic	8.00E-02	mg/kg/day	--	8.00E-02	mg/kg/day	Kidney	3000 x 1	IRIS	3/7/2007
Trichloroethene		--	--	--	--	--				
Trichlorofluoromethane	Chronic	3.00E-01	mg/kg/day	--	3.00E-01	mg/kg/day	Whole body	1000 x 1	IRIS	3/7/2007
Vinyl Chloride	Chronic	3.00E-03	mg/kg/day	--	3.00E-03	mg/kg/day	Liver	30 x 1	IRIS	3/7/2007
Xylenes (total)	Chronic	2.00E-01	mg/kg/day	--	2.00E-01	mg/kg/day	Whole body	1000 x 1	IRIS	3/7/2007

TABLE 3-31A
NON-CANCER TOXICITY DATA - ORAL/DERMAL
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Basis of Study (Chronic/ Subchronic)	Oral RfD		Oral Absorption Efficiency for Dermal (ABS_{gi}) (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Source	
		Value	Units		Value	Units			Source	Date
Inorganics		--	--	--	--	--				
Antimony	Chronic	4.00E-04	mg/kg/day	0.15	6.00E-05	mg/kg/day	Blood; whole body	1000 x 1	IRIS	3/7/2007
Arsenic	Chronic	3.00E-04	mg/kg/day	--	3.00E-04	mg/kg/day	Skin; cardiovascular system	3 x 1	IRIS	3/7/2007
Barium	Chronic	2.00E-01	mg/kg/day	0.07	1.40E-02	mg/kg/day	Kidney	300 x 1	IRIS	3/7/2007
Beryllium	Chronic	2.00E-03	mg/kg/day	0.007	1.40E-05	mg/kg/day	Intestines	300 x 1	IRIS	3/7/2007
Chromium	Chronic	3.00E-03	mg/kg/day	0.025	7.50E-05	mg/kg/day	None observed	3000 x 3	IRIS (values for hexavalent Cr)	3/7/2007
Cadmium		pathway-specific	mg/kg/day		pathway-specific	mg/kg/day				
Food	Chronic	1.00E-03	mg/kg/day	0.025	2.50E-05	mg/kg/day	Kidney	10 x 1	IRIS	3/7/2007
Water	Chronic	5.00E-04	mg/kg/day	0.05	2.50E-05	mg/kg/day	Kidney	10 x 1	IRIS	3/7/2007
Cobalt		--	--	--	--	--				
Copper		--	--	--	--	--				
Lead		NA (3)	--		NA (3)	mg/kg/day			IRIS	3/7/2007
Thallium	Chronic	8.00E-05	mg/kg/day	--	8.00E-05	mg/kg/day	Blood	3000 x 1	IRIS*	3/7/2007
Manganese		pathway-specific	mg/kg/day		pathway-specific	mg/kg/day				
Diet, soil	Chronic	1.40E-01	mg/kg/day	0.04	5.60E-03	mg/kg/day	Nervous system	1 x 1	IRIS	3/7/2007
Water	Chronic	4.67E-02	mg/kg/day	0.04	1.87E-03	mg/kg/day	Nervous system	1 x 1	IRIS (5)	3/7/2007
Nickel	Chronic	2.00E-02	mg/kg/day	0.04	8.00E-04	mg/kg/day	Whole body	300 x 1	IRIS	3/7/2007
Selenium	Chronic	5.00E-03	mg/kg/day	--	5.00E-03	mg/kg/day	Cardiovascular, alimentary and nervous systems	3 x 1	IRIS	3/7/2007
Silver	Chronic	5.00E-03	mg/kg/day	0.04	2.00E-04	mg/kg/day	Skin	3 x 1	IRIS	3/7/2007
Vanadium	Chronic	9.00E-03	mg/kg/day	0.026	2.34E-04	mg/kg/day	Hair cysteine	100 x 1	IRIS	3/7/2007
Zinc	Chronic	3.00E-01	mg/kg/day	--	3.00E-01	mg/kg/day	Blood	3 x 1	IRIS	3/7/2007

Footnotes:

IRIS = USEPA's Integrated Risk Information System (www.epa.gov/iris). Searched March 2007.

PPRTV = Provisional Peer-Review Toxicity Values, obtained from Superfund Technical Support Center (individual PPRTV dates reported above).

Region 9 = USEPA Region 9 Preliminary Remediation Goal (PRG) table, October 2004 (with December 2004 updates).

Region 6 = USEPA Region 6 Human Health Medium-Specific Screening Levels, 2006. (Revised 12/22/05). http://www.epa.gov/arkansas/6pd/rcra_c/pd-n/screenexpanded.xls

MADEP, 2003 = Massachusetts Department of Environmental Protection. 2003. Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology.

ATSDR MRL = Minimal Risk Levels, December 2005. (http://www.atsdr.cdc.gov/mrllist_12_05.pdf)

HEAST = National Center for Exposure Assessment, Health Effects Assessment Summary Tables, 1997.

-- = No information available.

* Value for Thallium chloride and thallium carbonate.

**Note: Only a subchronic value of 0.7 mg/kg-d was available for 4-chloro-3-methylphenol. We have adjusted the subchronic value by an uncertainty factor of 10 for chronic effects.

(1) Source: Exhibit 4-1, from USEPA, Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part E (Supplemental Guidance for Dermal Risk Assessment), Final, July 2004. Compounds lacking ABSgi values were assumed to have an oral absorption efficiency of 100%.

(2) Derivation of dermal RfD based on absorbed dose

$$RfD_{ABS} = RfD_o * ABS_{GI}$$ (USEPA, 2004)

(3) Lead risks were calculated using EPA's IEUBK model and Adult Lead Model. See Appendix E for details.

(4) RfD for 1,2-Dichlorobenzene used as surrogate.

(5) A modifying factor of 3 was applied to the oral RfD for manganese to account for drinking water exposures, in accordance with EPA IRIS recommendations.

TABLE 3-31B
NONCANCER TOXICITY DATA - INHALATION
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC:Source	
		Value	Units			Source	Date
Organics							
1,1,1-Trichloroethane	Chronic	3.80E+00	(mg/m³)	Nervous system		ATSDR MRL (intermediate)/STSC	5/23/2006
1,1,2-Trichloroethane	Chronic	1.40E-02	(mg/m³)	Blood		Calculated (1)	
1,1-Dichloroethane	Chronic	5.00E-01	(mg/m³)	None observed		HEAST	1997
1,1-Dichloroethene	Chronic	2.00E-01	(mg/m³)	Liver	30 x 1	IRIS	3/7/2007
1,2,4-Trimethylbenzene		--	--				
1,2-Dichloroethane	Chronic	2.43E+00	(mg/m³)	Liver	90	ATSDR MRL (0.6 ppm)	2005
1,2-Dichloroethene	Chronic	6.00E-02	(mg/m³)	Respiratory system; liver		PPRTV (value for trans isomer)	3/1/2006
1,2-Dichloropropane	Chronic	4.00E-03	(mg/m³)	Nasal mucosa	300 x 1	IRIS	3/7/2007
1,3,5-Trimethylbenzene		--	--				
1,4-Dichlorobenzene	Chronic	8.00E-01	(mg/m³)	Liver	100 X 1	IRIS	3/7/2007
1,4-Dioxane	Chronic	3.00E+00	(mg/m³)	Not available		CalEPA REL	9/21/2006
1-Methylnaphthalene	Chronic	2.45E-01	(mg/m³)	Respiratory system	1000	ATSDR MRL (Calculated from RfD)	2005
2,4-Dimethylphenol	Chronic	7.00E-02	(mg/m³)	Blood; whole body		Calculated (1)	
2,4-Dinitrotoluene		--	--				
2-Butanone	Chronic	5.00E+00	(mg/m³)	Development/fetus	300 x 1	IRIS	3/7/2007
2-Hexanone		--	--				
2-Methylnaphthalene	Chronic	1.40E-01	(mg/m³)	Respiratory system	100	ATSDR MRL (Calculated from RfD)	2005
2-Methylphenol	Chronic	1.75E-01	(mg/m³)	Whole body; nervous system		Calculated (1)	
3-Methylphenol/4-Methylphenol	Chronic	1.75E-02	(mg/m³)	Whole body; nervous system		Calculated (1)	
4-Chloro-3-methylphenol		--	--				
4-Methyl-2-pentanone	Chronic	3.00E+00	(mg/m³)	Development/fetus	300 x 1	IRIS	3/7/2007
4-Methylphenol	Chronic	1.75E-02	(mg/m³)	Whole body; nervous system		Calculated (1)	
Acetone	Chronic	3.15E+00	(mg/m³)	Kidney		Calculated (1)	
Acetophenone		--	--				
Acrylonitrile	Chronic	3.50E-03	(mg/m³)	Respiratory system	1000 x 1	IRIS (value for isopropylbenzene; calculated from RfD)	3/7/2007
Alpha-BHC	Chronic	1.75E-03	(mg/m³)	Not available		Calculated (1)	
Aroclor 1254	Chronic	7.00E-05	(mg/m³)	Eyes; immune system		Calculated (1)	
Benzene	Chronic	3.00E-02	(mg/m³)	Blood; immune system	300 x 1	IRIS	3/7/2007
Benzo(a)anthracene		--	--				
Benzo(a)pyrene		--	--				
Benzo(b)fluoranthene		--	--				
Benzo(e)pyrene		--	--				
Benzo(k)fluoranthene		--	--				
Benzyl alcohol		--	--				

TABLE 3-31B
NONCANCER TOXICITY DATA - INHALATION
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC:Source	
		Value	Units			Source	Date
Bis(2-Chloroethoxy)methane		--	--				
Bis(2-ethylhexyl)phthalate	Chronic	7.00E-02	(mg/m³)	Liver		Calculated (1)	
C11-C22 Aromatics	Chronic	5.00E-02	(mg/m³)	Liver, kidney		MADEP	2003
Carbazole		--	--				
Carbon tetrachloride	Chronic	2.45E-03	(mg/m³)	Liver		Calculated (1)	
Chlorobenzene	Chronic	5.00E-02	(mg/m³)	Kidney; liver	1000 x 3	PPRTV	10/17/2005
Chloroethane	Chronic	1.00E+01	(mg/m³)	Development/fetus	300 x 1	IRIS	3/7/2007
Chloroform	Chronic	3.00E-01	(mg/m³)	Kidney; development/fetus; alimentary system		CalEPA REL	9/21/2006
Chloromethane	Chronic	9.00E-02	(mg/m³)	Nervous system	1000 x 1	IRIS	3/7/2007
cis-1,2-Dichloroethene	Chronic	6.00E-02	(mg/m³)	Respiratory system; liver		PPRTV (value for trans isomer)	3/1/2006
Dibenzo(a,h)anthracene		--	--				
Dibenzofuran	Chronic	7.00E-03	(mg/m³)	Not available		Calculated (1)	
Dichlorodifluoromethane	Chronic	2.00E-01	(mg/m³)	None observed		HEAST	1997
Di-n-octylphthalate	Chronic	1.40E-01	(mg/m³)	Not available		Calculated (1)	
Ethyl ether	Chronic	7.00E-01	(mg/m³)	Whole body		Calculated (1)	
Ethylbenzene	Chronic	1.00E+00	(mg/m³)	Development/fetus	300 x 1	IRIS	3/7/2007
Ethyl methacrylate	Chronic	3.15E-01	(mg/m³)	Kidney		Calculated (1)	
Indeno(1,2,3-cd)pyrene		--	--				
Isopropylbenzene	Chronic	4.00E-01	(mg/m³)	Kidney/adrenal gland	1000 x 1	IRIS	3/7/2007
Methylene Chloride	Chronic	3.00E+00	(mg/m³)	Liver	100 x 1	HEAST	1997
Naphthalene	Chronic	3.00E-03	(mg/m³)	Respiratory system	3000 x 1	IRIS	3/7/2007
n-Butylbenzene	Chronic	1.40E-01	(mg/m³)	Not available		Calculated (1)	
n-Nitrosodi-n-butylamine		--	--				
n-Nitrosopyrrolidine		--	--				
n-Propylbenzene	Chronic	1.40E-01	(mg/m³)	Not available		Calculated (1)	
o-Chlorotoluene	Chronic	7.00E-02	(mg/m³)	Whole body		Calculated (1)	
o-Toluidine		--	--				
p-Isopropyltoluene	Chronic	4.00E-01	(mg/m³)	Kidney/adrenal gland	1000 x 1	IRIS	3/7/2007
Perylene		--	--				
Phenanthrene		--	--				
Phenol	Chronic	2.00E-01	(mg/m³)	Alimentary, cardiovascular, nervous systems; kidney		CalEPA REL	9/21/2006
Pyridine	Chronic	3.50E-03	(mg/m³)	Liver		Calculated (1)	
Styrene	Chronic	1.00E+00	(mg/m³)	Nervous system	30 x 1	IRIS	3/7/2007
tert-Butylbenzene	Chronic	1.40E-01	(mg/m³)	Not available		Calculated (1)	
Tetrachloroethene	Chronic	3.50E-02	(mg/m³)	Nervous system; eyes; respiratory system		CalEPA REL	1/17/2006
Tetrahydrofuran	Chronic	3.01E-01	(mg/m³)			Calculated (1)	
Toluene	Chronic	5.00E+00	(mg/m³)	Nervous system	10 x 1	IRIS	3/7/2007

TABLE 3-31B
NONCANCER TOXICITY DATA - INHALATION
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC:Source	
		Value	Units			Source	Date
Trichloroethene	Chronic	6.00E-01	(mg/m³)	Nervous system; eyes		CalEPA REL	9/21/2006
Trichlorofluoromethane		--	--				
Vinyl Chloride	Chronic	1.00E-01	(mg/m³)	Liver	30 x 1	IRIS	3/7/2007
Xylenes (total)	Chronic	1.00E-01	(mg/m³)	Nervous system	300 x 1	IRIS	3/7/2007
Inorganics		--	--				
Antimony		--	--				
Arsenic	Chronic	3.00E-05	(mg/m³)	Not available		CalEPA REL	9/21/2006
Barium	Chronic	5.00E-04	(mg/m³)	Fetus	1000	HEAST	1997
Beryllium	Chronic	2.00E-05	(mg/m³)	Respiratory system	10 x 1	IRIS	3/7/2007
Cadmium		--	--				
Chromium	Chronic	1.00E-04	(mg/m³)	Respiratory system	300 x 1	IRIS (hexavalent Cr)	3/7/2007
Cobalt	Chronic	1.00E-04	(mg/m³)	Respiratory system	10 x 1	ATSDR MRL	10/1/2004
Copper		--	--				
Lead		NA (2)	--				
Manganese	Chronic	5.00E-05	(mg/m³)	Nervous system	1000 x 1	IRIS	3/7/2007
Nickel	Chronic	5.00E-05	(mg/m³)	Not available		CalEPA REL	9/21/2006
Selenium		--	--				
Silver		--	--				
Thallium		--	--				
Vanadium		--	--				
Zinc		--	--				

Footnotes:

IRIS = USEPA's Integrated Risk Information System (www.epa.gov/iris). Searched March 2007.

CalEPA = California Environmental Protection Agency. REL = Reference Exposure Level. PELs are chronic unless otherwise noted. February, 2005. http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html

PPRTV = Provisional Peer-Review Toxicity Values, obtained from Superfund Technical Support Center (individual PPRTV dates reported above).

MADEP, 2003 = Massachusetts Department of Environmental Protection. 2003. Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology.

ATSDR MRL = Minimal Risk Levels, December 2005. (http://www.atsdr.cdc.gov/mrllist_12_05.pdf)

HEAST = National Center for Exposure Assessment, Health Effects Assessment Summary Tables, 1997.

-- = No information available.

(1) RfC calculated from the oral RfD or, if no oral RfD was available, from the inhalation RfD provided in the EPA Region 9 PRG table (October 2004). RfC = RfDi * (70 kg / 20 m^3/day).

(2) Lead risks were calculated using EPA's IEUBK model and Adult Lead Model. See Appendix E for details.

TABLE 3-31C
CANCER TOXICITY DATA - ORAL/DERMAL
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (ABS_{gi}) (1)	Absorbed Cancer Slope Factor for Dermal (1)		USEPA 1986 Weight of Evidence/ Cancer Guideline Description	CSF: Source	
	Value	Units		Value	Units		Source	Date
Organics								
1,1,1-Trichloroethane	--	--	--	--	--	D		
1,1,2-Trichloroethane	5.70E-02	$(mg/kg\text{-}day)^{-1}$	--	5.70E-02	$(mg/kg\text{-}day)^{-1}$	C	IRIS	3/7/2007
1,1-Dichloroethane	--	--	--	--	--	C		
1,1-Dichloroethene	--	--	--	--	--	C		
1,2,4-Trimethylbenzene	--	--	--	--	--	--		
1,2-Dichloroethane	9.10E-02	$(mg/kg\text{-}day)^{-1}$	--	9.10E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
1,2-Dichloroethene	--	--	--	--	--	--		
1,2-Dichloropropane	6.80E-02	$(mg/kg\text{-}day)^{-1}$	--	6.80E-02	$(mg/kg\text{-}day)^{-1}$	--	HEAST	1997
1,3,5-Trimethylbenzene	--	--	--	--	--	--		
1,4-Dichlorobenzene	2.40E-02	$(mg/kg\text{-}day)^{-1}$	--	2.40E-02	$(mg/kg\text{-}day)^{-1}$	--	HEAST	1997
1,4-Dioxane	1.10E-02	$(mg/kg\text{-}day)^{-1}$	--	1.10E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
1-Methylnaphthalene	--	--	--	--	--	--		
2,2'-Oxybis(1-chloropropane)	--	--	--	--	--	--		
2,4-Dimethylphenol	--	--	--	--	--	--		
2,4-Dinitrotoluene	3.10E-01	$(mg/kg\text{-}day)^{-1}$	--			B2	CalEPA	2005
2-Butanone	--	--	--	--	--	--		
2-Hexanone	--	--	--	--	--	--		
2-Methylnaphthalene	--	--	--	--	--	--		
2-Methylphenol	--	--	--	--	--	C		
3-Methylphenol/4-Methylphenol	--	--	--	--	--	--		
4-Chloro-3-methylphenol	--	--	--	--	--	--		
4-Methyl-2-pentanone	--	--	--	--	--	--		
4-Methylphenol	--	--	--	--	--	C		
Acetone	--	--	--	--	--	--		
Acetophenone	--	--	--	--	--	D		
Acrylonitrile	5.40E-01	$(mg/kg\text{-}day)^{-1}$		5.40E-01	$(mg/kg\text{-}day)^{-1}$	B1	IRIS	3/7/2007
Alpha-BHC	6.30E+00	$(mg/kg\text{-}day)^{-1}$	--	6.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
Aroclor 1254	Pathway-specific	$(mg/kg\text{-}day)^{-1}$	--	Pathway-specific	$(mg/kg\text{-}day)^{-1}$	--		
Aroclor 1254-Food/soil	2.00E+00	$(mg/kg\text{-}day)^{-1}$	--	2.00E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
Aroclor 1254-Water	4.00E-01	$(mg/kg\text{-}day)^{-1}$	--	4.00E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
Benzene	5.50E-02	$(mg/kg\text{-}day)^{-1}$	--	5.50E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	3/7/2007
Benzo(a)anthracene	7.30E-01	$(mg/kg\text{-}day)^{-1}$	--	7.30E-01	$(mg/kg\text{-}day)^{-1}$	--	IRIS (2)	3/7/2007
Benzo(a)pyrene	7.30E+00	$(mg/kg\text{-}day)^{-1}$	--	7.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
Benzo(b)fluoranthene	7.30E-01	$(mg/kg\text{-}day)^{-1}$	--	7.30E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS (2)	3/7/2007
Benzo(e)pyrene	--	--	--	--	--	--		
Benzo(k)fluoranthene	7.30E-02	$(mg/kg\text{-}day)^{-1}$	--	7.30E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS (2)	3/7/2007
Benzyl alcohol	--	--	--	--	--	--		
Bis(2-Chloroethoxy)methane	--	--	--	--	--	D		
Bis(2-ethylhexyl)phthalate	1.40E-02	$(mg/kg\text{-}day)^{-1}$	--	1.40E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007

TABLE 3-31C
CANCER TOXICITY DATA - ORAL/DERMAL
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (ABS_{gi})	Absorbed Cancer Slope Factor for Dermal (1)		USEPA 1986 Weight of Evidence/ Cancer Guideline Description	CSF: Source	
	Value	Units	(1)	Value	Units		Source	Date
C11-C22 Aromatics	--	--	--	--	--	--		
Carbazole	2.00E-02	$(mg/kg\text{-}day)^{-1}$	--	2.00E-02	$(mg/kg\text{-}day)^{-1}$	--	HEAST	1997
Carbon tetrachloride	1.30E-01	$(mg/kg\text{-}day)^{-1}$	--	1.30E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
Chlorobenzene	--	--	--	--	--	D		
Chloroethane	--	--	--	--	--	--		
Chloroform	3.10E-02	$(mg/kg\text{-}day)^{-1}$	--	3.10E-02	$(mg/kg\text{-}day)^{-1}$	B2	CalEPA	2005
Chloromethane	--	--	--	--	--	D		
cis-1,2-Dichloroethene	--	--	--	--	--	D		
Dibenzo(a,h)anthracene	7.30E+00	$(mg/kg\text{-}day)^{-1}$	--	7.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS (2)	3/7/2007
Dibenzofuran	--	--	--	--	--	D		
Dichlorodifluoromethane	--	--	--	--	--	--		
Di-n-octylphthalate	--	--	--	--	--	--		
Ethyl ether	--	--	--	--	--	--		
Ethylbenzene	--	--	--	--	--	D		
Ethyl methacrylate	--	--	--	--	--	--		
Indeno(1,2,3-cd)pyrene	7.30E-01	$(mg/kg\text{-}day)^{-1}$	--	7.30E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS (2)	3/7/2007
Isopropylbenzene	--	--	--	--	--	--		
Methylene Chloride	7.50E-03	$(mg/kg\text{-}day)^{-1}$	--	7.50E-03	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
Naphthalene	--	--	--	--	--	C		
n-Butylbenzene	--	--	--	--	--	--		
n-Nitrosodi-n-butylamine	5.40E+00	$(mg/kg\text{-}day)^{-1}$	--	5.40E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
n-Nitrosopyrrolidine	2.10E+00	$(mg/kg\text{-}day)^{-1}$	--	2.10E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	3/7/2007
n-Propylbenzene	--	--	--	--	--	--		
o-Chlorotoluene	--	--	--	--	--	--		
o-Toluidine	2.40E-01	$(mg/kg\text{-}day)^{-1}$	--	2.40E-01	$(mg/kg\text{-}day)^{-1}$	--	HEAST	1997
p-Isopropyltoluene	--	--	--	--	--	--		
Perylene	--	--	--	--	--	--		
Phenanthrene	--	--	--	--	--	D		
Phenol	--	--	--	--	--	D		
Pyridine	--	--	--	--	--	--		
Styrene	--	--	--	--	--	--		
tert-Butylbenzene	--	--	--	--	--	--		
Tetrachloroethene	5.40E-01	$(mg/kg\text{-}day)^{-1}$	--	5.40E-01	$(mg/kg\text{-}day)^{-1}$	B1	CalEPA	2005
Tetrahydrofuran	--	--	--	--	--	--		
Toluene	--	--	--	--	--	--		
Trichloroethene	4.00E-01	$(mg/kg\text{-}day)^{-1}$	--	4.00E-01	$(mg/kg\text{-}day)^{-1}$	--	EPA	2001
Trichlorofluoromethane	--	--	--	--	--	--		

TABLE 3-31C
CANCER TOXICITY DATA - ORAL/DERMAL
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (ABS_{gi}) (1)	Absorbed Cancer Slope Factor for Dermal (1)		USEPA 1986 Weight of Evidence/ Cancer Guideline Description	CSF: Source	
	Value	Units		Value	Units		Source	Date
Vinyl Chloride	age-specific	$(mg/kg\text{-}day)^{-1}$	--	age-specific	$(mg/kg\text{-}day)^{-1}$	--		
Vinyl chloride-Adult exposure	7.20E-01	$(mg/kg\text{-}day)^{-1}$	--	7.20E-01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	3/7/2007
Vinyl chloride-Lifetime exposure	1.50E+00	$(mg/kg\text{-}day)^{-1}$	--	1.50E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	3/7/2007
Xylenes (total)	--	--	--	--	--	--		
Inorganics	--	--	--	--	--			
Antimony	--	--	--	--	--	--		
Arsenic	1.50E+00	$(mg/kg\text{-}day)^{-1}$	--	1.50E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	3/7/2007
Barium	--	--	--	--	--	D		
Beryllium	--	--	--	--	--	B1		
Cadmium	--	--	--	--	--	B1 (via inhalation)		
Chromium	--	--	--	--	--	A (via inhalation)		
Cobalt	--	--	--	--	--	--		
Copper	--	--	--	--	--	D		
Lead	--	--	--	--	--	B2		
Manganese	--	--	--	--	--	D		
Nickel	--	--	--	--	--	--		
Selenium	--	--	--	--	--	D		
Silver	--	--	--	--	--	D		
Thallium	--	--	--	--	--	D		
Vanadium	--	--	--	--	--	--		
Zinc	--	--	--	--	--	D		

Footnotes:

References apply to both oral and dermal slope factors.

IRIS = USEPA's Integrated Risk Information System (www.epa.gov/iris). Searched March 2007.

CalEPA = California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Toxicity Criteria Database. August 10, 2005. http://www.oehha.ca.gov/risk/pdf/cancerpotalpha81005.pdf.

Region 9 = USEPA Region 9 Preliminary Remediation Goal (PRG) table, October 2004.

HEAST = National Center for Exposure Assessment, Health Effects Assessment Summary Tables, 1997.

EPA 2001. Trichloroethylene Health Risk Assessment: Synthesis and Characterization (External Review Draft). EPA/600/P-01/002A. August 1, 2001. Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, D.C.

-- = No information available.

(1) Derivation of dermal CSF based on absorbed dose

$$SF_{ABS} = SF_o / ABS_{GI}$$

Source: Exhibit 4-1, from USEPA, Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part E (Supplemental Guidance for Dermal Risk Assessment), Final, July 2004.

(2) The following toxicity equivalency factors (TEFs) were applied to the toxicity value for benzo(a)pyrene to derive a toxicity value for the seven carcinogenic PAHs:

Benzo(a)pyrene	1	chrysene	0.001
Benzo(a)anthracene	0.1	dibenz(a,h)anthracene	1
benzo(b)fluoranthene	0.1	indeno(1,2,3-cd)pyrene	0.1
benzo(k)fluoranthene	0.01		

TABLE 3-31D

CANCER TOXICITY DATA - INHALATION

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk or Inhalation CSF: Source	
	Value	Units	Value	Units		Source	Date
Organics							
1,1,1-Trichloroethane	--	--	--	--	D		
1,1,2-Trichloroethane	1.60E-02	$(mg/m^3)^{-1}$	5.60E-02	$(mg/kg\text{-}d)^{-1}$	C	IRIS*	3/7/2007
1,1-Dichloroethane	--	--	--	--	C		
1,1-Dichloroethene	--	--	--	--	C		
1,2,4-Trimethylbenzene	--	--	--	--	--		
1,2-Dichloroethane	2.60E-02	$(mg/m^3)^{-1}$	9.10E-02	$(mg/kg/day)^{-1}$	B2	IRIS*	3/7/2007
1,2-Dichloroethene	--	--	--	--	--		
1,2-Dichloropropane	--	--	--	--	--		
1,3,5-Trimethylbenzene	--	--	--	--	--		
1,4-Dichlorobenzene	--	--	--	--	--		
1,4-Dioxane	7.70E-03	$(mg/m^3)^{-1}$	2.70E-02	$(mg/kg\text{-}d)^{-1}$	B2	CalEPA*	2005
1-Methylnaphthalene	--	--	--	--	--		
2,2'-Oxybis(1-chloropropane)	--	--	--	--	--		
2,4-Dimethylphenol	--	--	--	--	--		
2,4-Dinitrotoluene	8.90E-02	$(mg/m^3)^{-1}$	3.12E-01	$(mg/kg\text{-}d)^{-1}$	B2	CalEPA*	2005
2-Butanone	--	--	--	--	--		
2-Hexanone	--	--	--	--	--		
2-Methylnaphthalene	--	--	--	--	--		
2-Methylphenol	--	--	--	--	C		
3-Methylphenol/4-Methylphenol	--	--	--	--	--		
4-Chloro-3-methylphenol	--	--	--	--	--		
4-Methyl-2-pentanone	--	--	--	--	--		
4-Methylphenol	--	--	--	--	C		
Acetone	--	--	--	--	--		
Acetophenone	--	--	--	--	D		
Acrylonitrile	6.80E-02	$(mg/m^3)^{-1}$	2.38E-01	$(mg/kg/day)^{-1}$	B1	IRIS	3/7/2007
Alpha-BHC	1.80E+00	$(mg/m^3)^{-1}$	6.30E+00	$(mg/kg\text{-}d)^{-1}$	B2	IRIS*	3/7/2007
Aroclor 1254	Pathway-specific	$(mg/m^3)^{-1}$	Pathway-specific	$(mg/kg\text{-}d)^{-1}$			
Aroclor 1254-Food/soil	5.71E-01	$(mg/m^3)^{-1}$	2.00E+00	$(mg/kg\text{-}d)^{-1}$	B2	IRIS*	3/7/2007
Aroclor 1254-Water/air	1.00E-01	$(mg/m^3)^{-1}$	3.50E-01	$(mg/kg\text{-}d)^{-1}$	B2	IRIS*	3/7/2007
Benzene	7.80E-03	$(mg/m^3)^{-1}$	2.73E-02	$(mg/kg/day)^{-1}$	A	IRIS*	3/7/2007
Benzo(a)anthracene	1.10E-01	$(mg/m^3)^{-1}$	3.90E-01	$(mg/kg/day)^{-1}$	--	CalEPA	2005
Benzo(a)pyrene	1.10E+00	$(mg/m^3)^{-1}$	3.90E+00	$(mg/kg/day)^{-1}$	B2	CalEPA	2005
Benzo(b)fluoranthene	1.10E-01	$(mg/m^3)^{-1}$	3.90E-01	$(mg/kg/day)^{-1}$	B2	CalEPA	2005
Benzo(e)pyrene	--	--	--	--	--		
Benzo(k)fluoranthene	1.10E-01	$(mg/m^3)^{-1}$	3.90E-01	$(mg/kg/day)^{-1}$	B2	CalEPA	2005
Benzyl alcohol	--	--	--	--	--		

TABLE 3-31D

CANCER TOXICITY DATA - INHALATION

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk or Inhalation CSF: Source	
	Value	Units	Value	Units		Source	Date
Bis(2-Chloroethoxy)methane	--	--	--	--	D		
Bis(2-ethylhexyl)phthalate	2.40E-03	$(mg/m^3)^{-1}$	8.40E-03	$(mg/kg/day)^{-1}$	B2	CalEPA	2005
C11-C22 Aromatics	--	--	--	--	--		
Carbazole	--	--	--	--	--		
Carbon tetrachloride	1.50E-02	$(mg/m^3)^{-1}$	5.25E-02	$(mg/kg\text{-}d)^{-1}$	B2	IRIS*	3/7/2007
Chlorobenzene	--	--	--	--	D		
Chloroethane	--	--	--	--	--		
Chloroform	2.30E-02	$(mg/m^3)^{-1}$	8.05E-02	$(mg/kg\text{-}d)^{-1}$	B2	IRIS*	3/7/2007
Chloromethane	--	--	--	--	D		
cis-1,2-Dichloroethene	--	--	--	--	D		
Dibenzo(a,h)anthracene	1.20E+00	$(mg/m^3)^{-1}$	4.10E+00	$(mg/kg/day)^{-1}$	B2	CalEPA	2005
Dibenzofuran	--	--	--	--	D		
Dichlorodifluoromethane	--	--	--	--	--		
Di-n-octylphthalate	--	--	--	--	--		
Ethyl ether	--	--	--	--	--		
Ethylbenzene	--	--	--	--	D		
Ethyl methacrylate	--	--	--	--	--		
Indeno(1,2,3-cd)pyrene	1.10E-01	$(mg/m^3)^{-1}$	3.90E-01	$(mg/kg/day)^{-1}$	B2	CalEPA	2005
Isopropylbenzene	--	--	--	--	--		
Methylene Chloride	4.70E-04	$(mg/m^3)^{-1}$	1.65E-03	$(mg/kg/day)^{-1}$	B2	IRIS*	3/7/2007
Naphthalene	--	--	--	--	C		
n-Butylbenzene	--	--	--	--	--		
n-Nitrosodi-n-butylamine	1.60E+00	$(mg/m^3)^{-1}$	5.60E+00	$(mg/kg/day)^{-1}$	B2	IRIS*	3/7/2007
n-Nitrosopyrrolidine	6.10E-01	$(mg/m^3)^{-1}$	2.14E+00	$(mg/kg/day)^{-1}$	B2	IRIS*	3/7/2007
n-Propylbenzene	--	--	--	--	--		
o-Chlorotoluene	--	--	--	--	--		
o-Toluidine	--	--	--	--	--		
p-Isopropyltoluene	--	--	--	--	--		
Perylene	--	--	--	--	--		
Phenanthrene	--	--	--	--	D		
Phenol	--	--	--	--	D		
Pyridine	--	--	--	--	--		
Styrene	--	--	--	--	--		
tert-Butylbenzene	--	--	--	--	--		
Tetrachloroethene	5.90E-03	$(mg/m^3)^{-1}$	2.07E-02	$(mg/kg/day)^{-1}$	B1	CalEPA	2005
Tetrahydrofuran	--	--	--	--	--		
Toluene	--	--	--	--	--		
Trichloroethene	2.00E-03	$(mg/m^3)^{-1}$	7.00E+00	$(mg/kg/day)^{-1}$	--	CalEPA	2005

TABLE 3-31D

CANCER TOXICITY DATA - INHALATION

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk or Inhalation CSF: Source	
	Value	Units	Value	Units		Source	Date
Trichlorofluoromethane	--	--	--	--	--		
Vinyl Chloride	age-specific	$(mg/m^3)^{-1}$	age-specific	$(mg/kg/day)^{-1}$	--		
Vinyl chloride-Adult exposure	4.40E-03	$(mg/m^3)^{-1}$	1.54E-02	$(mg/kg/day)^{-1}$	A	IRIS*	3/7/2007
Vinyl chloride-Lifetime exposure	8.80E-03	$(mg/m^3)^{-1}$	3.08E-02	$(mg/kg/day)^{-1}$	A	IRIS*	3/7/2007
Xylenes (total)	--	--	--	--	--		
Inorganics	--	--	--	--			
Antimony	--	--	--	--	--		
Arsenic	4.30E+00	$(mg/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS*	3/7/2007
Barium	--	--	--	--	D		
Beryllium	2.40E+00	$(mg/m^3)^{-1}$	8.40E+00	$(mg/kg\text{-}d)^{-1}$	B1	IRIS*	3/7/2007
Cadmium	1.80E+00	$(mg/m^3)^{-1}$	6.30E+00	$(mg/kg/day)^{-1}$	B1 (via inhalation)	IRIS*	3/7/2007
Chromium	1.20E+01	$(mg/m^3)^{-1}$	4.20E+01	$(mg/kg\text{-}d)^{-1}$	A (via inhalation)	IRIS*	3/7/2007
Cobalt	--	--	--	--	--		
Copper	--	--	--	--	D		
Lead	--	--	--	--	B2		
Manganese	--	--	--	--	D		
Nickel	--	--	--	--	--		
Selenium	--	--	--	--	D		
Silver	--	--	--	--	D		
Thallium	--	--	--	--	D		
Vanadium	--	--	--	--	--		
Zinc	--	--	--	--	D		

Footnotes:

References apply to both slope factors and unit risk values, unless otherwise noted (* indicates slope factor calculated from unit risk; ** indicates unit risk calculated from slope factor).

Slope factors were calculated from unit risk values using the following equation: SF = 70 kg/ 20 m^3-d^{-1} * UR

Unit risk values were calculated from slope factors using the following equation: UR = 20 m^3-d^{-1} / 70 kg * SF

IRIS = USEPA's Integrated Risk Information System (www.epa.gov/iris). Searched March 2007.

CalEPA = California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Toxicity Criteria Database. August 10, 2005. http://www.oehha.ca.gov/risk/pdf/cancerpotalpha81005.pdf.

Region 9 = USEPA Region 9 Preliminary Remediation Goal (PRG) table, October 2004 (with December 2004 updates).

A blank space indicates that no toxicity information is available.

TABLE 3-32A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Upland Soil	Group 3 Upland Area	Incidental Ingestion	Benzo(a)anthracene	1.1E+00	(mg/kg)	*		*		8.5E-08	3.0E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	*		*		8.5E-07	3.0E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	3.3E-08	mg/kg-day	--		--	2.1E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	*		*		6.5E-08	2.3E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	6.5E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	9.0E-07	4.1E-04	mg/kg-day	2.0E-02	mg/kg/day	2.1E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	6.9E-05	mg/kg-day	--		--	4.4E-04	mg/kg-day	4.0E-02	mg/kg/day	1.1E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	*		*		5.6E-08	2.0E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	4.3E-06	mg/kg-day	--		--	2.7E-05	mg/kg-day	2.0E-02	mg/kg/day	1.4E-03
				Toluene	7.1E+02	(mg/kg)	3.1E-05	mg/kg-day	--		--	1.9E-04	mg/kg-day	8.0E-02	mg/kg/day	2.4E-03
				Tetrachloroethene	2.7E+01	(mg/kg)	1.2E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	6.3E-07	7.4E-06	mg/kg-day	1.0E-02	mg/kg/day	7.4E-04
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	2.5E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	8.6E-06	mg/kg-day	--		--	5.5E-05	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	3.9E-05	mg/kg-day	--		--	2.5E-04	mg/kg-day	2.0E-01	mg/kg/day	1.2E-03
				Arsenic	5.9E+00	(mg/kg)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.4E-03
				Cadmium	3.8E+00	(mg/kg)	1.6E-07	mg/kg-day	--		--	1.0E-06	mg/kg-day	1.0E-03	mg/kg/day	1.0E-03
				Lead	7.3E+01	(mg/kg)	3.1E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	5.8E-07	mg/kg-day	--		--	3.7E-06	mg/kg-day	9.0E-03	mg/kg/day	4.1E-04
			Exp. Route Total								3.0E-06					4.4E-02
			Dermal Contact	Benzo(a)anthracene	1.1E+00	(mg/kg)	*		*		6.4E-08	2.3E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	*		*		6.4E-07	2.3E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	2.5E-08	mg/kg-day	--		--	1.6E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	*		*		4.9E-08	1.8E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	3.8E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.3E-07	2.4E-04	mg/kg-day	2.0E-02	mg/kg/day	1.2E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	4.0E-05	mg/kg-day	--		--	2.6E-04	mg/kg-day	4.0E-02	mg/kg/day	6.4E-03
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	*		*		4.2E-08	1.5E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	3.3E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	2.0E-02	mg/kg/day	1.0E-03
				Toluene	7.1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	2.7E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	5.9E+00	(mg/kg)	4.5E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.7E-08	2.8E-07	mg/kg-day	3.0E-04	mg/kg/day	9.5E-04
				Cadmium	3.8E+00	(mg/kg)	9.6E-10	mg/kg-day	--		--	6.1E-09	mg/kg-day	2.5E-05	mg/kg/day	2.4E-04
				Lead	7.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.4E-06					2.1E-02
		Exposure Point Total									4.4E-06					6.5E-02
	Exposure Medium Total										4.4E-06					6.5E-02
Risk From Reference											4.5E-07					8.7E-03
Risk from Site											3.9E-06					5.6E-02

TABLE 3-32A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	1.8E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	1.8E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.2E-08	2.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.3E-08	1.5E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.1E-08	mg/kg-day	--		--	6.8E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	6.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.7E-07	4.1E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Lead	6E+01	(mg/kg)	2.7E-06	mg/kg-day	--		--	1.7E-05	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	2.5E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	1.4E-01	mg/kg/day	1.1E-03
				Vanadium	1E+01	(mg/kg)	5.2E-07	mg/kg-day	--		--	3.3E-06	mg/kg-day	9.0E-03	mg/kg/day	3.7E-04
			Exp. Route Total								1.6E-06					1.5E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	2.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	2.4E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.1E-08	3.0E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.2E-08	2.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.5E-08	mg/kg-day	--		--	9.4E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.1E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.3E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.4E-07					4.3E-03
		Exposure Point Total									2.6E-06					2.0E-02
	Exposure Medium Total										2.6E-06					2.0E-02
Risk From Reference											1.3E-06					1.8E-02
Risk from Site											1.3E-06					1.5E-03
Medium Total											6.9E-06					8.4E-02
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	9.3E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.0E-09	5.9E-07	mg/kg-day	1.0E-01	mg/kg/day	5.9E-06
				Methylene Chloride	5E-03	(mg/L)	1.0E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.7E-10	6.5E-07	mg/kg-day	6.0E-02	mg/kg/day	1.1E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	4.7E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.3E-03
				Cadmium	7E-03	(mg/L)	2.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	2.5E-05	mg/kg/day	6.1E-03
				Lead	1E-02	(mg/L)	5.4E-09	mg/kg-day	--		--	3.4E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.1E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	1.9E-03	mg/kg/day	7.2E-03
				Vanadium	5E-03	(mg/L)	2.0E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	2.3E-04	mg/kg/day	5.4E-04
				Zinc	2E+00	(mg/L)	5.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	3.0E-01	mg/kg/day	1.1E-04
			Exp. Route Total								3.8E-07					1.9E-02
		Exposure Point Total									3.8E-07					1.9E-02
	Exposure Medium Total										3.8E-07					1.9E-02
Risk From Reference											0.0E+00					1.4E-02
Risk from Site											3.8E-07					5.4E-03
Medium Total											3.8E-07					1.9E-02

TABLE 3-32A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		4.1E-07	1.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	2.7E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.1E-09	1.7E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	5.0E-07	mg/kg-day	--		--	3.2E-06	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	6.8E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.0E-05	4.3E-05	mg/kg-day	3.0E-04	mg/kg/day	1.4E-01
				Lead	2E+01	(mg/kg)	8.8E-07	mg/kg-day	--		--	5.6E-06	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	6.3E-06	mg/kg-day	--		--	4.0E-05	mg/kg-day	1.4E-01	mg/kg/day	2.9E-04
				Vanadium	9E+00	(mg/kg)	3.7E-07	mg/kg-day	--		--	2.4E-06	mg/kg-day	9.0E-03	mg/kg/day	2.6E-04
			Exp. Route Total								1.1E-05					1.4E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		1.5E-06	5.2E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	5.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.5E-06	3.6E-05	mg/kg-day	3.0E-04	mg/kg/day	1.2E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.9E-06					1.2E-01
		Exposure Point Total									2.1E-05					2.6E-01
	Exposure Medium Total										2.1E-05					2.6E-01
Risk From Reference											2.1E-05					2.6E-01
Risk from Site											1.1E-09					0.0E+00
Medium Total											2.1E-05					2.6E-01
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	9.7E-06	mg/m^3	--		--	6.2E-05	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	3.2E-05	mg/m^3	--		--	2.0E-04	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	1.3E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	1.0E-07	8.2E-05	mg/m^3	3.0E-02	mg/kg/day	2.7E-03
				Xylenes (total)	9E-02	(mg/m3)	3.0E-04	mg/m^3	--		--	1.9E-03	mg/m^3	1.0E-01	mg/kg/day	1.9E-02
			Exp. Route Total								1.0E-07					2.2E-02
		Exposure Point Total									1.0E-07					2.2E-02
	Exposure Medium Total										1.0E-07					2.2E-02
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											1.0E-07					2.2E-02
Total of Receptor Risks Across All Media											3E-05	Total of Receptor Hazards Across All Media				4E-01
Risks from Reference											2E-05					3E-01
Risks from Site											6E-06					8E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 32M.

TABLE 3-32B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Upland Soil	Group 3 Upland Area	Incidental Ingestion	Benzo(a)anthracene	1.1E+00	(mg/kg)	*		*		1.7E-07	6.0E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	*		*		1.7E-06	6.0E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	6.5E-08	mg/kg-day	--		--	4.2E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	*		*		1.3E-07	4.6E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	1.3E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.8E-06	8.2E-04	mg/kg-day	2.0E-02	mg/kg/day	4.1E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	1.4E-04	mg/kg-day	--		--	8.8E-04	mg/kg-day	4.0E-02	mg/kg/day	2.2E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	*		*		1.1E-07	3.9E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	8.6E-06	mg/kg-day	--		--	5.5E-05	mg/kg-day	2.0E-02	mg/kg/day	2.7E-03
				Toluene	7.1E+02	(mg/kg)	6.1E-05	mg/kg-day	--		--	3.9E-04	mg/kg-day	8.0E-02	mg/kg/day	4.9E-03
				Tetrachloroethene	2.7E+01	(mg/kg)	2.3E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.3E-06	1.5E-05	mg/kg-day	1.0E-02	mg/kg/day	1.5E-03
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	5.1E-05	mg/kg-day	--		--	3.2E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	1.7E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	7.7E-05	mg/kg-day	--		--	4.9E-04	mg/kg-day	2.0E-01	mg/kg/day	2.5E-03
				Arsenic	5.9E+00	(mg/kg)	5.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.6E-07	3.2E-06	mg/kg-day	3.0E-04	mg/kg/day	1.1E-02
				Cadmium	3.8E+00	(mg/kg)	3.3E-07	mg/kg-day	--		--	2.1E-06	mg/kg-day	1.0E-03	mg/kg/day	2.1E-03
				Lead	7.3E+01	(mg/kg)	6.3E-06	mg/kg-day	--		--	4.0E-05	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	1.2E-06	mg/kg-day	--		--	7.4E-06	mg/kg-day	9.0E-03	mg/kg/day	8.2E-04
			Exp. Route Total								5.9E-06					8.8E-02
			Dermal Contact	Benzo(a)anthracene	1.1E+00	(mg/kg)	*		*		6.4E-08	2.3E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	*		*		6.4E-07	2.3E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	2.5E-08	mg/kg-day	--		--	1.6E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	*		*		4.9E-08	1.8E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	3.8E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.3E-07	2.4E-04	mg/kg-day	2.0E-02	mg/kg/day	1.2E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	4.0E-05	mg/kg-day	--		--	2.6E-04	mg/kg-day	4.0E-02	mg/kg/day	6.4E-03
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	*		*		4.2E-08	1.5E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	3.3E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	2.0E-02	mg/kg/day	1.0E-03
				Toluene	7.1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	2.7E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	5.9E+00	(mg/kg)	4.5E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.7E-08	2.8E-07	mg/kg-day	3.0E-04	mg/kg/day	9.5E-04
				Cadmium	3.8E+00	(mg/kg)	9.6E-10	mg/kg-day	--		--	6.1E-09	mg/kg-day	2.5E-05	mg/kg/day	2.4E-04
				Lead	7.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.4E-06					2.1E-02
		Exposure Point Total									7.3E-06					1.1E-01
	Exposure Medium Total										7.3E-06					1.1E-01
Risk From Reference											8.3E-07					1.5E-02
Risk from Site											6.5E-06					9.3E-02

TABLE 3-32B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		9.9E-08	3.5E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		9.9E-07	3.5E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		1.2E-07	4.4E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		8.6E-08	3.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	2.2E-08	mg/kg-day	--		--	1.4E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	1.3E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.9E-06	8.2E-06	mg/kg-day	3.0E-04	mg/kg/day	2.7E-02
				Lead	6E+01	(mg/kg)	5.4E-06	mg/kg-day	--		--	3.5E-05	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	5.0E-05	mg/kg-day	--		--	3.2E-04	mg/kg-day	1.4E-01	mg/kg/day	2.3E-03
				Vanadium	1E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.6E-06	mg/kg-day	9.0E-03	mg/kg/day	7.3E-04
			Exp. Route Total								3.2E-06					3.0E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	2.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	2.4E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.1E-08	3.0E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.2E-08	2.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.5E-08	mg/kg-day	--		--	9.4E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.1E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.3E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.4E-07					4.3E-03
		Exposure Point Total									4.2E-06					3.5E-02
	Exposure Medium Total										4.2E-06					3.5E-02
Risk From Reference											2.2E-06					3.2E-02
Risk from Site											1.9E-06					3.0E-03
Medium Total											1.1E-05					1.4E-01
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	9.3E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.0E-09	5.9E-07	mg/kg-day	1.0E-01	mg/kg/day	5.9E-06
				Methylene Chloride	5E-03	(mg/L)	1.0E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.7E-10	6.5E-07	mg/kg-day	6.0E-02	mg/kg/day	1.1E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	4.7E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.3E-03
				Cadmium	7E-03	(mg/L)	2.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	2.5E-05	mg/kg/day	6.1E-03
				Lead	1E-02	(mg/L)	5.4E-09	mg/kg-day	--		--	3.4E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.1E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	1.9E-03	mg/kg/day	7.2E-03
				Vanadium	5E-03	(mg/L)	2.0E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	2.3E-04	mg/kg/day	5.4E-04
				Zinc	2E+00	(mg/L)	5.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	3.0E-01	mg/kg/day	1.1E-04
			Exp. Route Total								3.8E-07					1.9E-02
		Exposure Point Total									3.8E-07					1.9E-02
	Exposure Medium Total										3.8E-07					1.9E-02
Risk From Reference											0.0E+00					1.4E-02
Risk from Site											3.8E-07					5.4E-03
Medium Total											3.8E-07					1.9E-02

TABLE 3-32B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		8.2E-07	2.9E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	5.3E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.1E-09	3.4E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.4E-06	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	1.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.0E-05	8.7E-05	mg/kg-day	3.0E-04	mg/kg/day	2.9E-01
				Lead	2E+01	(mg/kg)	1.8E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	1.3E-05	mg/kg-day	--		--	8.1E-05	mg/kg-day	1.4E-01	mg/kg/day	5.8E-04
				Vanadium	9E+00	(mg/kg)	7.5E-07	mg/kg-day	--		--	4.8E-06	mg/kg-day	9.0E-03	mg/kg/day	5.3E-04
			Exp. Route Total								2.1E-05					2.9E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		1.5E-06	5.2E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	5.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.5E-06	3.6E-05	mg/kg-day	3.0E-04	mg/kg/day	1.2E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.9E-06					1.2E-01
		Exposure Point Total									3.1E-05					4.1E-01
	Exposure Medium Total										3.1E-05					4.1E-01
Risk From Reference											3.1E-05					4.1E-01
Risk from Site											2.1E-09					0.0E+00
Medium Total											3.1E-05					4.1E-01
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	9.7E-06	mg/m^3	--		--	6.2E-05	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	3.2E-05	mg/m^3	--		--	2.0E-04	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	1.3E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	1.0E-07	8.2E-05	mg/m^3	3.0E-02	mg/kg/day	2.7E-03
				Xylenes (total)	9E-02	(mg/m3)	3.0E-04	mg/m^3	--		--	1.9E-03	mg/m^3	1.0E-01	mg/kg/day	1.9E-02
			Exp. Route Total								1.0E-07					2.2E-02
		Exposure Point Total									1.0E-07					2.2E-02
	Exposure Medium Total										1.0E-07					2.2E-02
Risk From Reference																
Risk from Site											1.0E-07					2.2E-02
Total of Receptor Risks Across All Media											4E-05	Total of Receptor Hazards Across All Media				6.E-01
Risks from Reference											3E-05					5.E-01
Risks from Site											9E-06					1E-01

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 32N.

TABLE 3-32C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-1' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	5.4E-01	(mg/kg)	*		*		4.2E-08	1.5E-07	mg/kg-day	--		--
				Benzo(a)pyrene	5.5E-01	(mg/kg)	*		*		4.3E-07	1.5E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	6.8E-01	(mg/kg)	*		*		5.2E-08	1.9E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	5.2E-01	(mg/kg)	*		*		4.0E-08	1.4E-07	mg/kg-day	--		--
				Arsenic	7.0E+00	(mg/kg)	3.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.5E-07	1.9E-06	mg/kg-day	3.0E-04	mg/kg/day	6.4E-03
				Lead	1.4E+02	(mg/kg)	5.9E-06	mg/kg-day	--		--	3.8E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	7.4E-06	mg/kg-day	--		--	4.7E-05	mg/kg-day	1.4E-01	mg/kg/day	3.4E-04
				Vanadium	1.6E+01	(mg/kg)	6.7E-07	mg/kg-day	--		--	4.3E-06	mg/kg-day	2.3E-04	mg/kg/day	1.8E-02
			Exp. Route Total								1.0E-06					2.5E-02
			Dermal Contact	Benzo(a)anthracene	5.4E-01	(mg/kg)	*		*		3.1E-08	1.1E-07	mg/kg-day	--		--
				Benzo(a)pyrene	5.5E-01	(mg/kg)	*		*		3.2E-07	1.2E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	6.8E-01	(mg/kg)	*		*		3.9E-08	1.4E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	5.2E-01	(mg/kg)	*		*		3.0E-08	1.1E-07	mg/kg-day	--		--
				Arsenic	7.0E+00	(mg/kg)	5.3E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.0E-08	3.4E-07	mg/kg-day	3.0E-04	mg/kg/day	1.1E-03
				Lead	1.4E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								5.0E-07					1.1E-03
		Exposure Point Total									1.5E-06					2.6E-02
	Exposure Medium Total										1.5E-06					2.6E-02
Risk From Reference											5.3E-07					7.5E-03
Risk from Site											9.8E-07					1.9E-02

TABLE 3-32C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	1.8E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	1.8E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.2E-08	2.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.3E-08	1.5E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.1E-08	mg/kg-day	--		--	6.8E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	6.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.7E-07	4.1E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Lead	6E+01	(mg/kg)	2.7E-06	mg/kg-day	--		--	1.7E-05	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	2.5E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	1.4E-01	mg/kg/day	1.1E-03
				Vanadium	1E+01	(mg/kg)	5.2E-07	mg/kg-day	--		--	3.3E-06	mg/kg-day	9.0E-03	mg/kg/day	3.7E-04
			Exp. Route Total								1.6E-06					1.5E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	2.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	2.4E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.1E-08	3.0E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.2E-08	2.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.5E-08	mg/kg-day	--		--	9.4E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.1E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.3E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.4E-07					4.3E-03
		Exposure Point Total									2.6E-06					2.0E-02
	Exposure Medium Total										2.6E-06					2.0E-02
Risk From Reference											1.3E-06					1.8E-02
Risk from Site											1.3E-06					1.5E-03
Medium Total											4.1E-06					4.6E-02
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	9.3E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.0E-09	5.9E-07	mg/kg-day	1.0E-01	mg/kg/day	5.9E-06
				Methylene Chloride	5E-03	(mg/L)	1.0E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.7E-10	6.5E-07	mg/kg-day	6.0E-02	mg/kg/day	1.1E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	4.7E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.3E-03
				Cadmium	7E-03	(mg/L)	2.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	2.5E-05	mg/kg/day	6.1E-03
				Lead	1E-02	(mg/L)	5.4E-09	mg/kg-day	--		--	3.4E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.1E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	1.9E-03	mg/kg/day	7.2E-03
				Vanadium	5E-03	(mg/L)	2.0E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	2.3E-04	mg/kg/day	5.4E-04
				Zinc	2E+00	(mg/L)	5.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	3.0E-01	mg/kg/day	1.1E-04
			Exp. Route Total								3.8E-07					1.9E-02
		Exposure Point Total									3.8E-07					1.9E-02
	Exposure Medium Total										3.8E-07					1.9E-02
Risk From Reference											0.0E+00					1.4E-02
Risk from Site											3.8E-07					5.4E-03
Medium Total											3.8E-07					1.9E-02

TABLE 3-32C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		4.1E-07	1.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	2.7E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.1E-09	1.7E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	5.0E-07	mg/kg-day	--		--	3.2E-06	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	6.8E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.0E-05	4.3E-05	mg/kg-day	3.0E-04	mg/kg/day	1.4E-01
				Lead	2E+01	(mg/kg)	8.8E-07	mg/kg-day	--		--	5.6E-06	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	6.3E-06	mg/kg-day	--		--	4.0E-05	mg/kg-day	1.4E-01	mg/kg/day	2.9E-04
				Vanadium	9E+00	(mg/kg)	3.7E-07	mg/kg-day	--		--	2.4E-06	mg/kg-day	9.0E-03	mg/kg/day	2.6E-04
			Exp. Route Total								1.1E-05					1.4E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		1.5E-06	5.2E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	5.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.5E-06	3.6E-05	mg/kg-day	3.0E-04	mg/kg/day	1.2E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	Not quantified (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.9E-06					1.2E-01
		Exposure Point Total									2.1E-05					2.6E-01
	Exposure Medium Total										2.1E-05					2.6E-01
Risk From Reference											2.1E-05					2.6E-01
Risk from Site											1.1E-09					0.0E+00
Medium Total											2.1E-05					2.6E-01
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	9.7E-06	mg/m^3	--		--	6.2E-05	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	3.2E-05	mg/m^3	--		--	2.0E-04	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	1.3E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	1.0E-07	8.2E-05	mg/m^3	3.0E-02	mg/kg/day	2.7E-03
				Xylenes (total)	9E-02	(mg/m3)	3.0E-04	mg/m^3	--		--	1.9E-03	mg/m^3	1.0E-01	mg/kg/day	1.9E-02
			Exp. Route Total								1.0E-07					2.2E-02
		Exposure Point Total									1.0E-07					2.2E-02
	Exposure Medium Total										1.0E-07					2.2E-02
Risk From Reference																
Risk from Site											1.0E-07					2.2E-02
Total of Receptor Risks Across All Media											3E-05	Total of Receptor Hazards Across All Media				4.E-01
Risks from Reference											2E-05					3.E-01
Risks from Site											3E-06					5.E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 32M.

TABLE 3-32D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-1' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	5.4E-01	(mg/kg)	*		*		8.3E-08	2.9E-07	mg/kg-day	--		--
				Benzo(a)pyrene	5.5E-01	(mg/kg)	*		*		8.5E-07	3.0E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	6.8E-01	(mg/kg)	*		*		1.0E-07	3.7E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	5.2E-01	(mg/kg)	*		*		8.0E-08	2.8E-07	mg/kg-day	--		--
				Arsenic	7.0E+00	(mg/kg)	6.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.1E-07	3.8E-06	mg/kg-day	3.0E-04	mg/kg/day	1.3E-02
				Lead	1.4E+02	(mg/kg)	1.2E-05	mg/kg-day	--		--	7.5E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	1.5E-05	mg/kg-day	--		--	9.5E-05	mg/kg-day	1.4E-01	mg/kg/day	6.8E-04
				Vanadium	1.6E+01	(mg/kg)	1.3E-06	mg/kg-day	--		--	8.5E-06	mg/kg-day	2.3E-04	mg/kg/day	3.6E-02
			Exp. Route Total								2.0E-06					5.0E-02
			Dermal Contact	Benzo(a)anthracene	5.4E-01	(mg/kg)	*			*	3.1E-08	1.1E-07	mg/kg-day	--		--
				Benzo(a)pyrene	5.5E-01	(mg/kg)	*			*	3.2E-07	1.2E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	6.8E-01	(mg/kg)	*		*		3.9E-08	1.4E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	5.2E-01	(mg/kg)	*		*		3.0E-08	1.1E-07	mg/kg-day	--		--
				Arsenic	7.0E+00	(mg/kg)	5.3E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.0E-08	3.4E-07	mg/kg-day	3.0E-04	mg/kg/day	1.1E-03
				Lead	1.4E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								5.0E-07					1.1E-03
		Exposure Point Total									2.5E-06					5.1E-02
	Exposure Medium Total										2.5E-06					5.1E-02
Risk From Reference											9.9E-07					1.4E-02
Risk from Site											1.5E-06					3.7E-02

TABLE 3-32D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		9.9E-08	3.5E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		9.9E-07	3.5E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		1.2E-07	4.4E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		8.6E-08	3.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	2.2E-08	mg/kg-day	--		--	1.4E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	1.3E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.9E-06	8.2E-06	mg/kg-day	3.0E-04	mg/kg/day	2.7E-02
				Lead	6E+01	(mg/kg)	5.4E-06	mg/kg-day	--		--	3.5E-05	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	5.0E-05	mg/kg-day	--		--	3.2E-04	mg/kg-day	1.4E-01	mg/kg/day	2.3E-03
				Vanadium	1E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.6E-06	mg/kg-day	9.0E-03	mg/kg/day	7.3E-04
			Exp. Route Total								3.2E-06					3.0E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	2.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	2.4E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.1E-08	3.0E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.2E-08	2.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.5E-08	mg/kg-day	--		--	9.4E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.1E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.3E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.4E-07					4.3E-03
		Exposure Point Total									4.2E-06					3.5E-02
	Exposure Medium Total										4.2E-06					3.5E-02
Risk From Reference											2.2E-06					3.2E-02
Risk from Site											1.9E-06					3.0E-03
Medium Total											6.7E-06					8.6E-02
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	9.3E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.0E-09	5.9E-07	mg/kg-day	1.0E-01	mg/kg/day	5.9E-06
				Methylene Chloride	5E-03	(mg/L)	1.0E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.7E-10	6.5E-07	mg/kg-day	6.0E-02	mg/kg/day	1.1E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	4.7E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.3E-03
				Cadmium	7E-03	(mg/L)	2.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	2.5E-05	mg/kg/day	6.1E-03
				Lead	1E-02	(mg/L)	5.4E-09	mg/kg-day	--		--	3.4E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.1E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	1.9E-03	mg/kg/day	7.2E-03
				Vanadium	5E-03	(mg/L)	2.0E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	2.3E-04	mg/kg/day	5.4E-04
				Zinc	2E+00	(mg/L)	5.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	3.0E-01	mg/kg/day	1.1E-04
			Exp. Route Total								3.8E-07					1.9E-02
		Exposure Point Total									3.8E-07					1.9E-02
	Exposure Medium Total										3.8E-07					1.9E-02
Risk From Reference											0.0E+00					1.4E-02
Risk from Site											3.8E-07					5.4E-03
Medium Total											3.8E-07					1.9E-02

TABLE 3-32D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		8.2E-07	2.9E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	5.3E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.1E-09	3.4E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.4E-06	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	1.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.0E-05	8.7E-05	mg/kg-day	3.0E-04	mg/kg/day	2.9E-01
				Lead	2E+01	(mg/kg)	1.8E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	1.3E-05	mg/kg-day	--		--	8.1E-05	mg/kg-day	1.4E-01	mg/kg/day	5.8E-04
				Vanadium	9E+00	(mg/kg)	7.5E-07	mg/kg-day	--		--	4.8E-06	mg/kg-day	9.0E-03	mg/kg/day	5.3E-04
			Exp. Route Total								2.1E-05					2.9E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		1.5E-06	5.2E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	5.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.5E-06	3.6E-05	mg/kg-day	3.0E-04	mg/kg/day	1.2E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.9E-06					1.2E-01
		Exposure Point Total									3.1E-05					4.1E-01
	Exposure Medium Total										3.1E-05					4.1E-01
Risk From Reference											3.1E-05					4.1E-01
Risk from Site											2.1E-09					0.0E+00
Medium Total											3.1E-05					4.1E-01
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	9.7E-06	mg/m^3	--		--	6.2E-05	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	3.2E-05	mg/m^3	--		--	2.0E-04	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	1.3E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	1.0E-07	8.2E-05	mg/m^3	3.0E-02	mg/kg/day	2.7E-03
				Xylenes (total)	9E-02	(mg/m3)	3.0E-04	mg/m^3	--		--	1.9E-03	mg/m^3	1.0E-01	mg/kg/day	1.9E-02
			Exp. Route Total								1.0E-07					2.2E-02
		Exposure Point Total									1.0E-07					2.2E-02
	Exposure Medium Total										1.0E-07					2.2E-02
Risk From Reference																
Risk from Site											1.0E-07					2.2E-02
Total of Receptor Risks Across All Media											4E-05	Total of Receptor Hazards Across All Media				5.E-01
Risks from Reference											3E-05					5.E-01
Risks from Site											4E-06					7.E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 32N.

TABLE 3-32E

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	*		*		2.9E-06	1.0E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	*		*		1.8E-05	6.2E-06	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	7.3E-07	mg/kg-day	--		--	4.7E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	*		*		1.2E-06	4.4E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	*		*		1.6E-07	5.6E-06	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	2.1E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	9.4E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.9E-08	6.0E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	1.6E-08	mg/kg-day	--		--	1.0E-07	mg/kg-day	7.0E-02	mg/kg/day	1.4E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	*		*		3.0E-06	1.1E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	8.7E-07	mg/kg-day	--		--	5.5E-06	mg/kg-day	2.0E-03	mg/kg/day	2.8E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	*		*		6.5E-07	2.3E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	5.2E-07	mg/kg-day	--		--	3.3E-06	mg/kg-day	4.0E-03	mg/kg/day	8.2E-04
				2-Methylnaphthalene	1.4E+01	(mg/kg)	6.2E-07	mg/kg-day	--		--	3.9E-06	mg/kg-day	4.0E-03	mg/kg/day	9.8E-04
				Naphthalene	1.3E+01	(mg/kg)	5.7E-07	mg/kg-day	--		--	3.6E-06	mg/kg-day	2.0E-02	mg/kg/day	1.8E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	3.1E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	3.0E-02	mg/kg/day	6.5E-04
				Arsenic	7.1E+00	(mg/kg)	3.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.6E-07	1.9E-06	mg/kg-day	3.0E-04	mg/kg/day	6.5E-03
				Lead	1.3E+02	(mg/kg)	5.8E-06	mg/kg-day	--		--	3.7E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	7.3E-06	mg/kg-day	--		--	4.7E-05	mg/kg-day	1.4E-01	mg/kg/day	3.3E-04
				Vanadium	1.6E+01	(mg/kg)	6.8E-07	mg/kg-day	--		--	4.3E-06	mg/kg-day	2.3E-04	mg/kg/day	1.9E-02
			Exp. Route Total								2.6E-05					3.2E-02
			Dermal Contact	Benzo(a)anthracene	3.8E+01	(mg/kg)	*		*		2.2E-06	7.9E-06	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	*		*		1.3E-05	4.8E-06	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	5.6E-07	mg/kg-day	--		--	3.5E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	*		*		9.4E-07	3.4E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	*		*		1.2E-07	4.2E-06	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.2E-08	mg/kg-day	--		--	7.9E-08	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	5.5E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.1E-08	3.5E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	9.3E-09	mg/kg-day	--		--	5.9E-08	mg/kg-day	7.0E-02	mg/kg/day	8.5E-07
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	*		*		4.5E-06	8.1E-07	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	5.1E-07	mg/kg-day	--		--	3.2E-06	mg/kg-day	2.0E-03	mg/kg/day	1.6E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	*		*		4.9E-07	1.8E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	3.9E-07	mg/kg-day	--		--	2.5E-06	mg/kg-day	4.0E-03	mg/kg/day	6.3E-04
				2-Methylnaphthalene	1.4E+01	(mg/kg)	4.7E-07	mg/kg-day	--		--	3.0E-06	mg/kg-day	4.0E-03	mg/kg/day	7.5E-04
				Naphthalene	1.3E+01	(mg/kg)	4.3E-07	mg/kg-day	--		--	2.7E-06	mg/kg-day	2.0E-02	mg/kg/day	1.4E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	1.8E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	3.0E-02	mg/kg/day	3.8E-04
				Arsenic	7.1E+00	(mg/kg)	5.4E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.1E-08	3.4E-07	mg/kg-day	3.0E-04	mg/kg/day	1.1E-03
				Lead	1.3E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.2E-05					4.7E-03
		Exposure Point Total									4.8E-05					3.6E-02
	Exposure Medium Total										4.8E-05					3.6E-02
Risk From Reference											8.0E-06					7.9E-03
Risk from Site											4.0E-05					2.8E-02

TABLE 3-32E

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	1.8E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	1.8E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.2E-08	2.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.3E-08	1.5E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.1E-08	mg/kg-day	--		--	6.8E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	6.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.7E-07	4.1E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Lead	6E+01	(mg/kg)	2.7E-06	mg/kg-day	--		--	1.7E-05	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	2.5E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	1.4E-01	mg/kg/day	1.1E-03
				Vanadium	1E+01	(mg/kg)	5.2E-07	mg/kg-day	--		--	3.3E-06	mg/kg-day	9.0E-03	mg/kg/day	3.7E-04
			Exp. Route Total								1.6E-06					1.5E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	2.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	2.4E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.1E-08	3.0E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.2E-08	2.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.5E-08	mg/kg-day	--		--	9.4E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.1E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.3E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.4E-07					4.3E-03
		Exposure Point Total									2.6E-06					2.0E-02
	Exposure Medium Total										2.6E-06					2.0E-02
Risk From Reference											1.3E-06					1.8E-02
Risk from Site											1.3E-06					1.5E-03
Medium Total											5.0E-05					5.6E-02
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	9.3E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.0E-09	5.9E-07	mg/kg-day	1.0E-01	mg/kg/day	5.9E-06
				Methylene Chloride	5E-03	(mg/L)	1.0E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.7E-10	6.5E-07	mg/kg-day	6.0E-02	mg/kg/day	1.1E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	4.7E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.3E-03
				Cadmium	7E-03	(mg/L)	2.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	2.5E-05	mg/kg/day	6.1E-03
				Lead	1E-02	(mg/L)	5.4E-09	mg/kg-day	--		--	3.4E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.1E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	1.9E-03	mg/kg/day	7.2E-03
				Vanadium	5E-03	(mg/L)	2.0E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	2.3E-04	mg/kg/day	5.4E-04
				Zinc	2E+00	(mg/L)	5.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	3.0E-01	mg/kg/day	1.1E-04
			Exp. Route Total								3.8E-07					1.9E-02
		Exposure Point Total									3.8E-07					1.9E-02
	Exposure Medium Total										3.8E-07					1.9E-02
Risk From Reference											0.0E+00					1.4E-02
Risk from Site											3.8E-07					5.4E-03
Medium Total											3.8E-07					1.9E-02

TABLE 3-32E

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		4.1E-07	1.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	2.7E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.1E-09	1.7E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	5.0E-07	mg/kg-day	--		--	3.2E-06	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	6.8E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.0E-05	4.3E-05	mg/kg-day	3.0E-04	mg/kg/day	1.4E-01
				Lead	2E+01	(mg/kg)	8.8E-07	mg/kg-day	--		--	5.6E-06	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	6.3E-06	mg/kg-day	--		--	4.0E-05	mg/kg-day	1.4E-01	mg/kg/day	2.9E-04
				Vanadium	9E+00	(mg/kg)	3.7E-07	mg/kg-day	--		--	2.4E-06	mg/kg-day	9.0E-03	mg/kg/day	2.6E-04
			Exp. Route Total								1.1E-05					1.4E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		1.5E-06	5.2E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	5.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.5E-06	3.6E-05	mg/kg-day	3.0E-04	mg/kg/day	1.2E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	Not quantified (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.9E-06					1.2E-01
		Exposure Point Total									2.1E-05					2.6E-01
	Exposure Medium Total										2.1E-05					2.6E-01
Risk From Reference											2.1E-05					2.6E-01
Risk from Site											1.1E-09					0.0E+00
Medium Total											2.1E-05					2.6E-01
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	9.7E-06	mg/m^3	--		--	6.2E-05	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	3.2E-05	mg/m^3	--		--	2.0E-04	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	1.3E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	1.0E-07	8.2E-05	mg/m^3	3.0E-02	mg/kg/day	2.7E-03
				Xylenes (total)	9E-02	(mg/m3)	3.0E-04	mg/m^3	--		--	1.9E-03	mg/m^3	1.0E-01	mg/kg/day	1.9E-02
			Exp. Route Total								1.0E-07					2.2E-02
		Exposure Point Total									1.0E-07					2.2E-02
	Exposure Medium Total										1.0E-07					2.2E-02
Risk From Reference																
Risk from Site											1.0E-07					2.2E-02
Total of Receptor Risks Across All Media											7E-05	Total of Receptor Hazards Across All Media				4.E-01
Risks from Reference											3E-05					3.E-01
Risks from Site											4E-05					6E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 32M.

TABLE 3-32F

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil	Group 4		Benzo(a)anthracene	3.8E+01	(mg/kg)	*		*		5.9E-06	2.1E-05	mg/kg-day	--		--
	(0-10' bgs)	Upland Area		Benzo(a)pyrene	2.3E+01	(mg/kg)	*		*		3.5E-05	1.2E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	1.5E-06	mg/kg-day	--		--	9.3E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	*		*		2.5E-06	8.8E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	*		*		3.1E-07	1.1E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	4.2E-08	mg/kg-day	--		--	2.7E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	1.9E-06	mg/kg-day	2.0E-02	(mg/kg-day)-1	3.8E-08	1.2E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	3.2E-08	mg/kg-day	--		--	2.0E-07	mg/kg-day	7.0E-02	mg/kg/day	2.9E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	*		*		6.0E-06	2.1E-06	mg/kg-day	--		--
			Incidental Ingestion	Dibenzofuran	2.0E+01	(mg/kg)	1.7E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	2.0E-03	mg/kg/day	5.5E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	*		*		1.3E-06	4.7E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.6E-06	mg/kg-day	4.0E-03	mg/kg/day	1.6E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	1.2E-06	mg/kg-day	--		--	7.9E-06	mg/kg-day	4.0E-03	mg/kg/day	2.0E-03
				Naphthalene	1.3E+01	(mg/kg)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	2.0E-02	mg/kg/day	3.6E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	6.2E-06	mg/kg-day	--		--	3.9E-05	mg/kg-day	3.0E-02	mg/kg/day	1.3E-03
				Arsenic	7.1E+00	(mg/kg)	6.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.2E-07	3.9E-06	mg/kg-day	3.0E-04	mg/kg/day	1.3E-02
				Lead	1.3E+02	(mg/kg)	1.2E-05	mg/kg-day	--		--	7.3E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	1.5E-05	mg/kg-day	--		--	9.3E-05	mg/kg-day	1.4E-01	mg/kg/day	6.7E-04
				Vanadium	1.6E+01	(mg/kg)	1.4E-06	mg/kg-day	--		--	8.7E-06	mg/kg-day	2.3E-04	mg/kg/day	3.7E-02
			Exp. Route Total								5.2E-05					6.3E-02
				Benzo(a)anthracene	3.8E+01	(mg/kg)	*		*		2.2E-06	7.9E-06	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	*		*		1.3E-05	4.8E-06	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	5.6E-07	mg/kg-day	--		--	3.5E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	*		*		9.4E-07	3.4E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	*		*		1.2E-07	4.2E-06	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.2E-08	mg/kg-day	--		--	7.9E-08	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	5.5E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.1E-08	3.5E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	9.3E-09	mg/kg-day	--		--	5.9E-08	mg/kg-day	7.0E-02	mg/kg/day	8.5E-07
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	*		*		2.3E-06	8.1E-07	mg/kg-day	--		--
			Dermal Contact	Dibenzofuran	2.0E+01	(mg/kg)	5.1E-07	mg/kg-day	--		--	3.2E-06	mg/kg-day	2.0E-03	mg/kg/day	1.6E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	*		*		4.9E-07	1.8E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	3.9E-07	mg/kg-day	--		--	2.5E-06	mg/kg-day	4.0E-03	mg/kg/day	6.3E-04
				2-Methylnaphthalene	1.4E+01	(mg/kg)	4.7E-07	mg/kg-day	--		--	3.0E-06	mg/kg-day	4.0E-03	mg/kg/day	7.5E-04
				Naphthalene	1.3E+01	(mg/kg)	4.3E-07	mg/kg-day	--		--	2.7E-06	mg/kg-day	2.0E-02	mg/kg/day	1.4E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	1.8E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	3.0E-02	mg/kg/day	3.8E-04
				Arsenic	7.1E+00	(mg/kg)	5.4E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.1E-08	3.4E-07	mg/kg-day	3.0E-04	mg/kg/day	1.1E-03
				Lead	1.3E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.9E-05					4.7E-03
		Exposure Point Total									7.1E-05					6.8E-02
	Exposure Medium Total										7.1E-05					6.8E-02
Risk From Reference											9.2E-06					1.5E-02
Risk from Site											6.2E-05					5.4E-02

TABLE 3-32F

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

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Receptor Population:	Trespasser/Recreational User
Receptor Age:	Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		9.9E-08	3.5E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		9.9E-07	3.5E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		1.2E-07	4.4E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		8.6E-08	3.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	2.2E-08	mg/kg-day	--		--	1.4E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	1.3E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.9E-06	8.2E-06	mg/kg-day	3.0E-04	mg/kg/day	2.7E-02
				Lead	6E+01	(mg/kg)	5.4E-06	mg/kg-day	--		--	3.5E-05	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	5.0E-05	mg/kg-day	--		--	3.2E-04	mg/kg-day	1.4E-01	mg/kg/day	2.3E-03
				Vanadium	1E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.6E-06	mg/kg-day	9.0E-03	mg/kg/day	7.3E-04
			Exp. Route Total								3.2E-06					3.0E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		4.9E-08	2.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		4.9E-07	2.4E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		6.1E-08	3.0E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		4.2E-08	2.1E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.5E-08	mg/kg-day	--		--	9.4E-08	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.1E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.3E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.4E-07					4.3E-03
		Exposure Point Total									4.2E-06					3.5E-02
	Exposure Medium Total										4.2E-06					3.5E-02
Risk From Reference											2.2E-06					3.2E-02
Risk from Site											1.9E-06					3.0E-03
Medium Total											7.6E-05					1.0E-01
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	9.3E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.0E-09	5.9E-07	mg/kg-day	1.0E-01	mg/kg/day	5.9E-06
				Methylene Chloride	5E-03	(mg/L)	1.0E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.7E-10	6.5E-07	mg/kg-day	6.0E-02	mg/kg/day	1.1E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	4.7E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.1E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	2.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-07	1.6E-06	mg/kg-day	3.0E-04	mg/kg/day	5.3E-03
				Cadmium	7E-03	(mg/L)	2.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	2.5E-05	mg/kg/day	6.1E-03
				Lead	1E-02	(mg/L)	5.4E-09	mg/kg-day	--		--	3.4E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.1E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	1.9E-03	mg/kg/day	7.2E-03
				Vanadium	5E-03	(mg/L)	2.0E-08	mg/kg-day	--		--	1.3E-07	mg/kg-day	2.3E-04	mg/kg/day	5.4E-04
				Zinc	2E+00	(mg/L)	5.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	3.0E-01	mg/kg/day	1.1E-04
			Exp. Route Total								3.8E-07					1.9E-02
		Exposure Point Total									3.8E-07					1.9E-02
	Exposure Medium Total										3.8E-07					1.9E-02
Risk From Reference											0.0E+00					1.4E-02
Risk from Site											3.8E-07					5.4E-03
Medium Total											3.8E-07					1.9E-02

TABLE 3-32F

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REASONABLE MAXIMUM EXPOSURE

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Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		8.2E-07	2.9E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	5.3E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.1E-09	3.4E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	1.0E-06	mg/kg-day	--		--	6.4E-06	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	1.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.0E-05	8.7E-05	mg/kg-day	3.0E-04	mg/kg/day	2.9E-01
				Lead	2E+01	(mg/kg)	1.8E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	1.3E-05	mg/kg-day	--		--	8.1E-05	mg/kg-day	1.4E-01	mg/kg/day	5.8E-04
				Vanadium	9E+00	(mg/kg)	7.5E-07	mg/kg-day	--		--	4.8E-06	mg/kg-day	9.0E-03	mg/kg/day	5.3E-04
			Exp. Route Total								2.1E-05					2.9E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		1.5E-06	5.2E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	5.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.5E-06	3.6E-05	mg/kg-day	3.0E-04	mg/kg/day	1.2E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								9.9E-06					1.2E-01
		Exposure Point Total									3.1E-05					4.1E-01
	Exposure Medium Total										3.1E-05					4.1E-01
Risk From Reference											3.1E-05					4.1E-01
Risk from Site											2.1E-09					0.0E+00
Medium Total											3.1E-05					4.1E-01
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	9.7E-06	mg/m^3	--		--	6.2E-05	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	3.2E-05	mg/m^3	--		--	2.0E-04	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	1.3E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	1.0E-07	8.2E-05	mg/m^3	3.0E-02	mg/kg/day	2.7E-03
				Xylenes (total)	9E-02	(mg/m3)	3.0E-04	mg/m^3	--		--	1.9E-03	mg/m^3	1.0E-01	mg/kg/day	1.9E-02
			Exp. Route Total								1.0E-07					2.2E-02
		Exposure Point Total									1.0E-07					2.2E-02
	Exposure Medium Total										1.0E-07					2.2E-02
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											1.0E-07					2.2E-02
Total of Receptor Risks Across All Media											1E-04	Total of Receptor Hazards Across All Media				6.E-01
Risks from Reference											4E-05					5.E-01
Risks from Site											6E-05					8.E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 32N.

TABLE 3-32G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current/Future

Receptor Population: Area 3 Trespasser/Recreational User

Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3, Upland	Benzo(a)anthracene	8.5E-08	--	6.4E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	8.5E-07	--	6.4E-07	1E-06	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	6.5E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	9.0E-07	--	5.3E-07	1E-06	Liver	2.1E-02	--	1.2E-02	3E-02
			Di-n-octylphthalate	--	--	--	--	Not available	1.1E-02	--	6.4E-03	2E-02
			Indeno(1,2,3-cd)Pyrene	5.6E-08	--	4.2E-08	1E-07	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	1.4E-03	--	1.0E-03	2E-03
			Toluene	--	--	--	--	Kidney	2.4E-03	--	0.0E+00	2E-03
			Tetrachloroethene	6.3E-07	--	0.0E+00	6E-07	Liver	7.4E-04	--	0.0E+00	7E-04
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	1.2E-03	--	0.0E+00	1E-03
			Arsenic	3.8E-07	--	6.7E-08	4E-07	Skin; cardiovascular system	5.4E-03	--	9.5E-04	6E-03
			Cadmium	--	--	--	--	--	1.0E-03	--	2.4E-04	1E-03
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	4.1E-04	--	0.0E+00	4E-04
			Chemical Total	**3.0E-06**	**0.0E+00**	**1.4E-06**	**4E-06**		**4.4E-02**	**0.0E+00**	**2.1E-02**	**6E-02**
		Exposure Point Total		3.0E-06	0.0E+00	1.4E-06	4E-06		4.4E-02	0.0E+00	2.1E-02	6E-02
	Exposure Medium Total			3.0E-06	0.0E+00	1.4E-06	4E-06		4.4E-02	0.0E+00	2.1E-02	6E-02
Medium Total				3.0E-06	0.0E+00	1.4E-06	4E-06		4.4E-02	0.0E+00	2.1E-02	6E-02
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)anthracene	4.9E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	4.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Benzo(b)fluoranthene	6.2E-08	--	6.1E-08	1E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	4.3E-08	--	4.2E-08	9E-08	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	9.7E-07	--	3.1E-07	1E-06	Skin; cardiovascular system	1.4E-02	--	4.3E-03	2E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.1E-03	--	0.0E+00	1E-03
			Vanadium	--	--	--	--	Hair cysteine	3.7E-04	--	0.0E+00	4E-04
			Chemical Total	**1.6E-06**	**0.0E+00**	**9.4E-07**	**3E-06**		**1.5E-02**	**0.0E+00**	**4.3E-03**	**2E-02**
		Exposure Point Total		1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
	Exposure Medium Total			1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
Medium Total				1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02

TABLE 3-32G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current/Future
Receptor Population: Area 3 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Surface Water	Groups 5/6, Wetlands	1,4-Dioxane	--	--	1.0E-09	1E-09	Liver	--	--	5.9E-06	6E-06
			Methylene Chloride	--	--	7.7E-10	8E-10	Liver	--	--	1.1E-05	1E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	3.8E-07	4E-07	Skin; cardiovascular system	--	--	5.3E-03	5E-03
			Cadmium	--	--	--	--	--	--	--	6.1E-03	6E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	7.2E-03	7E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	5.4E-04	5E-04
			Zinc	--	--	--	--	Blood	--	--	1.1E-04	1E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**3.8E-07**	**4E-07**		**0.0E+00**	**0.0E+00**	**1.9E-02**	**2E-02**
		Exposure Point Total		0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
	Exposure Medium Total			0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Medium Total				0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	4.1E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Trichloroethene	1.1E-09	--	0.0E+00	1E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	1.0E-05	--	8.5E-06	2E-05	Skin; cardiovascular system	1.4E-01	--	1.2E-01	3E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.9E-04	--	0.0E+00	3E-04
			Vanadium	--	--	--	--	Hair cysteine	2.6E-04	--	0.0E+00	3E-04
			Chemical Total	**1.1E-05**	**0.0E+00**	**9.9E-06**	**2E-05**		**1.4E-01**	**0.0E+00**	**1.2E-01**	**3E-01**
		Exposure Point Total		1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
	Exposure Medium Total			1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Medium Total				1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.0E-07	--	1E-07	Blood; immune system	--	2.7E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	1.9E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1E-07**		**0.0E+00**	**2.2E-02**	**0.0E+00**	**2E-02**
		Exposure Point Total		0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
	Exposure Medium Total			0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Medium Total				0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Receptor Total							**3E-05**				**Receptor HI Total**	**4E-01**
Site Related Receptor Risk Total							**6E-06**					**8E-02**
Reference Related Receptor Risk Total							**2E-05**					**3E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-32H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current/Future
Receptor Population: Area 3 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3, Upland	Benzo(a)anthracene	1.7E-07	--	6.4E-08	2E-07	--	--	--	--	--
			Benzo(a)pyrene	1.7E-06	--	6.4E-07	2E-06	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.3E-07	--	4.9E-08	2E-07	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	1.8E-06	--	5.3E-07	2E-06	Liver	4.1E-02	--	1.2E-02	5E-02
			Di-n-octylphthalate	--	--	--	--	Not available	2.2E-02	--	6.4E-03	3E-02
			Indeno(1,2,3-cd)Pyrene	1.1E-07	--	4.2E-08	2E-07	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	2.7E-03	--	1.0E-03	4E-03
			Toluene	--	--	--	--	Kidney	4.9E-03	--	0.0E+00	5E-03
			Tetrachloroethene	1.3E-06	--	0.0E+00	1E-06	Liver	1.5E-03	--	0.0E+00	1E-03
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	2.5E-03	--	0.0E+00	2E-03
			Arsenic	7.6E-07	--	6.7E-08	8E-07	Skin; cardiovascular system	1.1E-02	--	9.5E-04	1E-02
			Cadmium	--	--	--	--	--	2.1E-03	--	2.4E-04	2E-03
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	8.2E-04	--	0.0E+00	8E-04
			Chemical Total	**5.9E-06**	**0.0E+00**	**1.4E-06**	**7E-06**		**8.8E-02**	**0.0E+00**	**2.1E-02**	**1E-01**
		Exposure Point Total		5.9E-06	0.0E+00	1.4E-06	7E-06		8.8E-02	0.0E+00	2.1E-02	1E-01
	Exposure Medium Total			5.9E-06	0.0E+00	1.4E-06	7E-06		8.8E-02	0.0E+00	2.1E-02	1E-01
Medium Total				5.9E-06	0.0E+00	1.4E-06	7E-06		8.8E-02	0.0E+00	2.1E-02	1E-01
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)anthracene	9.9E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	9.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Benzo(b)fluoranthene	1.2E-07	--	6.1E-08	2E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	8.6E-08	--	4.2E-08	1E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	1.9E-06	--	3.1E-07	2E-06	Skin; cardiovascular system	2.7E-02	--	4.3E-03	3E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.3E-03	--	0.0E+00	2E-03
			Vanadium	--	--	--	--	Hair cysteine	7.3E-04	--	0.0E+00	7E-04
			Chemical Total	**3.2E-06**	**0.0E+00**	**9.4E-07**	**4E-06**		**3.0E-02**	**0.0E+00**	**4.3E-03**	**3E-02**
		Exposure Point Total		3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
	Exposure Medium Total			3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Medium Total				3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02

TABLE 3-32H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current/Future
Receptor Population: Area 3 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Surface Water	Groups 5/6, Wetlands	1,4-Dioxane	--	--	1.0E-09	1E-09	Liver	--	--	5.9E-06	6E-06
			Methylene Chloride	--	--	7.7E-10	8E-10	Liver	--	--	1.1E-05	1E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	3.8E-07	4E-07	Skin; cardiovascular system	--	--	5.3E-03	5E-03
			Cadmium	--	--	--	--	--	--	--	6.1E-03	6E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	7.2E-03	7E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	5.4E-04	5E-04
			Zinc	--	--	--	--	Blood	--	--	1.1E-04	1E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**3.8E-07**	**4E-07**		**0.0E+00**	**0.0E+00**	**1.9E-02**	**2E-02**
		Exposure Point Total		0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
	Exposure Medium Total			0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Medium Total				0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	8.2E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Trichloroethene	2.1E-09	--	0.0E+00	2E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	2.0E-05	--	8.5E-06	3E-05	Skin; cardiovascular system	2.9E-01	--	1.2E-01	4E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	5.8E-04	--	0.0E+00	6E-04
			Vanadium	--	--	--	--	Hair cysteine	5.3E-04	--	0.0E+00	5E-04
			Chemical Total	**2.1E-05**	**0.0E+00**	**9.9E-06**	**3E-05**		**2.9E-01**	**0.0E+00**	**1.2E-01**	**4E-01**
		Exposure Point Total		2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
	Exposure Medium Total			2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Medium Total				2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.0E-07	--	1E-07	Blood; immune system	--	2.7E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	1.9E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1E-07**		**0.0E+00**	**2.2E-02**	**0.0E+00**	**2E-02**
		Exposure Point Total		0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
	Exposure Medium Total			0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Medium Total				0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Receptor Total							**4E-05**				**Receptor HI Total**	**6E-01**
Site Related Receptor Risk Total							**9E-06**					**1E-01**
Reference Related Receptor Risk Total							**3E-05**					**5E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-32I

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-1' bgs)	Group 4. Upland	Benzo(a)anthracene	4.2E-08	--	3.1E-08	7E-08	--	--	--	--	--
			Benzo(a)pyrene	4.3E-07	--	3.2E-07	7E-07	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	5.2E-08	--	3.9E-08	9E-08	--	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	--	--	--	--	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	4.0E-08	--	3.0E-08	7E-08	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	--	--	--	--
			2-Methylnaphthalene	--	--	--	--	Lungs	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	--	--	--	--
			Arsenic	4.5E-07	--	8.0E-08	5E-07	Skin; cardiovascular system	6.4E-03	--	1.1E-03	8E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.4E-04	--	0.0E+00	3E-04
			Vanadium	--	--	--	--	Hair cysteine	1.8E-02	--	0.0E+00	2E-02
			Chemical Total	**1.0E-06**	**0.0E+00**	**5.0E-07**	**2E-06**		**2.5E-02**	**0.0E+00**	**1.1E-03**	**3E-02**
		Exposure Point Total		1.0E-06	0.0E+00	5.0E-07	2E-06		2.5E-02	0.0E+00	1.1E-03	3E-02
	Exposure Medium Total			1.0E-06	0.0E+00	5.0E-07	2E-06		2.5E-02	0.0E+00	1.1E-03	3E-02
Medium Total				1.0E-06	0.0E+00	5.0E-07	2E-06		2.5E-02	0.0E+00	1.1E-03	3E-02

TABLE 3-32J

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Wetland Soil	Groups 5/6. Wetlands	Benzo(a)anthracene	4.9E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	4.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Benzo(b)fluoranthene	6.1E-08	--	6.1E-08	1E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	4.3E-08	--	4.2E-08	9E-08	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	9.7E-07	--	3.1E-07	1E-06	Skin; cardiovascular system	1.4E-02	--	4.3E-03	2E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.1E-03	--	0.0E+00	1E-03
			Vanadium	--	--	--	--	Hair cysteine	3.7E-04	--	0.0E+00	4E-04
			Chemical Total	**1.6E-06**	**0.0E+00**	**9.4E-07**	**3E-06**		**1.5E-02**	**0.0E+00**	**4.3E-03**	**2E-02**
		Exposure Point Total		1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
	Exposure Medium Total			1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
Medium Total				1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
Surface Water	Surface Water	Groups 5/6. Wetlands	1,4-Dioxane	--	--	1.0E-09	1E-09	Liver	--	--	5.9E-06	6E-06
			Methylene Chloride	--	--	7.7E-10	8E-10	Liver	--	--	1.1E-05	1E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	3.8E-07	4E-07	Skin; cardiovascular system	--	--	5.3E-03	5E-03
			Cadmium	--	--	--	--	--	--	--	6.1E-03	6E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	7.2E-03	7E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	5.4E-04	5E-04
			Zinc	--	--	--	--	Blood	--	--	1.1E-04	1E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**3.8E-07**	**4E-07**		**0.0E+00**	**0.0E+00**	**1.9E-02**	**2E-02**
		Exposure Point Total		0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
	Exposure Medium Total			0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Medium Total				0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02

TABLE 3-321

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6. Wetlands	Benzo(a)pyrene	4.1E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Trichloroethene	1.1E-09	--	0.0E+00	1E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	1.0E-05	--	8.5E-06	2E-05	Skin; cardiovascular system	1.4E-01	--	1.2E-01	3E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.9E-04	--	0.0E+00	3E-04
			Vanadium	--	--	--	--	Hair cysteine	2.6E-04	--	0.0E+00	3E-04
			Chemical Total	**1.1E-05**	**0.0E+00**	**9.9E-06**	**2E-05**		**1.4E-01**	**0.0E+00**	**1.2E-01**	**3E-01**
		Exposure Point Total		1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
	Exposure Medium Total			1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Medium Total				1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.0E-07	--	1E-07	Blood; immune system	--	2.7E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	1.9E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1E-07**		**0.0E+00**	**2.2E-02**	**0.0E+00**	**2E-02**
		Exposure Point Total		0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
	Exposure Medium Total			0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Medium Total				0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Receptor Total							**3E-05**				**Receptor HI Total**	**4E-01**
Site Related Receptor Risk Total							**3E-06**					**5E-02**
Reference Related Receptor Risk Total							**2E-05**					**3E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-32J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-1' bgs)	Group 4. Upland	Benzo(a)anthracene	8.3E-08	--	3.1E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	8.5E-07	--	3.2E-07	1E-06	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.0E-07	--	3.9E-08	1E-07	--	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	--	--	--	--	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	8.0E-08	--	3.0E-08	1E-07	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	--	--	--	--
			2-Methylnaphthalene	--	--	--	--	Lungs	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	--	--	--	--
			Arsenic	9.1E-07	--	8.0E-08	1E-06	Skin; cardiovascular system	1.3E-02	--	1.1E-03	1E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.8E-04	--	0.0E+00	7E-04
			Vanadium	--	--	--	--	Hair cysteine	3.6E-02	--	0.0E+00	4E-02
			Chemical Total	**2.0E-06**	**0.0E+00**	**5.0E-07**	**3E-06**		**5.0E-02**	**0.0E+00**	**1.1E-03**	**5E-02**
		Exposure Point Total		2.0E-06	0.0E+00	5.0E-07	3E-06		5.0E-02	0.0E+00	1.1E-03	5E-02
	Exposure Medium Total			2.0E-06	0.0E+00	5.0E-07	3E-06		5.0E-02	0.0E+00	1.1E-03	5E-02
Medium Total				2.0E-06	0.0E+00	5.0E-07	3E-06		5.0E-02	0.0E+00	1.1E-03	5E-02

TABLE 3-32J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current

Receptor Population: Area 4 Trespasser/Recreational User

Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Wetland Soil	Groups 5/6. Wetlands	Benzo(a)anthracene	9.9E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	9.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Benzo(b)fluoranthene	1.2E-07	--	6.1E-08	2E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	8.6E-08	--	4.2E-08	1E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	1.9E-06	--	3.1E-07	2E-06	Skin; cardiovascular system	2.7E-02	--	4.3E-03	3E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.3E-03	--	0.0E+00	2E-03
			Vanadium	--	--	--	--	Hair cysteine	7.3E-04	--	0.0E+00	7E-04
			Chemical Total	**3.2E-06**	**0.0E+00**	**9.4E-07**	**4E-06**		**3.0E-02**	**0.0E+00**	**4.3E-03**	**3E-02**
		Exposure Point Total		3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
	Exposure Medium Total			3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Medium Total				3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Surface Water	Surface Water	Groups 5/6. Wetlands	1,4-Dioxane	--	--	1.0E-09	1E-09	Liver	--	--	5.9E-06	6E-06
			Methylene Chloride	--	--	7.7E-10	8E-10	Liver	--	--	1.1E-05	1E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	3.8E-07	4E-07	Skin; cardiovascular system	--	--	5.3E-03	5E-03
			Cadmium	--	--	--	--	--	--	--	6.1E-03	6E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	7.2E-03	7E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	5.4E-04	5E-04
			Zinc	--	--	--	--	Blood	--	--	1.1E-04	1E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**3.8E-07**	**4E-07**		**0.0E+00**	**0.0E+00**	**1.9E-02**	**2E-02**
		Exposure Point Total		0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
	Exposure Medium Total			0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Medium Total				0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02

TABLE 3-32J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6. Wetlands	Benzo(a)pyrene	8.2E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Trichloroethene	2.1E-09	--	0.0E+00	2E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	2.0E-05	--	8.5E-06	3E-05	Skin; cardiovascular system	2.9E-01	--	1.2E-01	4E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	5.8E-04	--	0.0E+00	6E-04
			Vanadium	--	--	--	--	Hair;cysteine	5.3E-04	--	0.0E+00	5E-04
			Chemical Total	**2.1E-05**	**0.0E+00**	**9.9E-06**	**3E-05**		**2.9E-01**	**0.0E+00**	**1.2E-01**	**4E-01**
		Exposure Point Total		2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
	Exposure Medium Total			2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Medium Total				2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.0E-07	--	1E-07	Blood; immune system	--	2.7E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	1.9E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1E-07**		**0.0E+00**	**2.2E-02**	**0.0E+00**	**2E-02**
		Exposure Point Total		0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
	Exposure Medium Total			0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Medium Total				0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Receptor Total							**4E-05**				**Receptor HI Total**	**5E-01**
Site Related Receptor Risk Total							**4E-06**					**7E-02**
Reference Related Receptor Risk Total							**3E-05**					**5E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-32K

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4. Upland	Benzo(a)anthracene	2.9E-06	--	2.2E-06	5E-06	--	--	--	--	--
			Benzo(a)pyrene	1.8E-05	--	1.3E-05	3E-05	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.2E-06	--	9.4E-07	2E-06	--	--	--	--	--
			Benzo(k)fluoranthene	1.6E-07	--	1.2E-07	3E-07	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	1.9E-08	--	1.1E-08	3E-08	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	1.4E-06	--	8.5E-07	2E-06
			Dibenzo(a,h)anthracene	3.0E-06	--	4.5E-06	8E-06	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	2.8E-03	--	1.6E-03	4E-03
			Indeno(1,2,3-cd)Pyrene	6.5E-07	--	4.9E-07	1E-06	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	8.2E-04	--	6.3E-04	1E-03
			2-Methylnaphthalene	--	--	--	--	Lungs	9.8E-04	--	7.5E-04	2E-03
			Naphthalene	--	--	--	--	Whole body	1.8E-04	--	1.4E-04	3E-04
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	6.5E-04	--	3.8E-04	1E-03
			Arsenic	4.6E-07	--	8.1E-08	5E-07	Skin; cardiovascular system	6.5E-03	--	1.1E-03	8E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.3E-04	--	0.0E+00	3E-04
			Vanadium	--	--	--	--	Hair cysteine	1.9E-02	--	0.0E+00	2E-02
			Chemical Total	**2.6E-05**	**0.0E+00**	**2.2E-05**	**5E-05**		**3.2E-02**	**0.0E+00**	**4.7E-03**	**4E-02**
		Exposure Point Total		2.6E-05	0.0E+00	2.2E-05	5E-05		3.2E-02	0.0E+00	4.7E-03	4E-02
	Exposure Medium Total			2.6E-05	0.0E+00	2.2E-05	5E-05		3.2E-02	0.0E+00	4.7E-03	4E-02
Medium Total				2.6E-05	0.0E+00	2.2E-05	5E-05		3.2E-02	0.0E+00	4.7E-03	4E-02

TABLE 3-32K

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)anthracene	4.9E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	4.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Benzo(b)fluoranthene	6.2E-08	--	6.1E-08	1E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	4.3E-08	--	4.2E-08	9E-08	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	9.7E-07	--	5.1E-07	1E-06	Skin; cardiovascular system	1.4E-02	--	4.3E-03	2E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.1E-03	--	0.0E+00	1E-03
			Vanadium	--	--	--	--	Hair cysteine	3.7E-04	--	0.0E+00	4E-04
			Chemical Total	**1.6E-06**	**0.0E+00**	**9.4E-07**	**3E-06**		**1.5E-02**	**0.0E+00**	**4.3E-03**	**2E-02**
		Exposure Point Total		1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
	Exposure Medium Total			1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
Medium Total				1.6E-06	0.0E+00	9.4E-07	3E-06		1.5E-02	0.0E+00	4.3E-03	2E-02
Surface Water	Surface Water	Groups 5/6, Wetlands	1,4-Dioxane	--	--	1.0E-09	1E-09	Liver	--	--	5.9E-06	6E-06
			Methylene Chloride	--	--	7.7E-10	8E-10	Liver	--	--	1.1E-05	1E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	3.8E-07	4E-07	Skin; cardiovascular system	--	--	5.3E-03	5E-03
			Cadmium	--	--	--	--	--	--	--	6.1E-03	6E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	7.2E-03	7E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	5.4E-04	5E-04
			Zinc	--	--	--	--	Blood	--	--	1.1E-04	1E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**3.8E-07**	**4E-07**		**0.0E+00**	**0.0E+00**	**1.9E-02**	**2E-02**
		Exposure Point Total		0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
	Exposure Medium Total			0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Medium Total				0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02

TABLE 3-32K

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6. Wetlands	Benzo(a)pyrene	4.1E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Trichloroethene	1.1E-09	--	0.0E+00	1E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	1.0E-05	--	8.5E-06	2E-05	Skin: cardiovascular system	1.4E-01	--	1.2E-01	3E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.9E-04	--	0.0E+00	3E-04
			Vanadium	--	--	--	--	Hair cysteine	2.6E-04	--	0.0E+00	3E-04
			Chemical Total	**1.1E-05**	**0.0E+00**	**9.9E-06**	**2E-05**		**1.4E-01**	**0.0E+00**	**1.2E-01**	**3E-01**
		Exposure Point Total		1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
	Exposure Medium Total			1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Medium Total				1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.0E-07	--	1E-07	Blood: immune system	--	2.7E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	1.9E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1E-07**		**0.0E+00**	**2.2E-02**	**0.0E+00**	**2E-02**
		Exposure Point Total		0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
	Exposure Medium Total			0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Medium Total				0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Receptor Total							**7E-05**				**Receptor HI Total**	**4E-01**
Site Related Receptor Risk Total							**4E-05**					**6E-02**
Reference Related Receptor Risk Total							**3E-05**					**3E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-32L

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4. Upland	Benzo(a)anthracene	5.9E-06	--	2.2E-06	8E-06	--	--	--	--	--
			Benzo(a)pyrene	3.5E-05	--	1.3E-05	5E-05	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	2.5E-06	--	9.4E-07	3E-06	--	--	--	--	--
			Benzo(k)fluoranthene	3.1E-07	--	1.2E-07	4E-07	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	3.8E-08	--	1.1E-08	5E-08	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	2.9E-06	--	8.5E-07	4E-06
			Dibenzo(a,h)anthracene	6.0E-06	--	2.3E-06	8E-06	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	5.5E-03	--	1.6E-03	7E-03
			Indeno(1,2,3-cd)Pyrene	1.3E-06	--	4.9E-07	2E-06	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	1.6E-03	--	6.3E-04	2E-03
			2-Methylnaphthalene	--	--	--	--	Lungs	2.0E-03	--	7.5E-04	3E-03
			Naphthalene	--	--	--	--	Whole body	3.6E-04	--	1.4E-04	5E-04
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	1.3E-03	--	3.8E-04	2E-03
			Arsenic	9.2E-07	--	8.1E-08	1E-06	Skin; cardiovascular system	1.3E-02	--	1.1E-03	1E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.7E-04	--	0.0E+00	7E-04
			Vanadium	--	--	--	--	Hair cysteine	3.7E-02	--	0.0E+00	4E-02
			Chemical Total	**5.2E-05**	**0.0E+00**	**1.9E-05**	**7E-05**		**6.3E-02**	**0.0E+00**	**4.7E-03**	**7E-02**
		Exposure Point Total		5.2E-05	0.0E+00	1.9E-05	7E-05		6.3E-02	0.0E+00	4.7E-03	7E-02
	Exposure Medium Total			5.2E-05	0.0E+00	1.9E-05	7E-05		6.3E-02	0.0E+00	4.7E-03	7E-02
Medium Total				5.2E-05	0.0E+00	1.9E-05	7E-05		6.3E-02	0.0E+00	4.7E-03	7E-02

TABLE 3-32L

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Wetland Soil	Groups 5/6. Wetlands	Benzo(a)anthracene	9.9E-08	--	4.9E-08	1E-07	--	--	--	--	--
			Benzo(a)pyrene	9.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Benzo(b)fluoranthene	1.2E-07	--	6.1E-08	2E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	8.6E-08	--	4.2E-08	1E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	1.9E-06	--	3.1E-07	2E-06	Skin; cardiovascular system	2.7E-02	--	4.3E-03	3E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.3E-03	--	0.0E+00	2E-03
			Vanadium	--	--	--	--	Hair cysteine	7.3E-04	--	0.0E+00	7E-04
			Chemical Total	**3.2E-06**	**0.0E+00**	**9.4E-07**	**4E-06**		**3.0E-02**	**0.0E+00**	**4.3E-03**	**3E-02**
		Exposure Point Total		3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
	Exposure Medium Total			3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Medium Total				3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Surface Water	Surface Water	Groups 5/6. Wetlands	1,4-Dioxane	--	--	1.0E-09	1E-09	Liver	--	--	5.9E-06	6E-06
			Methylene Chloride	--	--	7.7E-10	8E-10	Liver	--	--	1.1E-05	1E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	3.8E-07	4E-07	Skin; cardiovascular system	--	--	5.3E-03	5E-03
			Cadmium	--	--	--	--	--	--	--	6.1E-03	6E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	7.2E-03	7E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	5.4E-04	5E-04
			Zinc	--	--	--	--	Blood	--	--	1.1E-04	1E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**3.8E-07**	**4E-07**		**0.0E+00**	**0.0E+00**	**1.9E-02**	**2E-02**
		Exposure Point Total		0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
	Exposure Medium Total			0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02
Medium Total				0.0E+00	0.0E+00	3.8E-07	4E-07		0.0E+00	0.0E+00	1.9E-02	2E-02

TABLE 3-32L

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	8.2E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Trichloroethene	2.1E-09	--	0.0E+00	2E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	2.0E-05	--	8.5E-06	3E-05	Skin; cardiovascular system	2.9E-01	--	1.2E-01	4E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	5.8E-04	--	0.0E+00	6E-04
			Vanadium	--	--	--	--	Hair cysteine	5.3E-04	--	0.0E+00	5E-04
			Chemical Total	**2.1E-05**	**0.0E+00**	**9.9E-06**	**3E-05**		**2.9E-01**	**0.0E+00**	**1.2E-01**	**4E-01**
		Exposure Point Total		2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
	Exposure Medium Total			2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Medium Total				2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.0E-07	--	1E-07	Blood; immune system	--	2.7E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	1.9E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1E-07**		**0.0E+00**	**2.2E-02**	**0.0E+00**	**2E-02**
		Exposure Point Total		0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
	Exposure Medium Total			0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Medium Total				0.0E+00	1.0E-07	0.0E+00	1E-07		0.0E+00	2.2E-02	0.0E+00	2E-02
Receptor Total							**1E-04**				**Receptor HI Total**	**6E-01**
Site Related Receptor Risk Total							**6E-05**					**8E-02**
Reference Related Receptor Risk Total							**4E-05**					**5E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-32M
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 3
Exposure Medium:	Upland Soil (0-10')
Receptor:	Current/Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	1.10	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	7.5E-08
		1.10	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	9.4E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*8.5E-08*
	Benzo(a)pyrene	1.10	8 through <16	45	50	90	8	25550	1.00E-06	7.3	3	7.5E-07
		1.10	16 through <19	45	50	90	3	25550	1.00E-06	7.3	1	9.4E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*8.5E-07*
	Benzo(b)fluoranthene	0.840	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	5.8E-08
		0.840	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	7.2E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*6.5E-08*
	Indeno(1,2,3-cd)pyrene	0.720	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	4.9E-08
		0.720	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	6.2E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*5.6E-08*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**1.1E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	1.10	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	5.7E-08
		1.10	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	7.1E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*6.4E-08*
	Benzo(a)pyrene	1.10	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	5.7E-07
		1.10	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	7.1E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*6.4E-07*
	Benzo(b)fluoranthene	0.840	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	4.3E-08
		0.840	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	5.4E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*4.9E-08*
	Indeno(1,2,3-cd)pyrene	0.720	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	3.7E-08
		0.720	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	4.7E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.2E-08*
	CUMULATIVE RISK: Dermal Contact with Soil													**7.9E-07**
CUMULATIVE RISK, Group 3, Upland Soil (0-10') : Current/Future Trespasser														**1.8E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion: Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact: Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 4
Exposure Medium:	Upland Soil (0-1')
Receptor:	Current Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	0.538	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	3.7E-08
		0.538	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	4.6E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*4.2E-08*
	Benzo(a)pyrene	0.552	8 through <16	45	50	90	8	25550	1.00E-06	7.3	3	3.8E-07
		0.552	16 through <19	45	50	90	3	25550	1.00E-06	7.3	1	4.7E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*4.3E-07*
	Benzo(b)fluoranthene	0.676	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	4.6E-08
		0.676	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	5.8E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*5.2E-08*
	Indeno(1,2,3-cd)pyrene	0.516	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	3.5E-08
		0.516	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	4.4E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*4.0E-08*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**5.6E-07**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	0.538	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	2.8E-08
		0.538	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	3.5E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*3.1E-08*
	Benzo(a)pyrene	0.552	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	2.9E-07
		0.552	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	3.6E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*3.2E-07*
	Benzo(b)fluoranthene	0.676	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	3.5E-08
		0.676	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	4.4E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*3.9E-08*
	Indeno(1,2,3-cd)pyrene	0.516	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	2.7E-08
		0.516	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	3.3E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*3.0E-08*
	CUMULATIVE RISK: Dermal Contact with Soil													**4.2E-07**

CUMULATIVE RISK, Group 4, Upland Soil (0-1') : Current Trespasser	**9.8E-07**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 4
Exposure Medium:	Upland Soil (0-10')
Receptor:	Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	38.0	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	2.6E-06
		38.0	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	3.3E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*2.9E-06*
	Benzo(a)pyrene	22.8	8 through <16	45	50	90	8	25550	1.00E-06	7.3	3	1.6E-05
		22.8	16 through <19	45	50	90	3	25550	1.00E-06	7.3	1	2.0E-06
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*1.8E-05*
	Benzo(b)fluoranthene	16.1	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	1.1E-06
		16.1	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	1.4E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*1.2E-06*
	Benzo(k)fluoranthene	20.3	8 through <16	45	50	90	8	25550	1.00E-06	0.073	3	1.4E-07
		20.3	16 through <19	45	50	90	3	25550	1.00E-06	0.073	1	1.7E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(k)fluoranthene										*1.6E-07*
	Dibenzo(a,h)anthracene	3.88	8 through <16	45	50	90	8	25550	1.00E-06	7.3	3	2.7E-06
		3.88	16 through <19	45	50	90	3	25550	1.00E-06	7.3	1	3.3E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Dibenzo(a,h)anthracene										*3.0E-06*
	Indeno(1,2,3-cd)pyrene	8.49	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	5.8E-07
		8.49	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	7.3E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*6.5E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**2.6E-05**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	38.0	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	2.0E-06
		38.0	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	2.5E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*2.2E-06*
	Benzo(a)pyrene	22.8	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	1.2E-05
		22.8	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	1.5E-06
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*1.3E-05*
	Benzo(b)fluoranthene	16.1	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	8.3E-07
		16.1	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	1.0E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*9.4E-07*
	Benzo(k)fluoranthene	20.3	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.073	3	1.0E-07
		20.3	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.073	1	1.3E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(k)fluoranthene												*1.2E-07*
	Dibenzo(a,h)anthracene	3.88	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	2.0E-06
		3.88	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	2.5E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Dibenzo(a,h)anthracene												*4.5E-06*
	Indeno(1,2,3-cd)pyrene	8.49	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	4.4E-07
		8.49	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	5.5E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.9E-07*
	CUMULATIVE RISK: Dermal Contact with Soil													**2.2E-05**
CUMULATIVE RISK, Group 4, Upland Soil (0-10') : Future Trespasser														**4.7E-05**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 5
Exposure Medium:	Wetland Soil (0-1')
Receptor:	Current/Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	0.640	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	4.4E-08
		0.640	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	5.5E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*4.9E-08*
	Benzo(a)pyrene	0.640	8 through <16	45	50	90	8	25550	1.00E-06	7.3	3	4.4E-07
		0.640	16 through <19	45	50	90	3	25550	1.00E-06	7.3	1	5.5E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*4.9E-07*
	Benzo(b)fluoranthene	0.800	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	5.5E-08
		0.800	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	6.9E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*6.2E-08*
	Indeno(1,2,3-cd)pyrene	0.560	8 through <16	45	50	90	8	25550	1.00E-06	0.73	3	3.8E-08
		0.560	16 through <19	45	50	90	3	25550	1.00E-06	0.73	1	4.8E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*4.3E-08*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**6.5E-07**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	0.640	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	0.73	3	4.3E-08
		0.640	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	0.73	1	5.4E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*4.9E-08*
	Benzo(a)pyrene	0.640	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	7.3	3	4.3E-07
		0.640	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	7.3	1	5.4E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*4.9E-07*
	Benzo(b)fluoranthene	0.800	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	0.73	3	5.4E-08
		0.800	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	0.73	1	6.7E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*6.1E-08*
	Indeno(1,2,3-cd)pyrene	0.560	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	0.73	3	3.8E-08
		0.560	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	0.73	1	4.7E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.2E-08*
	CUMULATIVE RISK: Dermal Contact with Soil													**6.4E-07**
CUMULATIVE RISK, Group 5, Wetland Soil (0-1') : Current/Future Trespasser														**1.3E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion: Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact: Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Groups 5&6
Exposure Medium:	Sediment (0-1')
Receptor:	Current/Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Sediment	Benzo(a)pyrene	0.53	8 through <16	45	50	90	8	25550	1.00E-06	7.3	3	3.6E-07
		0.53	16 through <19	45	50	90	3	25550	1.00E-06	7.3	1	4.5E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*4.1E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**4.1E-07**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Sediment	Benzo(a)pyrene	0.53	8 through <16	45	4194	0.13	0.33	90	8	25550	1.00E-06	7.3	3	1.3E-06
		0.53	16 through <19	45	4194	0.13	0.33	90	3	25550	1.00E-06	7.3	1	1.6E-07
		CUMULATIVE RISK - Dermal Contact with Sediment:Benzo(a)pyrene												*1.5E-06*
	CUMULATIVE RISK: Dermal Contact with Soil													**1.5E-06**
CUMULATIVE RISK, Groups 5&6, Sediment (0-1') : Current/Future Trespasser														**1.9E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32N
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 3
Exposure Medium:	Upland Soil (0-10')
Receptor:	Current/Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	1.10	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	1.5E-07
		1.10	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.9E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*1.7E-07*
	Benzo(a)pyrene	1.10	8 through <16	45	100	90	8	25550	1.00E-06	7.3	3	1.5E-06
		1.10	16 through <19	45	100	90	3	25550	1.00E-06	7.3	1	1.9E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*1.7E-06*
	Benzo(b)fluoranthene	0.840	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	1.2E-07
		0.840	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.4E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*1.3E-07*
	Indeno(1,2,3-cd)pyrene	0.720	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	9.9E-08
		0.720	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.2E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*1.1E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**2.1E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	1.10	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	5.7E-08
		1.10	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	7.1E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*6.4E-08*
	Benzo(a)pyrene	1.10	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	5.7E-07
		1.10	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	7.1E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*6.4E-07*
	Benzo(b)fluoranthene	0.840	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	4.3E-08
		0.840	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	5.4E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*4.9E-08*
	Indeno(1,2,3-cd)pyrene	0.720	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	3.7E-08
		0.720	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	4.7E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.2E-08*
	CUMULATIVE RISK: Dermal Contact with Soil													**7.9E-07**
CUMULATIVE RISK, Group 3, Upland Soil (0-10') : Current/Future Trespasser														**2.9E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion: Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact: Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 4
Exposure Medium:	Upland Soil (0-1')
Receptor:	Current Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	0.538	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	7.4E-08
		0.538	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	9.2E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*8.3E-08*
	Benzo(a)pyrene	0.552	8 through <16	45	100	90	8	25550	1.00E-06	7.3	3	7.6E-07
		0.552	16 through <19	45	100	90	3	25550	1.00E-06	7.3	1	9.5E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*8.5E-07*
	Benzo(b)fluoranthene	0.676	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	9.3E-08
		0.676	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.2E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*1.0E-07*
	Indeno(1,2,3-cd)pyrene	0.516	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	7.1E-08
		0.516	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	8.8E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*8.0E-08*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**1.1E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	0.538	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	2.8E-08
		0.538	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	3.5E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*3.1E-08*
	Benzo(a)pyrene	0.552	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	2.9E-07
		0.552	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	3.6E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*3.2E-07*
	Benzo(b)fluoranthene	0.676	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	3.5E-08
		0.676	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	4.4E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*3.9E-08*
	Indeno(1,2,3-cd)pyrene	0.516	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	2.7E-08
		0.516	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	3.3E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*3.0E-08*
	CUMULATIVE RISK: Dermal Contact with Soil													**4.2E-07**
CUMULATIVE RISK, Group 4, Upland Soil (0-1') : Current Trespasser														**1.5E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion: Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact: Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 4
Exposure Medium:	Upland Soil (0-10')
Receptor:	Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	38.0	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	5.2E-06
		38.0	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	6.5E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*5.9E-06*
	Benzo(a)pyrene	22.8	8 through <16	45	100	90	8	25550	1.00E-06	7.3	3	3.1E-05
		22.8	16 through <19	45	100	90	3	25550	1.00E-06	7.3	1	3.9E-06
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*3.5E-05*
	Benzo(b)fluoranthene	16.1	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	2.2E-06
		16.1	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	2.8E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*2.5E-06*
	Benzo(k)fluoranthene	20.3	8 through <16	45	100	90	8	25550	1.00E-06	0.073	3	2.8E-07
		20.3	16 through <19	45	100	90	3	25550	1.00E-06	0.073	1	3.5E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(k)fluoranthene										*3.1E-07*
	Dibenzo(a,h)anthracene	3.88	8 through <16	45	100	90	8	25550	1.00E-06	7.3	3	5.3E-06
		3.88	16 through <19	45	100	90	3	25550	1.00E-06	7.3	1	6.7E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Dibenzo(a,h)anthracene										*6.0E-06*
	Indeno(1,2,3-cd)pyrene	8.49	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	1.2E-06
		8.49	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.5E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*1.3E-06*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**5.1E-05**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	38.0	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	2.0E-06
		38.0	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	2.5E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*2.2E-06*
	Benzo(a)pyrene	22.8	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	1.2E-05
		22.8	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	1.5E-06
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*1.3E-05*
	Benzo(b)fluoranthene	16.1	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	8.3E-07
		16.1	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	1.0E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*9.4E-07*
	Benzo(k)fluoranthene	20.3	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.073	3	1.0E-07
		20.3	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.073	1	1.3E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(k)fluoranthene												*1.2E-07*
	Dibenzo(a,h)anthracene	3.88	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	7.3	3	2.0E-06
		3.88	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	7.3	1	2.5E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Dibenzo(a,h)anthracene												*2.3E-06*
	Indeno(1,2,3-cd)pyrene	8.49	8 through <16	45	3220	0.13	0.09	90	8	25550	1.00E-06	0.73	3	4.4E-07
		8.49	16 through <19	45	3220	0.13	0.09	90	3	25550	1.00E-06	0.73	1	5.5E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.9E-07*
	CUMULATIVE RISK: Dermal Contact with Soil													**1.9E-05**
CUMULATIVE RISK, Group 4, Upland Soil (0-10') : Future Trespasser														**7.0E-05**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 5
Exposure Medium:	Wetland Soil (0-1')
Receptor:	Current/Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	0.64	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	8.8E-08
		0.64	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.1E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*9.9E-08*
	Benzo(a)pyrene	0.64	8 through <16	45	100	90	8	25550	1.00E-06	7.3	3	8.8E-07
		0.64	16 through <19	45	100	90	3	25550	1.00E-06	7.3	1	1.1E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*9.9E-07*
	Benzo(b)fluoranthene	0.80	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	1.1E-07
		0.80	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	1.4E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*1.2E-07*
	Indeno(1,2,3-cd)pyrene	0.56	8 through <16	45	100	90	8	25550	1.00E-06	0.73	3	7.7E-08
		0.56	16 through <19	45	100	90	3	25550	1.00E-06	0.73	1	9.6E-09
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*8.6E-08*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**1.3E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	0.64	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	0.73	3	4.3E-08
		0.64	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	0.73	1	5.4E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*4.9E-08*
	Benzo(a)pyrene	0.64	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	7.3	3	4.3E-07
		0.64	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	7.3	1	5.4E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*4.9E-07*
	Benzo(b)fluoranthene	0.80	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	0.73	3	5.4E-08
		0.80	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	0.73	1	6.7E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*6.1E-08*
	Indeno(1,2,3-cd)pyrene	0.56	8 through <16	45	3643	0.15	0.09	90	8	25550	1.00E-06	0.73	3	3.8E-08
		0.56	16 through <19	45	3643	0.15	0.09	90	3	25550	1.00E-06	0.73	1	4.7E-09
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.2E-08*
	CUMULATIVE RISK: Dermal Contact with Soil													**6.4E-07**
CUMULATIVE RISK, Group 5, Wetland Soil (0-1') : Current/Future Trespasser														**1.9E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-32N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Groups 5&6
Exposure Medium:	Sediment (0-1')
Receptor:	Current/Future Trespasser

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Sediment	Benzo(a)pyrene	0.53	8 through <16	45	100	90	8	25550	1.00E-06	7.3	3	7.3E-07
		0.53	16 through <19	45	100	90	3	25550	1.00E-06	7.3	1	9.1E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*8.2E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**8.2E-07**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Sediment	Benzo(a)pyrene	0.53	8 through <16	45	4194	0.13	0.33	90	8	25550	1.00E-06	7.3	3	1.3E-06
		0.53	16 through <19	45	4194	0.13	0.33	90	3	25550	1.00E-06	7.3	1	1.6E-07
	CUMULATIVE RISK: Dermal Contact with Soil													**1.5E-06**
CUMULATIVE RISK, Groups 5&6, Sediment (0-1') : Current/Future Trespasser														**2.3E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10')	Group 3 Upland Area	Incidental Ingestion	Benzo(a)anthracene	1.1E+00	(mg/kg)	*		*		8.6E-07	3.0E-06	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	*		*		8.6E-06	3.0E-06	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	2.0E-07	mg/kg-day	--		--	2.1E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	*		*		6.6E-07	2.3E-06	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	4.0E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.6E-06	4.1E-03	mg/kg-day	2.0E-02	mg/kg/day	2.1E-01
				Di-n-octylphthalate	1.6E+03	(mg/kg)	4.3E-04	mg/kg-day	--		--	4.4E-03	mg/kg-day	4.0E-02	mg/kg/day	1.1E-01
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	*		*		5.6E-07	2.0E-06	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	2.7E-05	mg/kg-day	--		--	2.7E-04	mg/kg-day	2.0E-02	mg/kg/day	1.4E-02
				Toluene	7.1E+02	(mg/kg)	1.9E-04	mg/kg-day	--		--	1.9E-03	mg/kg-day	8.0E-02	mg/kg/day	2.4E-02
				Tetrachloroethene	2.7E+01	(mg/kg)	7.2E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.9E-06	7.4E-05	mg/kg-day	1.0E-02	mg/kg/day	7.4E-03
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	1.6E-04	mg/kg-day	--		--	1.6E-03	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	5.3E-05	mg/kg-day	--		--	5.5E-04	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	2.4E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	2.0E-01	mg/kg/day	1.2E-02
				Arsenic	5.9E+00	(mg/kg)	1.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.4E-06	1.6E-05	mg/kg-day	3.0E-04	mg/kg/day	5.4E-02
				Cadmium	3.8E+00	(mg/kg)	1.0E-06	mg/kg-day	--		--	1.0E-05	mg/kg-day	1.0E-03	mg/kg/day	1.0E-02
				Lead	7.3E+01	(mg/kg)	1.9E-05	mg/kg-day	--		--	2.0E-04	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	3.6E-06	mg/kg-day	--		--	3.7E-05	mg/kg-day	9.0E-03	mg/kg/day	4.1E-03
			Exp. Route Total								2.3E-05					4.4E-01
			Dermal Contact	Benzo(a)anthracene	1E+00	(mg/kg)	*		*		6.2E-07	2.2E-06	mg/kg-day	--		--
				Benzo(a)pyrene	1E+00	(mg/kg)	*		*		6.2E-06	2.2E-06	mg/kg-day	--		--
				Benzo(e)pyrene	8E-01	(mg/kg)	1.5E-07	mg/kg-day	--		--	1.5E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		4.8E-07	1.7E-06	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	2E+03	(mg/kg)	2.2E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	3.1E-06	2.3E-03	mg/kg-day	2.0E-02	mg/kg/day	1.2E-01
				Di-n-octylphthalate	2E+03	(mg/kg)	2.4E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	4.0E-02	mg/kg/day	6.1E-02
				Indeno(1,2,3-cd)Pyrene	7E-01	(mg/kg)	*		*		4.1E-07	1.4E-06	mg/kg-day	--		--
				Naphthalene	1E+02	(mg/kg)	1.9E-05	mg/kg-day	--		--	2.0E-04	mg/kg-day	2.0E-02	mg/kg/day	1.0E-02
				Toluene	7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	3E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	6E+00	(mg/kg)	2.6E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.9E-07	2.7E-06	mg/kg-day	3.0E-04	mg/kg/day	9.0E-03
				Cadmium	4E+00	(mg/kg)	5.6E-09	mg/kg-day	--		--	5.8E-08	mg/kg-day	2.5E-05	mg/kg/day	2.3E-03
				Lead	7E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.1E-05					2.0E-01
		Exposure Point Total									3.4E-05					6.4E-01
	Exposure Medium Total										3.4E-05					6.4E-01
Risk From Reference											2.7E-06					8.6E-02
Risk from Site											3.1E-05					5.5E-01

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		3.0E-07	1.1E-06	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		3.0E-06	1.1E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		3.8E-07	1.3E-06	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		2.6E-07	9.2E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	4.0E-08	mg/kg-day	--		--	4.1E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.4E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.6E-06	2.5E-05	mg/kg-day	3.0E-04	mg/kg/day	8.2E-02
				Lead	6E+01	(mg/kg)	1.0E-05	mg/kg-day	--		--	1.0E-04	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	9.2E-05	mg/kg-day	--		--	9.5E-04	mg/kg-day	1.4E-01	mg/kg/day	6.8E-03
				Vanadium	1E+01	(mg/kg)	1.9E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	9.0E-03	mg/kg/day	2.2E-03
			Exp. Route Total								7.5E-06					9.1E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		1.4E-07	4.1E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		1.4E-06	4.1E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		1.8E-07	5.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		1.3E-07	3.6E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	2.0E-08	mg/kg-day	--		--	1.6E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.8E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.2E-07	2.2E-06	mg/kg-day	3.0E-04	mg/kg/day	7.5E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.3E-06					7.5E-03
		Exposure Point Total									9.9E-06					9.9E-02
	Exposure Medium Total										9.9E-06					9.9E-02
Risk From Reference											4.0E-06					9.0E-02
Risk from Site											5.8E-06					9.0E-03
Medium Total											4.4E-05					7.4E-01
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	1.2E-07	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.3E-09	4.3E-07	mg/kg-day	1.0E-01	mg/kg/day	4.3E-06
				Methylene Chloride	5E-03	(mg/L)	1.3E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	9.9E-10	4.8E-07	mg/kg-day	6.0E-02	mg/kg/day	7.9E-06
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	6.1E-06	mg/kg-day	--		--	2.2E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.5E-06	mg/kg-day	--		--	5.3E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	3.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.9E-07	1.2E-06	mg/kg-day	3.0E-04	mg/kg/day	3.9E-03
				Cadmium	7E-03	(mg/L)	3.1E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	2.5E-05	mg/kg/day	4.5E-03
				Lead	1E-02	(mg/L)	7.0E-09	mg/kg-day	--		--	2.5E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.7E-06	mg/kg-day	--		--	9.8E-06	mg/kg-day	1.9E-03	mg/kg/day	5.2E-03
				Vanadium	5E-03	(mg/L)	2.5E-08	mg/kg-day	--		--	9.2E-08	mg/kg-day	2.3E-04	mg/kg/day	3.9E-04
				Zinc	2E+00	(mg/L)	6.8E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	3.0E-01	mg/kg/day	8.2E-05
			Exp. Route Total								4.9E-07					1.4E-02
		Exposure Point Total									4.9E-07					1.4E-02
	Exposure Medium Total										4.9E-07					1.4E-02
Risk From Reference											0.0E+00					1.0E-02
Risk from Site											4.9E-07					3.9E-03
Medium Total											4.9E-07					1.4E-02

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		2.5E-06	8.7E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	9.9E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.0E-09	1.0E-07	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	1.9E-06	mg/kg-day	--		--	1.9E-05	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	2.5E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-05	2.6E-04	mg/kg-day	3.0E-04	mg/kg/day	8.7E-01
				Lead	2E+01	(mg/kg)	3.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	2.4E-05	mg/kg-day	--		--	2.4E-04	mg/kg-day	1.4E-01	mg/kg/day	1.7E-03
				Vanadium	9E+00	(mg/kg)	1.4E-06	mg/kg-day	--		--	1.4E-05	mg/kg-day	9.0E-03	mg/kg/day	1.6E-03
			Exp. Route Total								4.0E-05					8.7E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		3.0E-06	8.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	7.4E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.1E-05	5.9E-05	mg/kg-day	3.0E-04	mg/kg/day	2.0E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.4E-05					2.0E-01
		Exposure Point Total									5.4E-05					1.1E+00
	Exposure Medium Total										5.4E-05					1.1E+00
Risk From Reference											5.4E-05					1.1E+00
Risk from Site											4.0E-09					0.0E+00
Medium Total											5.4E-05					1.1E+00
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	6.2E-05	mg/m^3	--		--	4.8E-04	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	2.0E-04	mg/m^3	--		--	1.6E-03	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	8.2E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	6.4E-07	6.4E-04	mg/m^3	3.0E-02	mg/kg/day	2.1E-02
				Xylenes (total)	9E-02	(mg/m3)	1.9E-03	mg/m^3	--		--	1.5E-02	mg/m^3	1.0E-01	mg/kg/day	1.5E-01
			Exp. Route Total								6.4E-07					1.7E-01
		Exposure Point Total									6.4E-07					1.7E-01
	Exposure Medium Total										6.4E-07					1.7E-01
Risk From Reference																
Risk from Site											6.4E-07					1.7E-01

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

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Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
FUTURE SITE RESIDENTS ONLY																
Air	Indoor Air	Group 3	Inhalation	1,4-Dichlorobenzene	3E-05	mg/m3	4.0E-06	mg/m3	--	--	--	3.1E-05	mg/m3	8.0E-01	(mg/m³)	3.9E-05
				2,4-Dimethylphenol	1E-05	mg/m3	1.6E-06	mg/m3	--	--	--	1.3E-05	mg/m3	7.0E-02	(mg/m³)	1.8E-04
				2-Methylphenol	1E-04	mg/m3	1.2E-05	mg/m3	--	--	--	9.6E-05	mg/m3	1.8E-01	(mg/m³)	5.5E-04
				3-Methylphenol/4-Methylphenol	2E-04	mg/m3	1.9E-05	mg/m3	--	--	--	1.5E-04	mg/m3	1.8E-02	(mg/m³)	8.4E-03
				4-Methylphenol	--	mg/m3	--	mg/m3	--	--	--	--	mg/m3	1.8E-02	(mg/m³)	--
				Naphthalene	5E-05	mg/m3	6.3E-06	mg/m3	--	--	--	4.9E-05	mg/m3	3.0E-03	(mg/m³)	1.6E-02
				Phenol	1E-04	mg/m3	1.7E-05	mg/m3	--	--	--	1.3E-04	mg/m3	2.0E-01	(mg/m³)	6.7E-04
				1,1,1-Trichloroethane	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	3.8E+00	(mg/m³)	0.0E+00
				1,1,2-Trichloroethane	--	mg/m3	--	mg/m3	1.6E-02	(mg/m³)-¹	--	--	mg/m3	1.4E-02	(mg/m³)	--
				1,1-Dichloroethane	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	5.0E-01	(mg/m³)	0.0E+00
				1,1-Dichloroethene	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	2.0E-01	(mg/m³)	0.0E+00
				1,2,4-Trimethylbenzene	8E-02	mg/m3	1.0E-02	mg/m3	--	--	--	8.0E-02	mg/m3	--	--	--
				1,2-Dichloroethane	7E-06	mg/m3	9.1E-07	mg/m3	2.6E-02	(mg/m³)-¹	2.4E-08	7.0E-06	mg/m3	2.4E+00	(mg/m³)	2.9E-06
				1,2-Dichloroethene	--	mg/m3	--	mg/m3	--	--	--	--	mg/m3	6.0E-02	(mg/m³)	--
				cis-1,2-Dichloroethene	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	6.0E-02	(mg/m³)	0.0E+00
				1,2-Dichloropropane	2E-05	mg/m3	1.9E-06	mg/m3	--	--	--	1.5E-05	mg/m3	4.0E-03	(mg/m³)	3.7E-03
				1,3,5-Trimethylbenzene	2E-02	mg/m3	2.9E-03	mg/m3	--	--	--	2.3E-02	mg/m3	--	--	--
				1,4-Dioxane	0E+00	mg/m3	0.0E+00	mg/m3	7.7E-03	(mg/m³)-¹	0.0E+00	0.0E+00	mg/m3	3.0E+00	(mg/m³)	0.0E+00
				2-Butanone	1E-01	mg/m3	1.3E-02	mg/m3	--	--	--	1.0E-01	mg/m3	5.0E+00	(mg/m³)	2.0E-02
				4-Methyl-2-pentanone	4E-01	mg/m3	5.4E-02	mg/m3	--	--	--	4.2E-01	mg/m3	3.0E+00	(mg/m³)	1.4E-01
				Acetone	1E-01	mg/m3	1.2E-02	mg/m3	--	--	--	9.2E-02	mg/m3	3.2E+00	(mg/m³)	2.9E-02
				Acrylonitrile	4E-03	mg/m3	4.4E-04	mg/m3	6.8E-02	(mg/m³)-¹	3.0E-05	3.4E-03	mg/m3	3.5E-03	(mg/m³)	9.7E-01
				Benzene	4E-04	mg/m3	4.4E-05	mg/m3	7.8E-03	(mg/m³)-¹	3.4E-07	3.4E-04	mg/m3	3.0E-02	(mg/m³)	1.1E-02
				Carbon tetrachloride	--	mg/m3	--	mg/m3	1.5E-02	(mg/m³)-¹	--	--	mg/m3	2.5E-03	(mg/m³)	--
				Chloroform	--	mg/m3	--	mg/m3	2.3E-02	(mg/m³)-¹	--	--	mg/m3	3.0E-01	(mg/m³)	--
				Chloroethane	9E-01	mg/m3	1.1E-01	mg/m3	--	--	--	8.4E-01	mg/m3	1.0E+01	(mg/m³)	8.4E-02
				Ethylbenzene	9E-01	mg/m3	1.1E-01	mg/m3	--	--	--	8.3E-01	mg/m3	1.0E+00	(mg/m³)	8.3E-01
				Ethyl methacrylate	3E-02	mg/m3	4.0E-03	mg/m3	--	--	--	3.1E-02	mg/m3	3.2E-01	(mg/m³)	9.9E-02
				Isopropylbenzene	0E+00	mg/m3	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	4.0E-01	(mg/m³)	0.0E+00
				Methylene Chloride	1E-01	mg/m3	1.3E-02	mg/m3	4.7E-04	(mg/m³)-¹	6.1E-06	1.0E-01	mg/m3	3.0E+00	(mg/m³)	3.3E-02
				n-Propylbenzene	9E-03	mg/m3	1.1E-03	mg/m3	--	--	--	8.3E-03	mg/m3	1.4E-01	(mg/m³)	5.9E-02
				n-Butylbenzene	0E+00	mg/m3	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	1.4E-01	(mg/m³)	0.0E+00
				tert-Butylbenzene	0E+00	mg/m3	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	1.4E-01	(mg/m³)	0.0E+00
				p-Isopropyltoluene	1E-02	mg/m3	1.3E-03	mg/m3	--	--	--	9.8E-03	mg/m3	4.0E-01	(mg/m³)	2.5E-02
				Tetrachloroethene	5E-05	mg/m3	6.6E-06	mg/m3	5.9E-03	(mg/m³)-¹	3.9E-08	5.2E-05	mg/m3	3.5E-02	(mg/m³)	1.5E-03
				Tetrahydrofuran	1E-01	mg/m3	1.4E-02	mg/m3	--	--	--	1.1E-01	mg/m3	3.0E-01	(mg/m³)	3.7E-01
				Toluene	8E+00	mg/m3	1.0E+00	mg/m3	--	--	--	7.9E+00	mg/m3	5.0E+00	(mg/m³)	1.6E+00
				Trichloroethene	6E-05	mg/m3	7.7E-06	mg/m3	2.0E-03	(mg/m³)-¹	1.5E-08	6.0E-05	mg/m3	6.0E-01	(mg/m³)	1.0E-04
				Vinyl chloride	3E-04	mg/m3	3.9E-05	mg/m3	8.8E-03	(mg/m³)-¹	3.4E-07	3.0E-04	mg/m3	1.0E-01	(mg/m³)	3.0E-03
				Xylenes (total)	3E+00	mg/m3	3.1E-01	mg/m3	--	--	--	2.4E+00	mg/m3	1.0E-01	(mg/m³)	2.4E+01
			Exp. Route Total								3.7E-05					2.9E+01
	Exposure Medium Total										3.7E-05					2.9E+01
Risk From Reference																
Risk from Site											3.7E-05					2.9E+01
Medium Total											3.7E-05					2.9E+01

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	1.6E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	3.7E-07	1.4E-04	mg/kg-day	9.0E-02	mg/kg/day	1.6E-03
				2,4-Dimethylphenol	2E-01	mg/L	8.8E-04	mg/kg-day	--		--	8.1E-03	mg/kg-day	2.0E-02	mg/kg/day	4.0E-01
				2-Methylphenol	1E+00	mg/L	4.9E-03	mg/kg-day	--		--	4.5E-02	mg/kg-day	5.0E-02	mg/kg/day	8.9E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	1.0E-02	mg/kg-day	--		--	9.4E-02	mg/kg-day	5.0E-02	mg/kg/day	1.9E+00
				4-Methylphenol	3E-01	mg/L	1.3E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	5.0E-02	mg/kg/day	2.4E-01
				Aroclor 1254	1E-03	mg/L	5.8E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.3E-06	5.4E-05	mg/kg-day	2.0E-05	mg/kg/day	2.7E+00
				Alpha-BHC	5E-05	mg/L	2.3E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.4E-06	2.1E-06	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	3.0E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	4.2E-05	2.7E-02	mg/kg-day	2.0E-02	mg/kg/day	1.4E+00
				Naphthalene	1E-02	mg/L	5.3E-05	mg/kg-day	--		--	4.9E-04	mg/kg-day	2.0E-02	mg/kg/day	2.5E-02
				Phenol	9E+00	mg/L	4.6E-02	mg/kg-day	--		--	4.2E-01	mg/kg-day	3.0E-01	mg/kg/day	1.4E+00
				1,1,1-Trichloroethane	5E-01	mg/L	2.4E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	7.0E-01	mg/kg/day	3.1E-02
				1,1,2-Trichloroethane	7E-03	mg/L	3.4E-05	mg/kg-day	5.7E-02	(mg/kg-day)-1	1.9E-06	3.1E-04	mg/kg-day	4.0E-03	mg/kg/day	7.7E-02
				1,1-Dichloroethane	4E+00	mg/L	1.8E-02	mg/kg-day	--		--	1.6E-01	mg/kg-day	2.0E-01	mg/kg/day	8.1E-01
				1,1-Dichloroethene	1E-01	mg/L	6.3E-04	mg/kg-day	--		--	5.8E-03	mg/kg-day	5.0E-02	mg/kg/day	1.2E-01
				1,2,4-Trimethylbenzene	1E+00	mg/L	6.8E-03	mg/kg-day	--		--	6.3E-02	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.2E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.0E-05	2.0E-03	mg/kg-day	2.0E-01	mg/kg/day	9.9E-03
				1,2-Dichloroethene	1E-01	mg/L	6.3E-04	mg/kg-day	--		--	5.8E-03	mg/kg-day	9.0E-03	mg/kg/day	6.5E-01
				1,2-Dichloropropane	4E-03	mg/L	1.8E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.2E-06	1.6E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	5.8E-03	mg/kg-day	--		--	5.4E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.5E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.6E-04	1.3E-01	mg/kg-day	1.0E-01	mg/kg/day	1.3E+00
				2-Butanone	8E+01	mg/L	3.7E-01	mg/kg-day	--		--	3.4E+00	mg/kg-day	6.0E-01	mg/kg/day	5.7E+00
				4-Methyl-2-pentanone	2E+02	mg/L	9.2E-01	mg/kg-day	--		--	8.5E+00	mg/kg-day	8.0E-02	mg/kg/day	1.1E+02
				Acetone	7E+01	mg/L	3.6E-01	mg/kg-day	--		--	3.3E+00	mg/kg-day	9.0E-01	mg/kg/day	3.6E+00
				Acrylonitrile	1E+00	mg/L	6.3E-03	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.4E-03	5.8E-02	mg/kg-day	1.0E-03	mg/kg/day	5.8E+01
				Benzene	5E-02	mg/L	2.2E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.2E-05	2.0E-03	mg/kg-day	4.0E-03	mg/kg/day	5.0E-01
				Carbon tetrachloride	5E-02	mg/L	2.5E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	3.3E-05	2.3E-03	mg/kg-day	7.0E-04	mg/kg/day	3.3E+00
				Chloroethane	3E+00	mg/L	1.2E-02	mg/kg-day	--		--	1.1E-01	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	2.8E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	8.6E-07	2.6E-04	mg/kg-day	1.0E-02	mg/kg/day	2.6E-02
				cis-1,2-Dichloroethene	2E-01	mg/L	1.1E-03	mg/kg-day	--		--	9.8E-03	mg/kg-day	1.0E-02	mg/kg/day	9.8E-01
				Ethylbenzene	8E+00	mg/L	4.1E-02	mg/kg-day	--		--	3.8E-01	mg/kg-day	1.0E-01	mg/kg/day	3.8E+00
				Ethyl methacrylate	4E+00	mg/L	1.9E-02	mg/kg-day	--		--	1.8E-01	mg/kg-day	9.0E-02	mg/kg/day	2.0E+00
				Isopropylbenzene	8E-02	mg/L	4.0E-04	mg/kg-day	--		--	3.7E-03	mg/kg-day	1.0E-01	mg/kg/day	3.7E-02
				Methylene Chloride	2E+00	mg/L	1.1E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	8.0E-05	9.8E-02	mg/kg-day	6.0E-02	mg/kg/day	1.6E+00
				n-Propylbenzene	9E-02	mg/L	4.5E-04	mg/kg-day	--		--	4.1E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	4.4E-04	mg/kg-day	--		--	4.0E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	4.7E-04	mg/kg-day	--		--	4.3E-03	mg/kg-day	1.0E-01	mg/kg/day	4.3E-02
				tert-Butylbenzene	7E-02	mg/L	3.2E-04	mg/kg-day	--		--	3.0E-03	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	2.9E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.6E-05	2.7E-04	mg/kg-day	1.0E-02	mg/kg/day	2.7E-02
				Tetrahydrofuran	2E+01	mg/L	9.7E-02	mg/kg-day	--		--	8.9E-01	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.8E-01	mg/kg-day	--		--	3.5E+00	mg/kg-day	8.0E-02	mg/kg/day	4.4E+01
				Trichloroethene	6E-03	mg/L	2.9E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.2E-05	2.7E-04	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	3.5E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.2E-04	3.2E-03	mg/kg-day	3.0E-03	mg/kg/day	1.1E+00
				Xylenes (total)	3E+01	mg/L	1.4E-01	mg/kg-day	--		--	1.3E+00	mg/kg-day	2.0E-01	mg/kg/day	6.3E+00
				Antimony	1E-01	mg/L	4.9E-04	mg/kg-day	--		--	4.5E-03	mg/kg-day	4.0E-04	mg/kg/day	1.1E+01
				Arsenic	2E+00	mg/L	1.1E-02	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.7E-02	1.0E-01	mg/kg-day	3.0E-04	mg/kg/day	3.5E+02
				Barium	4E-01	mg/L	1.8E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	2.0E-01	mg/kg/day	8.3E-02
				Beryllium	6E-01	mg/L	2.7E-03	mg/kg-day	--		--	2.5E-02	mg/kg-day	2.0E-03	mg/kg/day	1.3E+01
				Cadmium	6E-02	mg/L	2.9E-04	mg/kg-day	--		--	2.7E-03	mg/kg-day	5.0E-04	mg/kg/day	5.4E+00
				Chromium	3E-02	mg/L	1.5E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	5.0E-04	mg/kg/day	2.7E+00
				Cobalt	1E-01	mg/L	6.8E-04	mg/kg-day	--		--	6.3E-03	mg/kg-day	--		--
				Lead	6E-02	mg/L	2.9E-04	mg/kg-day	--		--	2.7E-03	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.4E-01	mg/kg-day	--		--	1.3E+00	mg/kg-day	4.7E-02	mg/kg/day	2.8E+01
				Nickel	8E-02	mg/L	3.9E-04	mg/kg-day	--		--	3.6E-03	mg/kg-day	2.0E-02	mg/kg/day	1.8E-01
				Silver	8E-01	mg/L	3.9E-03	mg/kg-day	--		--	3.6E-02	mg/kg-day	5.0E-03	mg/kg/day	7.2E+00
				Thallium	5E-03	mg/L	2.3E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	8.0E-05	mg/kg/day	2.7E+00
				Vanadium	1E-02	mg/L	4.9E-05	mg/kg-day	--		--	4.5E-04	mg/kg-day	9.0E-03	mg/kg/day	5.0E-02
				Zinc	6E+01	mg/L	2.7E-01	mg/kg-day	--		--	2.5E+00	mg/kg-day	3.0E-01	mg/kg/day	8.2E+00
			Exp. Route Total								2.1E-02					6.7E+02

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	9.1E-06	mg/kg-day	2.4E-02	(mg/kg-day)-1	2.2E-07	7.6E-05	mg/kg-day	9.0E-02	mg/kg/day	8.4E-04
				2,4-Dimethylphenol	2E-01	mg/L	1.2E-04	mg/kg-day	--		--	9.6E-04	mg/kg-day	2.0E-02	mg/kg/day	4.8E-02
				2-Methylphenol	1E+00	mg/L	5.3E-04	mg/kg-day	--		--	4.4E-03	mg/kg-day	5.0E-02	mg/kg/day	8.9E-02
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	8.9E-04	mg/kg-day	--		--	7.4E-03	mg/kg-day	5.0E-02	mg/kg/day	1.5E-01
				4-Methylphenol	3E-01	mg/L	1.1E-04	mg/kg-day	--		--	9.5E-04	mg/kg-day	5.0E-02	mg/kg/day	1.9E-02
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Alpha-BHC	5E-05	mg/L	6.1E-08	mg/kg-day	6.3E+00	(mg/kg-day)-1	3.8E-07	5.0E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	3.9E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.4E-05	3.2E-02	mg/kg-day	2.0E-02	mg/kg/day	1.6E+00
				Naphthalene	1E-02	mg/L	3.1E-05	mg/kg-day	--		--	2.6E-04	mg/kg-day	2.0E-02	mg/kg/day	1.3E-02
				Phenol	9E+00	mg/L	3.7E-03	mg/kg-day	--		--	3.1E-02	mg/kg-day	3.0E-01	mg/kg/day	1.0E-01
				1,1,1-Trichloroethane	5E-01	mg/L	4.0E-04	mg/kg-day	--		--	3.3E-03	mg/kg-day	7.0E-01	mg/kg/day	4.7E-03
				1,1,2-Trichloroethane	7E-03	mg/L	2.8E-06	mg/kg-day	5.7E-02	(mg/kg-day)-1	1.6E-07	2.3E-05	mg/kg-day	4.0E-03	mg/kg/day	5.7E-03
				1,1-Dichloroethane	4E+00	mg/L	1.2E-03	mg/kg-day	--		--	1.0E-02	mg/kg-day	2.0E-01	mg/kg/day	5.0E-02
				1,1-Dichloroethene	1E-01	mg/L	7.7E-05	mg/kg-day	--		--	6.4E-04	mg/kg-day	5.0E-02	mg/kg/day	1.3E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	1.2E-02	mg/kg-day	--		--	1.0E-01	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	9.3E-06	mg/kg-day	9.1E-02	(mg/kg-day)-1	8.4E-07	7.7E-05	mg/kg-day	2.0E-01	mg/kg/day	3.9E-04
				1,2-Dichloroethene	1E-01	mg/L	4.9E-05	mg/kg-day	--		--	4.1E-04	mg/kg-day	9.0E-03	mg/kg/day	4.5E-02
				1,2-Dichloropropane	4E-03	mg/L	1.5E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.0E-07	1.3E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	5.9E-03	mg/kg-day	--		--	4.9E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	4.6E-05	mg/kg-day	1.1E-02	(mg/kg-day)-1	5.0E-07	3.8E-04	mg/kg-day	1.0E-01	mg/kg/day	3.8E-03
				2-Butanone	8E+01	mg/L	3.6E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	6.0E-01	mg/kg/day	5.0E-02
				4-Methyl-2-pentanone	2E+02	mg/L	3.8E-02	mg/kg-day	--		--	3.2E-01	mg/kg-day	8.0E-02	mg/kg/day	3.9E+00
				Acetone	7E+01	mg/L	3.1E-03	mg/kg-day	--		--	2.5E-02	mg/kg-day	9.0E-01	mg/kg/day	2.8E-02
				Acrylonitrile	1E+00	mg/L	5.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.1E-05	4.8E-04	mg/kg-day	1.0E-03	mg/kg/day	4.8E-01
				Benzene	5E-02	mg/L	2.9E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.6E-06	2.4E-04	mg/kg-day	4.0E-03	mg/kg/day	6.1E-02
				Carbon tetrachloride	5E-02	mg/L	5.9E-05	mg/kg-day	1.3E-01	(mg/kg-day)-1	7.7E-06	4.9E-04	mg/kg-day	7.0E-04	mg/kg/day	7.0E-01
				Chloroethane	3E+00	mg/L	6.0E-04	mg/kg-day	--		--	5.0E-03	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	2.2E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	6.9E-08	1.8E-05	mg/kg-day	1.0E-02	mg/kg/day	1.8E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	8.3E-05	mg/kg-day	--		--	6.9E-04	mg/kg-day	1.0E-02	mg/kg/day	6.9E-02
				Ethylbenzene	8E+00	mg/L	2.2E-02	mg/kg-day	--		--	1.8E-01	mg/kg-day	1.0E-01	mg/kg/day	1.8E+00
				Ethyl methacrylate	4E+00	mg/L	2.9E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	9.0E-02	mg/kg/day	2.7E-01
				Isopropylbenzene	8E-02	mg/L	4.6E-04	mg/kg-day	--		--	3.8E-03	mg/kg-day	1.0E-01	mg/kg/day	3.8E-02
				Methylene Chloride	2E+00	mg/L	3.5E-04	mg/kg-day	7.5E-03	(mg/kg-day)-1	2.6E-06	2.9E-03	mg/kg-day	6.0E-02	mg/kg/day	4.9E-02
				n-Propylbenzene	9E-02	mg/L	6.8E-04	mg/kg-day	--		--	5.7E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	1.3E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	1.1E-03	mg/kg-day	--		--	9.0E-03	mg/kg-day	1.0E-01	mg/kg/day	9.0E-02
				tert-Butylbenzene	7E-02	mg/L	7.5E-04	mg/kg-day	--		--	6.3E-03	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	1.5E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	8.2E-06	1.3E-04	mg/kg-day	1.0E-02	mg/kg/day	1.3E-02
				Tetrahydrofuran	2E+01	mg/L	2.1E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	--		--
				Toluene	8E+01	mg/L	1.2E-01	mg/kg-day	--		--	9.6E-01	mg/kg-day	8.0E-02	mg/kg/day	1.2E+01
				Trichloroethene	6E-03	mg/L	4.4E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.8E-06	3.7E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	1.6E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.4E-05	1.3E-04	mg/kg-day	3.0E-03	mg/kg/day	4.4E-02
				Xylenes (total)	3E+01	mg/L	1.0E-01	mg/kg-day	--		--	8.6E-01	mg/kg-day	2.0E-01	mg/kg/day	4.3E+00
				Antimony	1E-01	mg/L	1.7E-06	mg/kg-day	--		--	1.4E-05	mg/kg-day	6.0E-05	mg/kg/day	2.3E-01
				Arsenic	2E+00	mg/L	3.9E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.8E-05	3.2E-04	mg/kg-day	3.0E-04	mg/kg/day	1.1E+00
				Barium	4E-01	mg/L	6.2E-06	mg/kg-day	--		--	5.2E-05	mg/kg-day	1.4E-02	mg/kg/day	3.7E-03
				Beryllium	6E-01	mg/L	9.4E-06	mg/kg-day	--		--	7.8E-05	mg/kg-day	1.4E-05	mg/kg/day	5.6E+00
				Cadmium	6E-02	mg/L	1.0E-06	mg/kg-day	--		--	8.4E-06	mg/kg-day	2.5E-05	mg/kg/day	3.3E-01
				Chromium	3E-02	mg/L	1.0E-06	mg/kg-day	--		--	8.4E-06	mg/kg-day	2.5E-05	mg/kg/day	3.3E-01
				Cobalt	1E-01	mg/L	9.4E-07	mg/kg-day	--		--	7.8E-06	mg/kg-day	--		--
				Lead	6E-02	mg/L	1.0E-07	mg/kg-day	--		--	8.4E-07	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	4.9E-04	mg/kg-day	--		--	4.0E-03	mg/kg-day	1.9E-03	mg/kg/day	2.2E+00
				Nickel	8E-02	mg/L	2.7E-07	mg/kg-day	--		--	2.2E-06	mg/kg-day	8.0E-04	mg/kg/day	2.8E-03
				Silver	8E-01	mg/L	8.0E-06	mg/kg-day	--		--	6.7E-05	mg/kg-day	2.0E-04	mg/kg/day	3.3E-01
				Thallium	5E-03	mg/L	8.0E-08	mg/kg-day	--		--	6.7E-07	mg/kg-day	8.0E-05	mg/kg/day	8.4E-03
				Vanadium	1E-02	mg/L	1.7E-07	mg/kg-day	--		--	1.4E-06	mg/kg-day	2.3E-04	mg/kg/day	6.0E-03
				Zinc	6E+01	mg/L	5.5E-04	mg/kg-day	--		--	4.6E-03	mg/kg-day	3.0E-01	mg/kg/day	1.5E-02
			Exp. Route Total								1.9E-04					3.6E+01

TABLE 3-33A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Current/Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Shower Air	1,4-Dichlorobenzene	NC (4)		3.1E-05	(mg/m3)	--		--	6.7E-04	(mg/m3)	8.0E-01	(mg/m³)	8.4E-04
				2,4-Dimethylphenol	NC (4)		2.0E-05	(mg/m3)	--		--	4.5E-04	(mg/m3)	7.0E-02	(mg/m³)	6.4E-03
				2-Methylphenol	NC (4)		2.0E-03	(mg/m3)	--		--	7.3E-03	(mg/m3)	1.8E-01	(mg/m³)	4.2E-02
				3-Methylphenol/4-Methylphenol	NC (4)		3.6E-03	(mg/m3)	--		--	1.3E-02	(mg/m3)	1.8E-02	(mg/m³)	7.3E-01
				4-Methylphenol	NC (4)		4.6E-04	(mg/m3)	--		--	1.6E-03	(mg/m3)	1.8E-02	(mg/m³)	9.4E-02
				Aroclor 1254	NC (4)		NA	(mg/m3)	1.0E-01	(mg/m³)-¹	--	NA	(mg/m3)	7.0E-05	(mg/m³)	--
				Alpha-BHC	NC (4)		NA	(mg/m3)	1.8E+00	(mg/m³)-¹	--	NA	(mg/m3)	1.8E-03	(mg/m³)	--
				Bis(2-Ethylhexyl)phthalate	NC (4)		2.0E-06	(mg/m3)	2.4E-03	(mg/m³)-¹	4.8E-09	4.4E-05	(mg/m3)	7.0E-02	(mg/m³)	6.2E-04
				Naphthalene	NC (4)		8.6E-05	(mg/m3)	--		--	1.9E-03	(mg/m3)	3.0E-03	(mg/m³)	6.3E-01
				Phenol	NC (4)		2.4E-04	(mg/m3)	--		--	5.3E-03	(mg/m3)	2.0E-01	(mg/m³)	2.7E-02
				1,1,1-Trichloroethane	NC (4)		5.2E-03	(mg/m3)	--		--	1.1E-01	(mg/m3)	3.8E+00	(mg/m³)	3.0E-02
				1,1,2-Trichloroethane	NC (4)		6.1E-05	(mg/m3)	1.6E-02	(mg/m³)-¹	9.8E-07	1.3E-03	(mg/m3)	1.4E-02	(mg/m³)	9.6E-02
				1,1-Dichloroethane	NC (4)		4.2E-02	(mg/m3)	--		--	9.1E-01	(mg/m3)	5.0E-01	(mg/m³)	1.8E+00
				1,1-Dichloroethene	NC (4)		1.6E-03	(mg/m3)	--		--	3.4E-02	(mg/m3)	2.0E-01	(mg/m³)	1.7E-01
				1,2,4-Trimethylbenzene	NC (4)		4.2E-01	(mg/m3)	--		--	1.5E+00	(mg/m3)	--		--
				1,2-Dichloroethane	NC (4)		4.5E-04	(mg/m3)	2.6E-02	(mg/m³)-¹	1.2E-05	9.8E-03	(mg/m3)	2.4E+00	(mg/m³)	4.0E-03
				1,2-Dichloroethene	NC (4)		1.5E-03	(mg/m3)	--		--	3.4E-02	(mg/m3)	6.0E-02	(mg/m³)	5.6E-01
				1,2-Dichloropropane	NC (4)		3.9E-05	(mg/m3)	--		--	8.4E-04	(mg/m3)	4.0E-03	(mg/m³)	2.1E-01
				1,3,5-Trimethylbenzene	NC (4)		3.7E-01	(mg/m3)	--		--	1.3E+00	(mg/m3)	--		--
				1,4-Dioxane	NC (4)		9.7E-04	(mg/m3)	7.7E-03	(mg/m³)-¹	7.5E-06	2.1E-02	(mg/m3)	3.0E+00	(mg/m³)	7.1E-03
				2-Butanone	NC (4)		1.4E-01	(mg/m3)	--		--	3.0E+00	(mg/m3)	5.0E+00	(mg/m³)	6.0E-01
				4-Methyl-2-pentanone	NC (4)		9.7E-01	(mg/m3)	--		--	2.1E+01	(mg/m3)	3.0E-00	(mg/m³)	7.0E+00
				Acetone	NC (4)		1.9E-01	(mg/m3)	--		--	4.2E+00	(mg/m3)	3.2E+00	(mg/m³)	1.3E+00
				Acrylonitrile	NC (4)		6.7E-03	(mg/m3)	6.8E-02	(mg/m³)-¹	4.5E-04	1.5E-01	(mg/m3)	3.5E-03	(mg/m³)	4.2E+01
				Benzene	NC (4)		5.7E-04	(mg/m3)	7.8E-03	(mg/m³)-¹	4.4E-06	1.2E-02	(mg/m3)	3.0E-02	(mg/m³)	4.2E-01
				Carbon tetrachloride	NC (4)		5.2E-04	(mg/m3)	1.5E-02	(mg/m³)-¹	7.9E-06	1.1E-02	(mg/m3)	2.5E-03	(mg/m³)	4.7E+00
				Chloroethane	NC (4)		1.0E+00	(mg/m3)	--		--	3.8E+00	(mg/m3)	1.0E+01	(mg/m³)	3.8E-01
				Chloroform	NC (4)		6.1E-05	(mg/m3)	2.3E-02	(mg/m³)-¹	1.4E-06	1.3E-03	(mg/m3)	3.0E-01	(mg/m³)	4.4E-03
				cis-1,2-Dichloroethene	NC (4)		2.5E-03	(mg/m3)	--		--	5.6E-02	(mg/m3)	6.0E-02	(mg/m³)	9.3E-01
				Ethylbenzene	NC (4)		9.6E-02	(mg/m3)	--		--	2.1E+00	(mg/m3)	1.0E+00	(mg/m³)	2.1E+00
				Ethyl methacrylate	NC (4)		3.4E-02	(mg/m3)	--		--	7.5E-01	(mg/m3)	3.2E-01	(mg/m³)	2.4E+00
				Isopropylbenzene	NC (4)		2.6E-02	(mg/m3)	--		--	9.2E-02	(mg/m3)	4.0E-01	(mg/m³)	2.3E-01
				Methylene Chloride	NC (4)		2.6E-02	(mg/m3)	4.7E-04	(mg/m³)-¹	1.2E-05	5.6E-01	(mg/m3)	3.0E+00	(mg/m³)	1.9E-01
				n-Propylbenzene	NC (4)		6.8E-02	(mg/m3)	--		--	2.5E-01	(mg/m3)	1.4E-01	(mg/m³)	1.8E+00
				n-Butylbenzene	NC (4)		2.7E-02	(mg/m3)	--		--	9.5E-02	(mg/m3)	1.4E-01	(mg/m³)	6.8E-01
				p-Isopropyltoluene	NC (4)		1.0E-03	(mg/m3)	--		--	2.2E-02	(mg/m3)	4.0E-01	(mg/m³)	5.5E-02
				tert-Butylbenzene	NC (4)		2.0E-02	(mg/m3)	--		--	7.1E-02	(mg/m3)	1.4E-01	(mg/m³)	5.1E-01
				Tetrachloroethene	NC (4)		5.9E-05	(mg/m3)	5.9E-03	(mg/m³)-¹	3.5E-07	1.3E-03	(mg/m3)	3.5E-02	(mg/m³)	3.7E-02
				Tetrahydrofuran	NC (4)		7.4E+00	(mg/m3)	--		--	2.7E+01	(mg/m3)	3.0E-01	(mg/m³)	8.8E+01
				Toluene	NC (4)		9.4E-01	(mg/m3)	--		--	2.0E+01	(mg/m3)	5.0E+00	(mg/m³)	4.1E+00
				Trichloroethene	NC (4)		6.4E-05	(mg/m3)	2.0E-03	(mg/m³)-¹	1.3E-07	1.4E-03	(mg/m3)	6.0E-01	(mg/m³)	2.3E-03
				Vinyl chloride	NC (4)		9.9E-04	(mg/m3)	8.8E-03	(mg/m³)-¹	8.7E-06	2.2E-02	(mg/m3)	1.0E-01	(mg/m³)	2.2E-01
				Xylenes (total)	NC (4)		3.2E-01	(mg/m3)	--		--	7.0E+00	(mg/m3)	1.0E-01	(mg/m³)	7.0E+01
			Exp. Route Total								5.1E-04					2.3E+02
	Exposure Medium Total										2.2E-02					9.4E+02
Risk From Reference											0.0E+00					5.4E+01
Risk from Site											2E-02					887
Total of Receptor Risks Across All Media											2E-02	Total of Receptor Hazards Across All Media				972
Risks from Reference											6E-05					55
Risks from Site											2E-02					917

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

(4) Shower model calculates an intake concentration.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene includes a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 33-M.

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10')	Group 3 Upland Area	Incidental Ingestion	Benzo(a)anthracene	1.1E+00	(mg/kg)	*		*		1.8E-06	6.0E-06	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	*		*		1.8E-05	6.0E-06	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	5.1E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	*		*		1.4E-06	4.6E-06	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	1.0E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.4E-05	8.2E-03	mg/kg-day	2.0E-02	mg/kg/day	4.1E-01
				Di-n-octylphthalate	1.6E+03	(mg/kg)	1.1E-03	mg/kg-day	--		--	8.8E-03	mg/kg-day	4.0E-02	mg/kg/day	2.2E-01
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	*		*		1.2E-06	3.9E-06	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	6.7E-05	mg/kg-day	--		--	5.5E-04	mg/kg-day	2.0E-02	mg/kg/day	2.7E-02
				Toluene	7.1E+02	(mg/kg)	4.8E-04	mg/kg-day	--		--	3.9E-03	mg/kg-day	8.0E-02	mg/kg/day	4.9E-02
				Tetrachloroethene	2.7E+01	(mg/kg)	1.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	9.8E-06	1.5E-04	mg/kg-day	1.0E-02	mg/kg/day	1.5E-02
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	4.0E-04	mg/kg-day	--		--	3.2E-03	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	1.3E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	6.0E-04	mg/kg-day	--		--	4.9E-03	mg/kg-day	2.0E-01	mg/kg/day	2.5E-02
				Arsenic	5.9E+00	(mg/kg)	4.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.9E-06	3.2E-05	mg/kg-day	3.0E-04	mg/kg/day	1.1E-01
				Cadmium	3.8E+00	(mg/kg)	2.5E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	1.0E-03	mg/kg/day	2.1E-02
				Lead	7.3E+01	(mg/kg)	4.9E-05	mg/kg-day	--		--	4.0E-04	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	9.0E-06	mg/kg-day	--		--	7.4E-05	mg/kg-day	9.0E-03	mg/kg/day	8.2E-03
			Exp. Route Total								5.2E-05					8.8E-01
			Dermal Contact	Benzo(a)anthracene	1E+00	(mg/kg)	*		*		7.2E-07	2.2E-06	mg/kg-day	--		--
				Benzo(a)pyrene	1E+00	(mg/kg)	*		*		7.2E-06	2.2E-06	mg/kg-day	--		--
				Benzo(e)pyrene	8E-01	(mg/kg)	2.1E-07	mg/kg-day	--		--	1.5E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		5.5E-07	1.7E-06	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	2E+03	(mg/kg)	3.2E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	4.4E-06	2.3E-03	mg/kg-day	2.0E-02	mg/kg/day	1.2E-01
				Di-n-octylphthalate	2E+03	(mg/kg)	3.4E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	4.0E-02	mg/kg/day	6.1E-02
				Indeno(1,2,3-cd)Pyrene	7E-01	(mg/kg)	*		*		4.7E-07	1.4E-06	mg/kg-day	--		--
				Naphthalene	1E+02	(mg/kg)	2.8E-05	mg/kg-day	--		--	2.0E-04	mg/kg-day	2.0E-02	mg/kg/day	1.0E-02
				Toluene	7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	3E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	6E+00	(mg/kg)	3.7E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.6E-07	2.7E-06	mg/kg-day	3.0E-04	mg/kg/day	9.0E-03
				Cadmium	4E-00	(mg/kg)	8.0E-09	mg/kg-day	--		--	5.8E-08	mg/kg-day	2.5E-05	mg/kg-day	2.3E-03
				Lead	7E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.4E-05					2.0E-01
		Exposure Point Total									6.6E-05					1.1E+00
	Exposure Medium Total										6.6E-05					1.1E+00
Risk From Reference											6.5E-06					1.5E-01
Risk from Site											6.0E-05					9.3E-01

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		6.3E-07	2.1E-06	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		6.3E-06	2.1E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		7.8E-07	2.6E-06	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		5.5E-07	1.8E-06	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.0E-07	mg/kg-day	--		--	8.2E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	6.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.1E-06	4.9E-05	mg/kg-day	3.0E-04	mg/kg/day	1.6E-01
				Lead	6E+01	(mg/kg)	2.5E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	2.3E-04	mg/kg-day	--		--	1.9E-03	mg/kg-day	1.4E-01	mg/kg/day	1.4E-02
				Vanadium	1E+01	(mg/kg)	4.8E-06	mg/kg-day	--		--	3.9E-05	mg/kg-day	9.0E-03	mg/kg/day	4.4E-03
			Exp. Route Total								1.7E-05					1.8E-01
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		2.1E-07	4.1E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		2.1E-06	4.1E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		2.6E-07	5.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		1.8E-07	3.6E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	3.7E-08	mg/kg-day	--		--	1.6E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	5.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.8E-07	2.2E-06	mg/kg-day	3.0E-04	mg/kg/day	7.4E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								3.5E-06					7.4E-03
		Exposure Point Total									2.1E-05					1.9E-01
	Exposure Medium Total										2.1E-05					1.9E-01
Risk From Reference											9.8E-06					1.7E-01
Risk from Site											1.1E-05					1.8E-02
Medium Total											8.7E-05					1.5E+00
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	2.3E-07	mg/kg-day	1.1E-02	(mg/kg-day)-1	2.6E-09	9.4E-07	mg/kg-day	1.0E-01	mg/kg/day	9.4E-06
				Methylene Chloride	5E-03	(mg/L)	2.6E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	1.9E-09	1.0E-06	mg/kg-day	6.0E-02	mg/kg/day	1.7E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	1.2E-05	mg/kg-day	--		--	4.7E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	2.9E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	6.3E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.5E-07	2.5E-06	mg/kg-day	3.0E-04	mg/kg/day	8.5E-03
				Cadmium	7E-03	(mg/L)	6.0E-08	mg/kg-day	--		--	2.4E-07	mg/kg-day	2.5E-05	mg/kg/day	9.7E-03
				Lead	1E-02	(mg/L)	1.4E-08	mg/kg-day	--		--	5.5E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	5.3E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	1.9E-03	mg/kg/day	1.1E-02
				Vanadium	5E-03	(mg/L)	5.0E-08	mg/kg-day	--		--	2.0E-07	mg/kg-day	2.3E-04	mg/kg/day	8.5E-04
				Zinc	2E+00	(mg/L)	1.3E-05	mg/kg-day	--		--	5.3E-05	mg/kg-day	3.0E-01	mg/kg/day	1.8E-04
			Exp. Route Total								9.5E-07					3.1E-02
		Exposure Point Total									9.5E-07					3.1E-02
	Exposure Medium Total										9.5E-07					3.1E-02
Risk From Reference											0.0E+00					2.2E-02
Risk from Site											9.5E-07					8.5E-03
Medium Total											9.5E-07					3.1E-02

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		5.2E-06	1.7E-06	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	2.5E-08	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.0E-08	2.0E-07	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	4.7E-06	mg/kg-day	--		--	2.8E-05	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	6.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.5E-05	3.2E-04	mg/kg-day	3.0E-04	mg/kg/day	1.7E+00
				Lead	2E+01	(mg/kg)	8.3E-06	mg/kg-day	--		--	6.8E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	5.9E-05	mg/kg-day	--		--	4.8E-04	mg/kg-day	1.4E-01	mg/kg/day	3.5E-03
				Vanadium	9E+00	(mg/kg)	3.5E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	9.0E-03	mg/kg/day	3.2E-03
			Exp. Route Total								1.0E-04					1.7E+00
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		4.4E-06	8.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	1.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.1E-05	5.9E-05	mg/kg-day	3.0E-04	mg/kg/day	2.0E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.6E-05					2.0E-01
		Exposure Point Total									1.3E-04					1.9E+00
	Exposure Medium Total										1.3E-04					1.9E+00
Risk From Reference											1.3E-04					1.9E+00
Risk from Site											1.0E-08					0.0E+00
Medium Total											1.3E-04					1.9E+00
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	1.6E-04	mg/m^3	--		--	4.8E-04	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	5.4E-04	mg/m^3	--		--	1.6E-03	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	2.2E-04	mg/m^3	7.8E-03	(mg/kg-day)-1	1.7E-06	6.4E-04	mg/m^3	3.0E-02	mg/kg/day	2.1E-02
				Xylenes (total)	9E-02	(mg/m3)	5.0E-03	mg/m^3	--		--	1.5E-02	mg/m^3	1.0E-01	mg/kg/day	1.5E-01
			Exp. Route Total								1.7E-06					1.7E-01
		Exposure Point Total									1.7E-06					1.7E-01
	Exposure Medium Total										1.7E-06					1.7E-01
Risk From Reference																
Risk from Site											1.7E-06					1.7E-01

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
FUTURE SITE RESIDENTS ONLY																
Air	Indoor Air	Group 3	Inhalation	1,4-Dichlorobenzene	3E-05	mg/m3	1.1E-05	mg/m3	--	--	--	3.1E-05	mg/m3	8.0E-01	(mg/m³)	3.9E-05
				2,4-Dimethylphenol	1E-05	mg/m3	4.3E-06	mg/m3	--	--	--	1.3E-05	mg/m3	7.0E-02	(mg/m³)	1.8E-04
				2-Methylphenol	1E-04	mg/m3	3.3E-05	mg/m3	--	--	--	9.6E-05	mg/m3	1.8E-01	(mg/m³)	5.5E-04
				3-Methylphenol/4-Methylphenol	2E-04	mg/m3	5.1E-05	mg/m3	--	--	--	1.5E-04	mg/m3	1.8E-02	(mg/m³)	8.4E-03
				4-Methylphenol	--	mg/m3	--	mg/m3	--	--	--	--	mg/m3	1.8E-02	(mg/m³)	--
				Naphthalene	5E-05	mg/m3	1.7E-05	mg/m3	--	--	--	4.9E-05	mg/m3	3.0E-03	(mg/m³)	1.6E-02
				Phenol	1E-04	mg/m3	4.6E-05	mg/m3	--	--	--	1.3E-04	mg/m3	2.0E-01	(mg/m³)	6.7E-04
				1,1,1-Trichloroethane	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	3.8E+00	(mg/m³)	0.0E+00
				1,1,2-Trichloroethane	--	mg/m3	--	mg/m3	1.6E-02	(mg/m³)-¹	--	--	mg/m3	1.4E-02	(mg/m³)	--
				1,1-Dichloroethane	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	5.0E-01	(mg/m³)	0.0E+00
				1,1-Dichloroethene	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	2.0E-01	(mg/m³)	0.0E+00
				1,2,4-Trimethylbenzene	8E-02	mg/m3	2.7E-02	mg/m3	--	--	--	8.0E-02	mg/m3	--	--	--
				1,2-Dichloroethane	7E-06	mg/m3	2.4E-06	mg/m3	2.6E-02	(mg/m³)-¹	6.3E-08	7.0E-06	mg/m3	2.4E+00	(mg/m³)	2.9E-06
				1,2-Dichloroethene	--	mg/m3	--	mg/m3	--	--	--	--	mg/m3	6.0E-02	(mg/m³)	--
				cis-1,2-Dichloroethene	0E+00	0E+00	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	6.0E-02	(mg/m³)	0.0E+00
				1,2-Dichloropropane	2E-05	mg/m3	5.0E-06	mg/m3	--	--	--	1.5E-05	mg/m3	4.0E-03	(mg/m³)	3.7E-03
				1,3,5-Trimethylbenzene	2E-02	mg/m3	7.8E-03	mg/m3	--	--	--	2.3E-02	mg/m3	--	--	--
				1,4-Dioxane	0E+00	mg/m3	0.0E+00	mg/m3	7.7E-03	(mg/m³)-¹	0.0E+00	0.0E+00	mg/m3	3.0E+00	(mg/m³)	0.0E+00
				2-Butanone	1E-01	mg/m3	3.5E-02	mg/m3	--	--	--	1.0E-01	mg/m3	5.0E+00	(mg/m³)	2.0E-02
				4-Methyl-2-pentanone	4E-01	mg/m3	1.5E-01	mg/m3	--	--	--	4.2E-01	mg/m3	3.0E+00	(mg/m³)	1.4E-01
				Acetone	1E-01	mg/m3	3.2E-02	mg/m3	--	--	--	9.2E-02	mg/m3	3.2E+00	(mg/m³)	2.9E-02
				Acrylonitrile	4E-03	mg/m3	1.2E-03	mg/m3	6.8E-02	(mg/m³)-¹	7.9E-05	3.4E-03	mg/m3	3.5E-03	(mg/m³)	9.7E-01
				Benzene	4E-04	mg/m3	1.2E-04	mg/m3	7.8E-03	(mg/m³)-¹	9.1E-07	3.4E-04	mg/m3	3.0E-02	(mg/m³)	1.1E-02
				Carbon tetrachloride	--	mg/m3	--	mg/m3	1.5E-02	(mg/m³)-¹	--	--	mg/m3	2.5E-03	(mg/m³)	--
				Chloroform	--	mg/m3	--	mg/m3	2.3E-02	(mg/m³)-¹	--	--	mg/m3	3.0E-01	(mg/m³)	--
				Chloroethane	9E-01	mg/m3	2.9E-01	mg/m3	--	--	--	8.4E-01	mg/m3	1.0E+01	(mg/m³)	8.4E-02
				Ethylbenzene	9E-01	mg/m3	2.8E-01	mg/m3	--	--	--	8.3E-01	mg/m3	1.0E+00	(mg/m³)	8.3E-01
				Ethyl methacrylate	3E-02	mg/m3	1.1E-02	mg/m3	--	--	--	3.1E-02	mg/m3	3.2E-01	(mg/m³)	9.9E-02
				Isopropylbenzene	0E+00	mg/m3	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	4.0E-01	(mg/m³)	0.0E+00
				Methylene Chloride	1E-01	mg/m3	3.4E-02	mg/m3	4.7E-04	(mg/m³)-¹	1.6E-05	1.0E-01	mg/m3	3.0E+00	(mg/m³)	3.3E-02
				n-Propylbenzene	9E-03	mg/m3	2.8E-03	mg/m3	--	--	--	8.3E-03	mg/m3	1.4E-01	(mg/m³)	5.9E-02
				n-Butylbenzene	0E+00	mg/m3	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	1.4E-01	(mg/m³)	0.0E+00
				tert-Butylbenzene	0E+00	mg/m3	0.0E+00	mg/m3	--	--	--	0.0E+00	mg/m3	1.4E-01	(mg/m³)	0.0E+00
				p-Isopropyltoluene	1E-02	mg/m3	3.4E-03	mg/m3	--	--	--	9.8E-03	mg/m3	4.0E-01	(mg/m³)	2.5E-02
				Tetrachloroethene	5E-05	mg/m3	1.8E-05	mg/m3	5.9E-03	(mg/m³)-¹	1.0E-07	5.2E-05	mg/m3	3.5E-02	(mg/m³)	1.5E-03
				Tetrahydrofuran	1E-01	mg/m3	3.8E-02	mg/m3	--	--	--	1.1E-01	mg/m3	3.0E-01	(mg/m³)	3.7E-01
				Toluene	8E+00	mg/m3	2.7E+00	mg/m3	--	--	--	7.9E+00	mg/m3	5.0E+00	(mg/m³)	1.6E+00
				Trichloroethene	6E-05	mg/m3	2.1E-05	mg/m3	2.0E-03	(mg/m³)-¹	4.1E-08	6.0E-05	mg/m3	6.0E-01	(mg/m³)	1.0E-04
				Vinyl chloride	3E-04	mg/m3	1.0E-04	mg/m3	8.8E-03	(mg/m³)-¹	9.1E-07	3.0E-04	mg/m3	1.0E-01	(mg/m³)	3.0E-03
				Xylenes (total)	3E+00	mg/m3	8.4E-01	mg/m3	--	--	--	2.4E+00	mg/m3	1.0E-01	(mg/m³)	2.4E+01
			Exp. Route Total								9.7E-05					2.9E+01
	Exposure Medium Total										9.7E-05					2.9E+01
Risk From Reference																
Risk from Site											9.7E-05					2.9E+01

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	5.2E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	1.3E-06	2.7E-04	mg/kg-day	9.0E-02	mg/kg/day	3.0E-03
				2,4-Dimethylphenol	2E-01	mg/L	3.0E-03	mg/kg-day	--		--	1.5E-02	mg/kg-day	2.0E-02	mg/kg/day	7.5E-01
				2-Methylphenol	1E+00	mg/L	1.6E-02	mg/kg-day	--		--	8.3E-02	mg/kg-day	5.0E-02	mg/kg/day	1.7E+00
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	3.4E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	5.0E-02	mg/kg/day	3.5E+00
				4-Methylphenol	3E-01	mg/L	4.4E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	5.0E-02	mg/kg/day	4.5E-01
				Aroclor 1254	1E-03	mg/L	2.0E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	7.9E-06	1.0E-04	mg/kg-day	2.0E-05	mg/kg/day	5.0E+00
				Alpha-BHC	5E-05	mg/L	7.7E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	4.9E-06	3.9E-06	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.0E-02	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.4E-04	5.1E-02	mg/kg-day	2.0E-02	mg/kg/day	2.5E+00
				Naphthalene	1E-02	mg/L	1.8E-04	mg/kg-day	--		--	9.1E-04	mg/kg-day	2.0E-02	mg/kg/day	4.6E-02
				Phenol	9E+00	mg/L	1.5E-01	mg/kg-day	--		--	7.8E-01	mg/kg-day	3.0E-01	mg/kg/day	2.6E+00
				1,1,1-Trichloroethane	5E-01	mg/L	8.0E-03	mg/kg-day	--		--	4.1E-02	mg/kg-day	7.0E-01	mg/kg/day	5.8E-02
				1,1,2-Trichloroethane	7E-03	mg/L	1.1E-04	mg/kg-day	5.7E-02	(mg/kg-day)-1	6.5E-06	5.8E-04	mg/kg-day	4.0E-03	mg/kg/day	1.4E-01
				1,1-Dichloroethane	4E+00	mg/L	5.9E-02	mg/kg-day	--		--	3.0E-01	mg/kg-day	2.0E-01	mg/kg/day	1.5E+00
				1,1-Dichloroethene	1E-01	mg/L	2.1E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	5.0E-02	mg/kg/day	2.2E-01
				1,2,4-Trimethylbenzene	1E+00	mg/L	2.3E-02	mg/kg-day	--		--	1.2E-01	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	7.3E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	6.6E-05	3.7E-03	mg/kg-day	2.0E-01	mg/kg/day	1.8E-02
				1,2-Dichloroethene	1E-01	mg/L	2.1E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	9.0E-03	mg/kg/day	1.2E+00
				1,2-Dichloropropane	4E-03	mg/L	5.9E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	4.0E-06	3.0E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	2.0E-02	mg/kg-day	--		--	1.0E-01	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	4.9E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	5.4E-04	2.5E-01	mg/kg-day	1.0E-01	mg/kg/day	2.5E+00
				2-Butanone	8E+01	mg/L	1.3E+00	mg/kg-day	--		--	6.4E+00	mg/kg-day	6.0E-01	mg/kg/day	1.1E+01
				4-Methyl-2-pentanone	2E+02	mg/L	3.1E+00	mg/kg-day	--		--	1.6E+01	mg/kg-day	8.0E-02	mg/kg/day	2.0E+02
				Acetone	7E+01	mg/L	1.2E+00	mg/kg-day	--		--	6.1E+00	mg/kg-day	9.0E-01	mg/kg/day	6.7E+00
				Acrylonitrile	1E+00	mg/L	2.1E-02	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.2E-02	1.1E-01	mg/kg-day	1.0E-03	mg/kg/day	1.1E+02
				Benzene	5E-02	mg/L	7.4E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	4.1E-05	3.7E-03	mg/kg-day	4.0E-03	mg/kg/day	9.3E-01
				Carbon tetrachloride	5E-02	mg/L	8.5E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	1.1E-04	4.3E-03	mg/kg-day	7.0E-04	mg/kg/day	6.2E+00
				Chloroethane	3E+00	mg/L	4.1E-02	mg/kg-day	--		--	2.1E-01	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	9.3E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.9E-06	4.7E-04	mg/kg-day	1.0E-02	mg/kg/day	4.7E-02
				cis-1,2-Dichloroethene	2E-01	mg/L	3.6E-03	mg/kg-day	--		--	1.8E-02	mg/kg-day	1.0E-02	mg/kg/day	1.8E+00
				Ethylbenzene	8E+00	mg/L	1.4E-01	mg/kg-day	--		--	7.0E-01	mg/kg-day	1.0E-01	mg/kg/day	7.0E+00
				Ethyl methacrylate	4E+00	mg/L	6.6E-02	mg/kg-day	--		--	3.3E-01	mg/kg-day	9.0E-02	mg/kg/day	3.7E+00
				Isopropylbenzene	8E-02	mg/L	1.3E-03	mg/kg-day	--		--	6.8E-03	mg/kg-day	1.0E-01	mg/kg/day	6.8E-02
				Methylene Chloride	2E+00	mg/L	3.6E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	2.7E-04	1.8E-01	mg/kg-day	6.0E-02	mg/kg/day	3.0E+00
				n-Propylbenzene	9E-02	mg/L	1.5E-03	mg/kg-day	--		--	7.6E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	1.5E-03	mg/kg-day	--		--	7.5E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	1.6E-03	mg/kg-day	--		--	8.0E-03	mg/kg-day	1.0E-01	mg/kg/day	8.0E-02
				tert-Butylbenzene	7E-02	mg/L	1.1E-03	mg/kg-day	--		--	5.6E-03	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	9.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	5.3E-05	5.0E-04	mg/kg-day	1.0E-02	mg/kg/day	5.0E-02
				Tetrahydrofuran	2E+01	mg/L	3.3E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	--		--
				Toluene	8E+01	mg/L	1.3E+00	mg/kg-day	--		--	6.5E+00	mg/kg-day	8.0E-02	mg/kg/day	8.1E+01
				Trichloroethene	6E-03	mg/L	9.8E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	3.9E-05	5.0E-04	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	1.2E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.7E-03	5.9E-03	mg/kg-day	3.0E-03	mg/kg/day	2.0E+00
				Xylenes (total)	3E+01	mg/L	4.6E-01	mg/kg-day	--		--	2.3E+00	mg/kg-day	2.0E-01	mg/kg/day	1.2E+01
				Antimony	1E-01	mg/L	1.6E-03	mg/kg-day	--		--	8.3E-03	mg/kg-day	4.0E-04	mg/kg/day	2.1E+01
				Arsenic	2E+00	mg/L	3.8E-02	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.7E-02	1.9E-01	mg/kg-day	3.0E-04	mg/kg/day	6.4E+02
				Barium	4E-01	mg/L	6.1E-03	mg/kg-day	--		--	3.1E-02	mg/kg-day	2.0E-01	mg/kg/day	1.5E-01
				Beryllium	6E-01	mg/L	9.2E-03	mg/kg-day	--		--	4.7E-02	mg/kg-day	2.0E-03	mg/kg/day	2.3E+01
				Cadmium	6E-02	mg/L	9.8E-04	mg/kg-day	--		--	5.0E-03	mg/kg-day	5.0E-04	mg/kg/day	1.0E+01
				Chromium	3E-02	mg/L	4.9E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	5.0E-04	mg/kg/day	5.0E+00
				Cobalt	1E-01	mg/L	2.3E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	--		--
				Lead	6E-02	mg/L	9.8E-04	mg/kg-day	--		--	5.0E-03	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	4.8E-01	mg/kg-day	--		--	2.4E+00	mg/kg-day	4.7E-02	mg/kg/day	5.2E+01
				Nickel	8E-02	mg/L	1.3E-03	mg/kg-day	--		--	6.6E-03	mg/kg-day	2.0E-02	mg/kg/day	3.3E-01
				Silver	8E-01	mg/L	1.3E-02	mg/kg-day	--		--	6.6E-02	mg/kg-day	5.0E-03	mg/kg/day	1.3E+01
				Thallium	5E-03	mg/L	7.9E-05	mg/kg-day	--		--	4.0E-04	mg/kg-day	8.0E-05	mg/kg/day	5.0E+00
				Vanadium	1E-02	mg/L	1.6E-04	mg/kg-day	--		--	8.3E-04	mg/kg-day	9.0E-03	mg/kg/day	9.2E-02
				Zinc	6E+01	mg/L	9.0E-01	mg/kg-day	--		--	4.6E+00	mg/kg-day	3.0E-01	mg/kg/day	1.5E+01
			Exp. Route Total								7.2E-02					1.2E+03

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	2.9E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	6.9E-07	1.3E-04	mg/kg-day	9.0E-02	mg/kg-day	1.5E-03
				2,4-Dimethylphenol	2E-01	mg/L	3.6E-04	mg/kg-day	--		--	1.7E-03	mg/kg-day	2.0E-02	mg/kg-day	8.3E-02
				2-Methylphenol	1E+00	mg/L	1.7E-03	mg/kg-day	--		--	7.7E-03	mg/kg-day	5.0E-02	mg/kg-day	1.5E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	2.8E-03	mg/kg-day	--		--	1.3E-02	mg/kg-day	5.0E-02	mg/kg-day	2.6E-01
				4-Methylphenol	3E-01	mg/L	3.6E-04	mg/kg-day	--		--	1.7E-03	mg/kg-day	5.0E-02	mg/kg-day	3.3E-02
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg-day	0.0E+00
				Alpha-BHC	5E-05	mg/L	1.9E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.2E-06	8.8E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.2E-02	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.7E-04	5.6E-02	mg/kg-day	2.0E-02	mg/kg/day	2.8E+00
				Naphthalene	1E-02	mg/L	9.8E-05	mg/kg-day	--		--	4.5E-04	mg/kg-day	2.0E-02	mg/kg/day	2.3E-02
				Phenol	9E+00	mg/L	1.2E-02	mg/kg-day	--		--	5.3E-02	mg/kg-day	3.0E-01	mg/kg-day	1.8E-01
				1,1,1-Trichloroethane	5E-01	mg/L	1.3E-03	mg/kg-day	--		--	5.8E-03	mg/kg-day	7.0E-01	mg/kg/day	8.2E-03
				1,1,2-Trichloroethane	7E-03	mg/L	8.7E-06	mg/kg-day	5.7E-02	(mg/kg-day)-1	5.0E-07	4.0E-05	mg/kg-day	4.0E-03	mg/kg/day	1.0E-02
				1,1-Dichloroethane	4E+00	mg/L	3.8E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	2.0E-01	mg/kg/day	8.7E-02
				1,1-Dichloroethene	1E-01	mg/L	2.4E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	5.0E-02	mg/kg/day	2.2E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	3.9E-02	mg/kg-day	--		--	1.8E-01	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.9E-05	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.7E-06	1.3E-04	mg/kg-day	2.0E-01	mg/kg/day	6.7E-04
				1,2-Dichloroethene	1E-01	mg/L	1.5E-04	mg/kg-day	--		--	7.1E-04	mg/kg-day	9.0E-02	mg/kg/day	7.9E-02
				1,2-Dichloropropane	4E-03	mg/L	4.8E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.3E-07	2.2E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	1.9E-02	mg/kg-day	--		--	8.5E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.4E-04	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.6E-06	6.6E-04	mg/kg-day	1.0E-01	mg/kg/day	6.6E-03
				2-Butanone	8E+01	mg/L	1.1E-02	mg/kg-day	--		--	5.2E-02	mg/kg-day	6.0E-01	mg/kg/day	8.6E-02
				4-Methyl-2-pentanone	2E+02	mg/L	1.2E-01	mg/kg-day	--		--	5.5E-01	mg/kg-day	8.0E-02	mg/kg/day	6.9E+00
				Acetone	7E+01	mg/L	9.6E-03	mg/kg-day	--		--	4.4E-02	mg/kg-day	9.0E-01	mg/kg/day	4.9E-02
				Acrylonitrile	1E+00	mg/L	1.8E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	9.8E-05	8.3E-04	mg/kg-day	1.0E-03	mg/kg/day	8.3E-01
				Benzene	5E-02	mg/L	9.2E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	5.1E-06	4.2E-04	mg/kg-day	4.0E-03	mg/kg/day	1.1E-01
				Carbon tetrachloride	5E-02	mg/L	1.9E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	2.4E-05	8.6E-04	mg/kg-day	7.0E-04	mg/kg/day	1.2E+00
				Chloroethane	3E+00	mg/L	1.9E-03	mg/kg-day	--		--	8.7E-03	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	7.0E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.2E-07	3.2E-05	mg/kg-day	1.0E-02	mg/kg/day	3.2E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	2.6E-04	mg/kg-day	--		--	1.2E-03	mg/kg-day	1.0E-02	mg/kg/day	1.2E-01
				Ethylbenzene	8E+00	mg/L	6.8E-02	mg/kg-day	--		--	3.1E-01	mg/kg-day	1.0E-01	mg/kg/day	3.1E+00
				Ethyl methacrylate	4E+00	mg/L	9.3E-03	mg/kg-day	--		--	4.3E-02	mg/kg-day	9.0E-02	mg/kg/day	4.7E-01
				Isopropylbenzene	8E-02	mg/L	1.5E-03	mg/kg-day	--		--	6.7E-03	mg/kg-day	1.0E-01	mg/kg/day	6.7E-02
				Methylene Chloride	2E+00	mg/L	1.1E-03	mg/kg-day	7.5E-03	(mg/kg-day)-1	8.3E-06	5.1E-03	mg/kg-day	6.0E-02	mg/kg/day	8.5E-02
				n-Propylbenzene	9E-02	mg/L	2.2E-03	mg/kg-day	--		--	9.9E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	4.1E-03	mg/kg-day	--		--	1.9E-02	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	3.4E-03	mg/kg-day	--		--	1.6E-02	mg/kg-day	1.0E-01	mg/kg/day	1.6E-01
				tert-Butylbenzene	7E-02	mg/L	2.4E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	4.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.6E-05	2.2E-04	mg/kg-day	1.0E-02	mg/kg/day	2.2E-02
				Tetrahydrofuran	2E+01	mg/L	6.6E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.6E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	8.0E-02	mg/kg/day	2.1E+01
				Trichloroethene	6E-03	mg/L	1.4E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	5.6E-06	6.4E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	5.0E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.4E-05	2.3E-04	mg/kg-day	3.0E-03	mg/kg/day	7.6E-02
				Xylenes (total)	3E+01	mg/L	3.3E-01	mg/kg-day	--		--	1.5E+00	mg/kg-day	2.0E-01	mg/kg/day	7.5E+00
				Antimony	1E-01	mg/L	7.0E-06	mg/kg-day	--		--	4.2E-05	mg/kg-day	6.0E-05	mg/kg/day	7.0E-01
				Arsenic	2E+00	mg/L	1.6E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.4E-04	9.8E-04	mg/kg-day	3.0E-04	mg/kg/day	3.3E+00
				Barium	4E-01	mg/L	2.6E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	1.4E-02	mg/kg/day	1.1E-02
				Beryllium	8E-01	mg/L	3.9E-05	mg/kg-day	--		--	2.4E-04	mg/kg-day	1.4E-05	mg/kg/day	1.7E+01
				Cadmium	6E-02	mg/L	4.2E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	2.5E-05	mg/kg/day	1.0E+00
				Chromium	3E-02	mg/L	4.2E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	2.5E-05	mg/kg/day	1.0E+00
				Cobalt	1E-01	mg/L	3.9E-06	mg/kg-day	--		--	2.4E-05	mg/kg-day	--		--
				Lead	8E-02	mg/L	4.2E-07	mg/kg-day	--		--	2.5E-06	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	2.0E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	1.9E-03	mg/kg/day	6.5E+00
				Nickel	8E-02	mg/L	1.1E-06	mg/kg-day	--		--	6.8E-06	mg/kg-day	8.0E-04	mg/kg/day	8.4E-03
				Silver	8E-01	mg/L	3.4E-05	mg/kg-day	--		--	2.0E-04	mg/kg-day	2.0E-04	mg/kg/day	1.0E+00
				Thallium	5E-03	mg/L	3.4E-07	mg/kg-day	--		--	2.0E-06	mg/kg-day	8.0E-05	mg/kg/day	2.5E-02
				Vanadium	1E-02	mg/L	7.0E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	2.3E-04	mg/kg/day	1.8E-02
				Zinc	6E+01	mg/L	2.3E-03	mg/kg-day	--		--	1.4E-02	mg/kg-day	3.0E-01	mg/kg/day	4.6E-02
			Exp. Route Total								6.6E-04					7.6E+01

TABLE 3-33B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 3 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Shower Air	1,4-Dichlorobenzene	NC (4)		8.6E-04	(mg/m3)	--		--	3.1E-03	(mg/m3)	8.0E-01	(mg/m³)	3.9E-03
				2,4-Dimethylphenol	NC (4)		5.7E-04	(mg/m3)	--		--	2.1E-03	(mg/m3)	7.0E-02	(mg/m³)	2.9E-02
				2-Methylphenol	NC (4)		2.0E-03	(mg/m3)	--		--	7.3E-03	(mg/m3)	1.8E-01	(mg/m³)	4.2E-02
				3-Methylphenol/4-Methylphenol	NC (4)		3.6E-03	(mg/m3)	--		--	1.3E-02	(mg/m3)	1.8E-02	(mg/m³)	7.3E-01
				4-Methylphenol	NC (4)		4.6E-04	(mg/m3)	--		--	1.6E-03	(mg/m3)	1.8E-02	(mg/m³)	9.4E-02
				Aroclor 1254	NC (4)		NA	(mg/m3)	1.0E-01	(mg/m³)-¹	--	NA	(mg/m3)	7.0E-05	(mg/m³)	--
				Alpha-BHC	NC (4)		NA	(mg/m3)	1.8E+00	(mg/m³)-¹	--	NA	(mg/m2)	1.8E-03	(mg/m³)	--
				Bis(2-Ethylhexyl)phthalate	NC (4)		5.6E-05	(mg/m3)	2.4E-03	(mg/m³)-¹	1.3E-07	2.0E-04	(mg/m3)	7.0E-02	(mg/m³)	2.9E-03
				Naphthalene	NC (4)		2.4E-03	(mg/m2)	--		--	8.6E-03	(mg/m2)	3.0E-03	(mg/m³)	2.9E+00
				Phenol	NC (4)		6.8E-03	(mg/m3)	--		--	2.5E-02	(mg/m3)	2.0E-01	(mg/m³)	1.2E-01
				1,1,1-Trichloroethane	NC (4)		1.5E-01	(mg/m3)	--		--	5.2E-01	(mg/m3)	3.8E+00	(mg/m³)	1.4E-01
				1,1,2-Trichloroethane	NC (4)		1.7E-03	(mg/m3)	1.6E-02	(mg/m³)-¹	2.8E-05	6.2E-03	(mg/m3)	1.4E-02	(mg/m³)	4.4E-01
				1,1-Dichloroethane	NC (4)		1.2E+00	(mg/m3)	--		--	4.2E+00	(mg/m3)	5.0E-01	(mg/m³)	8.4E+00
				1,1-Dichloroethene	NC (4)		4.4E-02	(mg/m3)	--		--	1.6E-01	(mg/m3)	2.0E-01	(mg/m³)	7.9E-01
				1,2,4-Trimethylbenzene	NC (4)		4.2E-01	(mg/m3)	--		--	1.5E+00	(mg/m3)	--		--
				1,2-Dichloroethane	NC (4)		1.3E-02	(mg/m3)	2.6E-02	(mg/m³)-¹	3.3E-04	4.5E-02	(mg/m3)	2.4E+00	(mg/m³)	1.9E-02
				1,2-Dichloroethene	NC (4)		4.3E-02	(mg/m3)	--		--	1.6E-01	(mg/m3)	6.0E-02	(mg/m³)	2.6E-00
				1,2-Dichloropropane	NC (4)		1.1E-03	(mg/m3)	--		--	3.9E-03	(mg/m3)	4.0E-03	(mg/m³)	9.7E-01
				1,3,5-Trimethylbenzene	NC (4)		3.7E-01	(mg/m3)	--		--	1.3E+00	(mg/m3)	--		--
				1,4-Dioxane	NC (4)		2.7E-02	(mg/m3)	7.7E-03	(mg/m³)-¹	2.1E-04	9.8E-02	(mg/m3)	3.0E+00	(mg/m³)	3.3E-02
				2-Butanone	NC (4)		3.8E+00	(mg/m3)	--		--	1.4E+01	(mg/m3)	5.0E+00	(mg/m³)	2.8E+00
				4-Methyl-2-pentanone	NC (4)		2.7E+01	(mg/m3)	--		--	9.7E+01	(mg/m3)	3.0E+00	(mg/m³)	3.2E+01
				Acetone	NC (4)		5.4E+00	(mg/m3)	--		--	2.0E+01	(mg/m3)	3.2E+00	(mg/m³)	6.2E+00
				Acrylonitrile	NC (4)		1.9E-01	(mg/m3)	6.8E-02	(mg/m³)-¹	1.3E-02	6.7E-01	(mg/m3)	3.5E-03	(mg/m³)	1.9E+02
				Benzene	NC (4)		1.6E-02	(mg/m3)	7.8E-03	(mg/m³)-¹	1.2E-04	5.7E-02	(mg/m3)	3.0E-02	(mg/m³)	1.9E+00
				Carbon tetrachloride	NC (4)		1.5E-02	(mg/m3)	1.5E-02	(mg/m³)-¹	2.2E-04	5.3E-02	(mg/m3)	2.5E-03	(mg/m³)	2.2E+01
				Chloroethane	NC (4)		1.0E+00	(mg/m3)	--		--	3.8E+00	(mg/m3)	1.0E+01	(mg/m³)	3.8E-01
				Chloroform	NC (4)		1.7E-03	(mg/m3)	2.3E-02	(mg/m³)-¹	3.9E-05	6.1E-03	(mg/m3)	3.0E-01	(mg/m³)	2.0E-02
				cis-1,2-Dichloroethene	NC (4)		7.1E-02	(mg/m3)	--		--	2.6E-01	(mg/m3)	6.0E-02	(mg/m³)	4.3E+00
				Ethylbenzene	NC (4)		2.7E+00	(mg/m3)	--		--	9.7E+00	(mg/m3)	1.0E+00	(mg/m³)	9.7E-00
				Ethyl methacrylate	NC (4)		9.6E-01	(mg/m3)	--		--	3.4E+00	(mg/m3)	3.2E-01	(mg/m³)	1.1E+01
				Isopropylbenzene	NC (4)		2.6E-02	(mg/m3)	--		--	9.2E-02	(mg/m3)	4.0E-01	(mg/m³)	2.3E-01
				Methylene Chloride	NC (4)		7.2E-01	(mg/m3)	4.7E-04	(mg/m³)-¹	3.4E-04	2.6E+00	(mg/m3)	3.0E+00	(mg/m³)	8.6E-01
				n-Propylbenzene	NC (4)		6.8E-02	(mg/m3)	--		--	2.5E-01	(mg/m3)	1.4E-01	(mg/m³)	1.8E+00
				n-Butylbenzene	NC (4)		2.7E-02	(mg/m3)	--		--	9.5E-02	(mg/m3)	1.4E-01	(mg/m³)	6.8E-01
				p-Isopropyltoluene	NC (4)		2.8E-02	(mg/m3)	--		--	1.0E-01	(mg/m3)	4.0E-01	(mg/m³)	2.5E-01
				tert-Butylbenzene	NC (4)		2.0E-02	(mg/m3)	--		--	7.1E-02	(mg/m3)	1.4E-01	(mg/m³)	5.1E-01
				Tetrachloroethene	NC (4)		1.6E-03	(mg/m3)	5.9E-03	(mg/m³)-¹	9.7E-06	5.9E-03	(mg/m3)	3.5E-02	(mg/m³)	1.7E-01
				Tetrahydrofuran	NC (4)		7.4E+00	(mg/m3)	--		--	2.7E-01	(mg/m3)	3.0E-01	(mg/m³)	8.8E+01
				Toluene	NC (4)		2.6E-01	(mg/m3)	--		--	9.4E+01	(mg/m3)	5.0E+00	(mg/m³)	1.9E-01
				Trichloroethene	NC (4)		1.8E-03	(mg/m3)	2.0E-03	(mg/m³)-¹	3.6E-06	6.4E-03	(mg/m3)	6.0E-01	(mg/m³)	1.1E-02
				Vinyl chloride	NC (4)		2.8E-02	(mg/m3)	8.8E-03	(mg/m³)-¹	2.4E-04	1.0E-01	(mg/m3)	1.0E-01	(mg/m³)	1.0E-00
				Xylenes (total)	NC (4)		9.0E+00	(mg/m3)	--		--	3.2E+01	(mg/m3)	1.0E-01	(mg/m³)	3.2E+02
			Exp. Route Total								1.4E-02					7.3E+02
	Exposure Medium Total										8.6E-02					2.1E+02
Risk From Reference											0.0E+00					1.1E+02
Risk from Site											8.6E-02					2.0E+03
Total of Receptor Risks Across All Media											9E-02	Total of Receptor Hazards Across All Media				2093
Risks from Reference											1E-04					110
Risks from Site											9E-02					1983

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

(4) Shower model calculates an intake concentration.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene includes a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 33-N.

TABLE 3-33C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Upland Soil (0-10')	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	*		*		3.0E-05	1.0E-04	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	*		*		1.8E-04	6.3E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	4.5E-06	mg/kg-day	--		--	4.7E-05	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	*		*		1.3E-05	4.4E-05	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E-01	(mg/kg)	*		*		1.6E-06	5.6E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.3E-07	mg/kg-day	--		--	1.3E-06	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	5.8E-06	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.2E-07	6.0E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	9.9E-08	mg/kg-day	--		--	1.0E-06	mg/kg-day	7.0E-02	mg/kg/day	1.4E-05
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	*		*		3.0E-05	1.1E-05	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	5.4E-06	mg/kg-day	--		--	5.5E-05	mg/kg-day	2.0E-03	mg/kg/day	2.8E-02
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	*		*		6.6E-06	2.3E-05	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	3.2E-06	mg/kg-day	--		--	3.3E-05	mg/kg-day	4.0E-03	mg/kg/day	8.2E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	3.8E-06	mg/kg-day	--		--	3.9E-05	mg/kg-day	4.0E-03	mg/kg/day	9.8E-03
				Naphthalene	1.3E+01	(mg/kg)	3.5E-06	mg/kg-day	--		--	3.6E-05	mg/kg-day	2.0E-02	mg/kg/day	1.8E-03
				Perylene	--	(mg/kg)	--	mg/kg-day	--		--	--	mg/kg-day	--		--
				C11-C22 Aromatics	7.2E+01	(mg/kg)	1.9E-05	mg/kg-day	--		--	2.0E-04	mg/kg-day	3.0E-02	mg/kg/day	6.5E-03
				Arsenic	7.1E+00	(mg/kg)	1.9E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.8E-06	1.9E-05	mg/kg-day	3.0E-04	mg/kg/day	6.5E-02
				Lead	1.3E+02	(mg/kg)	3.6E-05	mg/kg-day	--		--	3.7E-04	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	4.5E-05	mg/kg-day	--		--	4.7E-04	mg/kg-day	1.4E-01	mg/kg/day	3.3E-03
				Vanadium	1.6E+01	(mg/kg)	4.2E-06	mg/kg-day	--		--	4.3E-05	mg/kg-day	9.0E-03	mg/kg/day	4.8E-03
			Exp. Route Total								2.6E-04					1.4E-01
			Dermal Contact	Benzo(a)anthracene	4E+01	(mg/kg)	*		*		2.1E-05	7.6E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2E+01	(mg/kg)	*		*		1.3E-04	4.6E-05	mg/kg-day	--		--
				Benzo(e)pyrene	2E+01	(mg/kg)	3.3E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	--		--
				Benzo(b)fluoranthene	2E+01	(mg/kg)	*		*		9.1E-06	3.2E-05	mg/kg-day	--		--
				Benzo(k)fluoranthene	2E+01	(mg/kg)	*		*		1.2E-06	4.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	5E-01	(mg/kg)	7.2E-08	mg/kg-day	--		--	7.5E-07	mg/kg-day	--		--
				Carbazole	2E+01	(mg/kg)	3.2E-06	mg/kg-day	2.0E-02	(mg/kg-day)-1	6.5E-08	3.4E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	4E-01	(mg/kg)	5.5E-08	mg/kg-day	--		--	5.7E-07	mg/kg-day	7.0E-02	mg/kg/day	8.1E-06
				Dibenzo(a,h)anthracene	4E+00	(mg/kg)	*		*		2.3E-05	7.7E-06	mg/kg-day	--		--
				Dibenzofuran	2E+01	(mg/kg)	3.0E-06	mg/kg-day	--		--	3.1E-05	mg/kg-day	2.0E-03	mg/kg/day	1.6E-02
				Indeno(1,2,3-cd)Pyrene	8E+00	(mg/kg)	*		*		4.8E-06	1.7E-05	mg/kg-day	--		--
				1-Methylnaphthalene	1E+01	(mg/kg)	2.3E-06	mg/kg-day	--		--	2.4E-05	mg/kg-day	4.0E-03	mg/kg/day	6.0E-03
				2-Methylnaphthalene	1E+01	(mg/kg)	2.8E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	4.0E-03	mg/kg/day	7.2E-03
				Naphthalene	1E+01	(mg/kg)	2.5E-06	mg/kg-day	--		--	2.6E-05	mg/kg-day	2.0E-02	mg/kg/day	1.3E-03
				Perylene	--	(mg/kg)	--	mg/kg-day	--		--	--	mg/kg-day	--		--
				C11-C22 Aromatics	7E+01	(mg/kg)	1.1E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	3.0E-02	mg/kg/day	3.7E-03
				Arsenic	7E+00	(mg/kg)	3.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.7E-07	3.3E-06	mg/kg-day	3.0E-04	mg/kg/day	1.1E-02
				Lead	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	2E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.9E-04					4.5E-02
		Exposure Point Total									4.5E-04					1.8E-01
	Exposure Medium Total										4.5E-04					1.8E-01
Risk From Reference											5.7E-05					7.9E-02
Risk from Site											3.9E-04					1.0E-01

TABLE 3-33C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
					Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		3.0E-07	1.1E-06	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		3.0E-06	1.1E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		3.8E-07	1.3E-06	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		2.6E-07	9.2E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	4.0E-08	mg/kg-day	--		--	4.1E-07	mg/kg-day	--		--
				Arsenic	1.5E+01	(mg/kg)	2.4E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.6E-06	2.5E-05	mg/kg-day	3.0E-04	mg/kg/day	8.2E-02
				Lead	6E+01	(mg/kg)	1.0E-05	mg/kg-day	--		--	1.0E-04	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	9.2E-05	mg/kg-day	--		--	9.5E-04	mg/kg-day	1.4E-01	mg/kg/day	6.8E-03
				Vanadium	1E+01	(mg/kg)	1.9E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	9.0E-03	mg/kg/day	2.2E-03
			Exp. Route Total								7.5E-06					9.1E-02
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		1.4E-07	4.1E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		1.4E-06	4.1E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		1.8E-07	5.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		1.3E-07	3.6E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	2.0E-08	mg/kg-day	--		--	1.6E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	2.8E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.2E-07	2.2E-06	mg/kg-day	3.0E-04	mg/kg/day	7.5E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.3E-06					7.5E-03
		Exposure Point Total									9.9E-06					9.9E-02
	Exposure Medium Total										9.9E-06					9.9E-02
Risk From Reference											4.0E-06					9.0E-02
Risk from Site											5.8E-06					9.0E-03
Medium Total											4.6E-04					2.8E-01
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	1.2E-07	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.3E-09	4.3E-07	mg/kg-day	1.0E-01	mg/kg/day	4.3E-06
				Methylene Chloride	5E-03	(mg/L)	1.3E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	9.9E-10	4.8E-07	mg/kg-day	6.0E-02	mg/kg/day	7.9E-06
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	6.1E-06	mg/kg-day	--		--	2.2E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	1.5E-06	mg/kg-day	--		--	5.3E-06	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	3.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.9E-07	1.2E-06	mg/kg-day	3.0E-04	mg/kg/day	3.9E-03
				Cadmium	7E-03	(mg/L)	3.1E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	2.5E-05	mg/kg/day	4.5E-03
				Lead	1E-02	(mg/L)	7.0E-09	mg/kg-day	--		--	2.5E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	2.7E-06	mg/kg-day	--		--	9.8E-06	mg/kg-day	1.9E-03	mg/kg/day	5.2E-03
				Vanadium	5E-03	(mg/L)	2.5E-08	mg/kg-day	--		--	9.2E-08	mg/kg-day	2.3E-04	mg/kg/day	3.9E-04
				Zinc	2E+00	(mg/L)	6.8E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	3.0E-01	mg/kg/day	8.2E-05
			Exp. Route Total								4.9E-07					1.4E-02
		Exposure Point Total									4.9E-07					1.4E-02
	Exposure Medium Total										4.9E-07					1.4E-02
Risk From Reference											0.0E+00					1.0E-02
Risk from Site											4.9E-07					3.9E-03
Medium Total											4.9E-07					1.4E-02

TABLE 3-33C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5-6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		2.5E-06	8.7E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	9.9E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.0E-09	1.0E-07	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	1.9E-06	mg/kg-day	--		--	1.9E-05	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	2.5E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.8E-05	2.6E-04	mg/kg-day	3.0E-04	mg/kg/day	8.7E-01
				Lead	2E+01	(mg/kg)	3.2E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	2.4E-05	mg/kg-day	--		--	2.4E-04	mg/kg-day	1.4E-01	mg/kg/day	1.7E-03
				Vanadium	9E+00	(mg/kg)	1.4E-06	mg/kg-day	--		--	1.4E-05	mg/kg-day	9.0E-03	mg/kg/day	1.6E-03
			Exp. Route Total								4.0E-05					8.7E-01
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		3.0E-06	8.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	7.4E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.1E-05	5.9E-05	mg/kg-day	3.0E-04	mg/kg/day	2.0E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.4E-05					2.0E-01
		Exposure Point Total									5.4E-05					1.1E+00
	Exposure Medium Total										5.4E-05					1.1E+00
Risk From Reference											5.4E-05					1.1E+00
Risk from Site											4.0E-09					0.0E+00
Medium Total											5.4E-05					1.1E+00
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	6.2E-05	mg/m^3	--		--	4.8E-04	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	2.0E-04	mg/m^3	--		--	1.6E-03	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	8.2E-05	mg/m^3	7.8E-03	(mg/kg-day)-1	6.4E-07	6.4E-04	mg/m^3	3.0E-02	mg/kg-day	2.1E-02
				Xylenes (total)	9E-02	(mg/m3)	1.9E-03	mg/m^3	--		--	1.5E-02	mg/m^3	1.0E-01	mg/kg-day	1.5E-01
			Exp. Route Total								6.4E-07					1.7E-01
		Exposure Point Total									6.4E-07					1.7E-01
	Exposure Medium Total										6.4E-07					1.7E-01
Risk From Reference																
Risk from Site											6.4E-07					1.7E-01
FUTURE SITE RESIDENTS ONLY																
Air	Indoor Air	Group 4	Inhalation	Tetrachloroethene	4E-06	mg/m3	5.0E-07	mg/m3	5.9E-03	(mg/m^3)-1	3.0E-09	3.9E-06	mg/m3	3.5E-02	(mg/m^3)	1.1E-04
				Trichloroethene	3E-06	mg/m3	3.5E-07	mg/m3	2.0E-03	(mg/m^3)-1	7.0E-10	2.7E-06	mg/m3	6.0E-01	(mg/m^3)	4.5E-06
			Exp. Route Total								3.7E-09					1.2E-04
	Exposure Medium Total										3.7E-09					1.2E-04
Risk From Reference																
Risk from Site											3.7E-09					1.2E-04
Medium Total											3.7E-09					1.2E-04

TABLE 3-33C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	1.6E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	3.7E-07	1.4E-04	mg/kg-day	9.0E-02	mg/kg-day	1.6E-03
				2,4-Dimethylphenol	2E-01	mg/L	8.8E-04	mg/kg-day	--		--	8.1E-03	mg/kg-day	2.0E-02	mg/kg-day	4.0E-01
				2-Methylphenol	1E+00	mg/L	4.9E-03	mg/kg-day	--		--	4.5E-02	mg/kg-day	5.0E-02	mg/kg-day	8.9E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	1.0E-02	mg/kg-day	--		--	9.4E-02	mg/kg-day	5.0E-02	mg/kg-day	1.9E+00
				4-Methylphenol	3E-01	mg/L	1.3E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	5.0E-02	mg/kg-day	2.4E-01
				Aroclor 1254	1E-03	mg/L	5.8E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.3E-06	5.4E-05	mg/kg-day	2.0E-05	mg/kg-day	2.7E+00
				Alpha-BHC	5E-05	mg/L	2.3E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.4E-06	2.1E-06	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	3.0E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	4.2E-05	2.7E-02	mg/kg-day	2.0E-02	mg/kg-day	1.4E+00
				Naphthalene	1E-02	mg/L	5.3E-05	mg/kg-day	--		--	4.9E-04	mg/kg-day	2.0E-02	mg/kg-day	2.5E-02
				Phenol	9E+00	mg/L	4.6E-02	mg/kg-day	--		--	4.2E-01	mg/kg-day	3.0E-01	mg/kg-day	1.4E+00
				1,1,1-Trichloroethane	5E-01	mg/L	2.4E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	7.0E-01	mg/kg-day	3.1E-02
				1,1,2-Trichloroethane	7E-03	mg/L	3.4E-05	mg/kg-day	5.7E-02	(mg/kg-day)-1	1.9E-06	3.1E-04	mg/kg-day	4.0E-03	mg/kg-day	7.7E-02
				1,1-Dichloroethane	4E+00	mg/L	1.8E-02	mg/kg-day	--		--	1.6E-01	mg/kg-day	2.0E-01	mg/kg-day	8.1E-01
				1,1-Dichloroethene	1E-01	mg/L	6.3E-04	mg/kg-day	--		--	5.8E-03	mg/kg-day	5.0E-02	mg/kg-day	1.2E-01
				1,2,4-Trimethylbenzene	1E+00	mg/L	6.8E-03	mg/kg-day	--		--	6.3E-02	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.2E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.0E-05	2.0E-03	mg/kg-day	2.0E-01	mg/kg-day	9.9E-03
				1,2-Dichloroethene	1E-01	mg/L	6.3E-04	mg/kg-day	--		--	5.8E-03	mg/kg-day	9.0E-03	mg/kg-day	6.5E-01
				1,2-Dichloropropane	4E-03	mg/L	1.8E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.2E-06	1.6E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	5.8E-03	mg/kg-day	--		--	5.4E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.5E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.6E-04	1.3E-01	mg/kg-day	1.0E-01	mg/kg-day	1.3E+00
				2-Butanone	8E+01	mg/L	3.7E-01	mg/kg-day	--		--	3.4E+00	mg/kg-day	6.0E-01	mg/kg-day	5.7E+00
				4-Methyl-2-pentanone	2E+02	mg/L	9.2E-01	mg/kg-day	--		--	8.5E+00	mg/kg-day	8.0E-02	mg/kg-day	1.1E+02
				Acetone	7E+01	mg/L	3.6E-01	mg/kg-day	--		--	3.3E+00	mg/kg-day	9.0E-01	mg/kg-day	3.6E+00
				Acrylonitrile	1E+00	mg/L	6.3E-03	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.4E-03	5.8E-02	mg/kg-day	1.0E-03	mg/kg-day	5.8E-01
				Benzene	5E-02	mg/L	2.2E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.2E-05	2.0E-03	mg/kg-day	4.0E-03	mg/kg-day	5.0E-01
				Carbon tetrachloride	5E-02	mg/L	2.5E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	3.3E-05	2.3E-03	mg/kg-day	7.0E-04	mg/kg-day	3.3E+00
				Chloroethane	3E+00	mg/L	1.2E-02	mg/kg-day	--		--	1.1E-01	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	2.8E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	8.6E-07	2.6E-04	mg/kg-day	1.0E-02	mg/kg-day	2.6E-02
				cis-1,2-Dichloroethene	2E-01	mg/L	1.1E-03	mg/kg-day	--		--	9.8E-03	mg/kg-day	1.0E-02	mg/kg-day	9.8E-01
				Ethylbenzene	8E+00	mg/L	4.1E-02	mg/kg-day	--		--	3.8E-01	mg/kg-day	1.0E-01	mg/kg-day	3.8E+00
				Ethyl methacrylate	4E+00	mg/L	1.9E-02	mg/kg-day	--		--	1.8E-01	mg/kg-day	9.0E-02	mg/kg-day	2.0E+00
				Isopropylbenzene	8E-02	mg/L	4.0E-04	mg/kg-day	--		--	3.7E-03	mg/kg-day	1.0E-01	mg/kg-day	3.7E-02
				Methylene Chloride	2E+00	mg/L	1.1E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	8.0E-05	9.8E-02	mg/kg-day	6.0E-02	mg/kg-day	1.6E+00
				n-Propylbenzene	9E-02	mg/L	4.5E-04	mg/kg-day	--		--	4.1E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	4.4E-04	mg/kg-day	--		--	4.0E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	4.7E-04	mg/kg-day	--		--	4.3E-03	mg/kg-day	1.0E-01	mg/kg-day	4.3E-02
				tert-Butylbenzene	7E-02	mg/L	3.2E-04	mg/kg-day	--		--	3.0E-03	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	2.9E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.6E-05	2.7E-04	mg/kg-day	1.0E-02	mg/kg-day	2.7E-02
				Tetrahydrofuran	2E+01	mg/L	9.7E-02	mg/kg-day	--		--	8.9E-01	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.8E-01	mg/kg-day	--		--	3.5E+00	mg/kg-day	8.0E-02	mg/kg-day	4.4E+01
				Trichloroethene	6E-03	mg/L	2.9E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.2E-05	2.7E-04	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	3.5E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.2E-04	3.2E-03	mg/kg-day	3.0E-03	mg/kg-day	1.1E+00
				Xylenes (total)	3E+01	mg/L	1.4E-01	mg/kg-day	--		--	1.3E+00	mg/kg-day	2.0E-01	mg/kg-day	6.3E+00
				Antimony	1E-01	mg/L	4.9E-04	mg/kg-day	--		--	4.5E-03	mg/kg-day	4.0E-04	mg/kg/day	1.1E+01
				Arsenic	2E+00	mg/L	1.1E-02	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.7E-02	1.0E-01	mg/kg-day	3.0E-04	mg/kg-day	3.5E+02
				Barium	4E-01	mg/L	1.8E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	2.0E-01	mg/kg-day	8.3E-02
				Beryllium	6E-01	mg/L	2.7E-03	mg/kg-day	--		--	2.5E-02	mg/kg-day	2.0E-03	mg/kg/day	1.3E+01
				Cadmium	6E-02	mg/L	2.9E-04	mg/kg-day	--		--	2.7E-03	mg/kg-day	5.0E-04	mg/kg/day	5.4E+00
				Chromium	3E-02	mg/L	1.5E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	5.0E-04	mg/kg/day	2.7E+00
				Cobalt	1E-01	mg/L	6.8E-04	mg/kg-day	--		--	6.3E-03	mg/kg-day	--		--
				Lead	6E-02	mg/L	2.9E-04	mg/kg-day	--		--	2.7E-03	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.4E-01	mg/kg-day	--		--	1.3E+00	mg/kg-day	4.7E-02	mg/kg-day	2.8E+01
				Nickel	8E-02	mg/L	3.9E-04	mg/kg-day	--		--	3.6E-03	mg/kg-day	2.0E-02	mg/kg/day	1.8E-01
				Silver	8E-01	mg/L	3.9E-03	mg/kg-day	--		--	3.6E-02	mg/kg-day	5.0E-03	mg/kg/day	7.2E+00
				Thallium	5E-03	mg/L	2.3E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	8.0E-05	mg/kg/day	2.7E+00
				Vanadium	1E-02	mg/L	4.9E-05	mg/kg-day	--		--	4.5E-04	mg/kg-day	9.0E-03	mg/kg/day	5.0E-02
				Zinc	6E+01	mg/L	2.7E-01	mg/kg-day	--		--	2.5E+00	mg/kg-day	3.0E-01	mg/kg/day	8.2E+00
			Exp. Route Total								2.1E-02					6.7E+02

TABLE 3-33C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	9.1E-06	mg/kg-day	2.4E-02	(mg/kg-day)-1	2.2E-07	7.6E-05	mg/kg-day	9.0E-02	mg/kg-day	8.4E-04
				2,4-Dimethylphenol	2E-01	mg/L	1.2E-04	mg/kg-day	--		--	9.6E-04	mg/kg-day	2.0E-02	mg/kg-day	4.8E-02
				2-Methylphenol	1E+00	mg/L	5.3E-04	mg/kg-day	--		--	4.4E-03	mg/kg-day	5.0E-02	mg/kg-day	8.9E-02
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	8.9E-04	mg/kg-day	--		--	7.4E-03	mg/kg-day	5.0E-02	mg/kg-day	1.5E-01
				4-Methylphenol	3E-01	mg/L	1.1E-04	mg/kg-day	--		--	9.5E-04	mg/kg-day	5.0E-02	mg/kg-day	1.9E-02
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg-day	0.0E+00
				Alpha-BHC	5E-05	mg/L	6.1E-08	mg/kg-day	6.3E+00	(mg/kg-day)-1	3.8E-07	5.0E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	3.9E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.4E-05	3.2E-02	mg/kg-day	2.0E-02	mg/kg-day	1.6E+00
				Naphthalene	1E-02	mg/L	3.1E-05	mg/kg-day	--		--	2.6E-04	mg/kg-day	2.0E-02	mg/kg-day	1.3E-02
				Phenol	9E+00	mg/L	3.7E-03	mg/kg-day	--		--	3.1E-02	mg/kg-day	3.0E-01	mg/kg-day	1.0E-01
				1,1,1-Trichloroethane	5E-01	mg/L	4.0E-04	mg/kg-day	--		--	3.3E-03	mg/kg-day	7.0E-01	mg/kg-day	4.7E-03
				1,1,2-Trichloroethane	7E-03	mg/L	2.8E-06	mg/kg-day	5.7E-02	(mg/kg-day)-1	1.6E-07	2.3E-05	mg/kg-day	4.0E-03	mg/kg-day	5.7E-03
				1,1-Dichloroethane	4E+00	mg/L	1.2E-03	mg/kg-day	--		--	1.0E-02	mg/kg-day	2.0E-01	mg/kg-day	5.0E-02
				1,1-Dichloroethene	1E-01	mg/L	7.7E-05	mg/kg-day	--		--	6.4E-04	mg/kg-day	5.0E-02	mg/kg-day	1.3E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	1.2E-02	mg/kg-day	--		--	1.0E-01	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	9.3E-06	mg/kg-day	9.1E-02	(mg/kg-day)-1	8.4E-07	7.7E-05	mg/kg-day	2.0E-01	mg/kg-day	3.9E-04
				1,2-Dichloroethene	1E-01	mg/L	4.9E-05	mg/kg-day	--		--	4.1E-04	mg/kg-day	9.0E-03	mg/kg-day	4.5E-02
				1,2-Dichloropropane	4E-03	mg/L	1.5E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.0E-07	1.3E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	5.9E-03	mg/kg-day	--		--	4.9E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	4.6E-05	mg/kg-day	1.1E-02	(mg/kg-day)-1	5.0E-07	3.8E-04	mg/kg-day	1.0E-01	mg/kg-day	3.8E-03
				2-Butanone	8E+01	mg/L	3.6E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	6.0E-01	mg/kg-day	5.0E-02
				4-Methyl-2-pentanone	2E+02	mg/L	3.8E-02	mg/kg-day	--		--	3.2E-01	mg/kg-day	8.0E-02	mg/kg-day	3.9E+00
				Acetone	7E+01	mg/L	3.1E-03	mg/kg-day	--		--	2.5E-02	mg/kg-day	9.0E-01	mg/kg-day	2.8E-02
				Acrylonitrile	1E+00	mg/L	5.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.1E-05	4.8E-04	mg/kg-day	1.0E-03	mg/kg-day	4.8E-01
				Benzene	5E-02	mg/L	2.9E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.6E-06	2.4E-04	mg/kg-day	4.0E-03	mg/kg-day	6.1E-02
				Carbon tetrachloride	5E-02	mg/L	5.9E-05	mg/kg-day	1.3E-01	(mg/kg-day)-1	7.7E-06	4.9E-04	mg/kg-day	7.0E-04	mg/kg/day	7.0E-01
				Chloroethane	3E+00	mg/L	6.0E-04	mg/kg-day	--		--	5.0E-03	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	2.2E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	6.9E-08	1.8E-05	mg/kg-day	1.0E-02	mg/kg/day	1.8E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	8.3E-05	mg/kg-day	--		--	6.9E-04	mg/kg-day	1.0E-02	mg/kg/day	6.9E-02
				Ethylbenzene	8E+00	mg/L	2.2E-02	mg/kg-day	--		--	1.8E-01	mg/kg-day	1.0E-01	mg/kg/day	1.8E+00
				Ethyl methacrylate	4E+00	mg/L	2.9E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	9.0E-02	mg/kg/day	2.7E-01
				Isopropylbenzene	8E-02	mg/L	4.6E-04	mg/kg-day	--		--	3.8E-03	mg/kg-day	1.0E-01	mg/kg/day	3.8E-02
				Methylene Chloride	2E+00	mg/L	3.5E-04	mg/kg-day	7.5E-03	(mg/kg-day)-1	2.6E-06	2.9E-03	mg/kg-day	6.0E-02	mg/kg/day	4.9E-02
				n-Propylbenzene	9E-02	mg/L	6.8E-04	mg/kg-day	--		--	5.7E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	1.3E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	1.1E-03	mg/kg-day	--		--	9.0E-03	mg/kg-day	1.0E-01	mg/kg/day	9.0E-02
				tert-Butylbenzene	7E-02	mg/L	7.5E-04	mg/kg-day	--		--	6.3E-03	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	1.5E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	8.2E-06	1.3E-04	mg/kg-day	1.0E-02	mg/kg/day	1.3E-02
				Tetrahydrofuran	2E+01	mg/L	2.1E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	--		--
				Toluene	8E+01	mg/L	1.2E-01	mg/kg-day	--		--	9.6E-01	mg/kg-day	8.0E-02	mg/kg/day	1.2E+01
				Trichloroethene	6E-03	mg/L	4.4E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.8E-06	3.7E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	1.6E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.4E-05	1.3E-04	mg/kg-day	3.0E-03	mg/kg/day	4.4E-02
				Xylenes (total)	3E+01	mg/L	1.0E-01	mg/kg-day	--		--	8.6E-01	mg/kg-day	2.0E-01	mg/kg/day	4.3E+00
				Antimony	1E-01	mg/L	1.7E-06	mg/kg-day	--		--	1.4E-05	mg/kg-day	6.0E-05	mg/kg/day	2.3E-01
				Arsenic	2E+00	mg/L	3.9E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.8E-05	3.2E-04	mg/kg-day	3.0E-04	mg/kg/day	1.1E+00
				Barium	4E-01	mg/L	6.2E-06	mg/kg-day	--		--	5.2E-05	mg/kg-day	1.4E-02	mg/kg/day	3.7E-03
				Beryllium	6E-01	mg/L	9.4E-06	mg/kg-day	--		--	7.8E-05	mg/kg-day	1.4E-05	mg/kg/day	5.6E+00
				Cadmium	6E-02	mg/L	1.0E-06	mg/kg-day	--		--	8.4E-06	mg/kg-day	2.5E-05	mg/kg/day	3.3E-01
				Chromium	3E-02	mg/L	1.0E-06	mg/kg-day	--		--	8.4E-06	mg/kg-day	2.5E-05	mg/kg/day	3.3E-01
				Cobalt	1E-01	mg/L	9.4E-07	mg/kg-day	--		--	7.8E-06	mg/kg-day	--		--
				Lead	6E-02	mg/L	1.0E-07	mg/kg-day	--		--	8.4E-07	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	4.9E-04	mg/kg-day	--		--	4.0E-03	mg/kg-day	1.9E-03	mg/kg/day	2.2E+00
				Nickel	8E-02	mg/L	2.7E-07	mg/kg-day	--		--	2.2E-06	mg/kg-day	8.0E-04	mg/kg/day	2.8E-03
				Silver	8E-01	mg/L	8.0E-06	mg/kg-day	--		--	6.7E-05	mg/kg-day	2.0E-04	mg/kg/day	3.3E-01
				Thallium	5E-03	mg/L	8.0E-08	mg/kg-day	--		--	6.7E-07	mg/kg-day	8.0E-05	mg/kg/day	8.4E-03
				Vanadium	1E-02	mg/L	1.7E-07	mg/kg-day	--		--	1.4E-06	mg/kg-day	2.5E-04	mg/kg/day	6.0E-03
				Zinc	6E+01	mg/L	5.5E-04	mg/kg-day	--		--	4.6E-03	mg/kg-day	3.0E-01	mg/kg/day	1.5E-02
			Exp. Route Total								1.9E-04					3.6E+01

TABLE 3-33C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD R/C		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Shower Air	1,4-Dichlorobenzene	NC (4)		3.1E-05	(mg/m3)	--		--	6.7E-04	(mg/m3)	8.0E-01	(mg/m³)	8.4E-04
				2,4-Dimethylphenol	NC (4)		2.0E-05	(mg/m3)	--		--	4.5E-04	(mg/m3)	7.0E-02	(mg/m³)	6.4E-03
				2-Methylphenol	NC (4)		2.0E-03	(mg/m3)	--		--	7.3E-03	(mg/m3)	1.8E-01	(mg/m³)	4.2E-02
				3-Methylphenol/4-Methylphenol	NC (4)		3.6E-03	(mg/m3)	--		--	1.3E-02	(mg/m3)	1.8E-02	(mg/m³)	7.3E-01
				4-Methylphenol	NC (4)		4.6E-04	(mg/m3)	--		--	1.6E-03	(mg/m3)	1.8E-02	(mg/m³)	9.4E-02
				Aroclor 1254	NC (4)		NA	(mg/m3)	1.0E-01	(mg/m³)-¹	--	NA	(mg/m3)	2.0E-05	(mg/m³)	--
				Alpha-BHC	NC (4)		NA	(mg/m3)	1.8E+00	(mg/m³)-¹	--	NA	(mg/m3)	1.8E-03	(mg/m³)	--
				Bis(2-Ethylhexyl)phthalate	NC (4)		2.0E-06	(mg/m3)	2.4E-03	(mg/m³)-¹	4.8E-09	4.4E-05	(mg/m3)	7.0E-02	(mg/m³)	6.2E-04
				Naphthalene	NC (4)		8.6E-05	(mg/m3)	--		--	1.9E-03	(mg/m3)	3.0E-03	(mg/m³)	6.3E-01
				Phenol	NC (4)		2.4E-04	(mg/m3)	--		--	5.3E-03	(mg/m3)	2.0E-01	(mg/m³)	2.7E-02
				1,1,1-Trichloroethane	NC (4)		5.2E-03	(mg/m3)	--		--	1.1E-01	(mg/m3)	3.8E+00	(mg/m³)	3.0E-02
				1,1,2-Trichloroethane	NC (4)		6.1E-05	(mg/m3)	1.6E-02	(mg/m³)-¹	9.8E-07	1.3E-03	(mg/m3)	1.4E-02	(mg/m³)	9.6E-02
				1,1-Dichloroethane	NC (4)		4.2E-02	(mg/m3)	--		--	9.1E-01	(mg/m3)	5.0E-01	(mg/m³)	1.8E+00
				1,1-Dichloroethene	NC (4)		1.6E-03	(mg/m3)	--		--	3.4E-02	(mg/m3)	2.0E-01	(mg/m³)	1.7E-01
				1,2,4-Trimethylbenzene	NC (4)		4.2E-01	(mg/m3)	--		--	1.5E+00	(mg/m3)	--		--
				1,2-Dichloroethane	NC (4)		4.5E-04	(mg/m3)	2.6E-02	(mg/m³)-¹	1.2E-05	9.8E-03	(mg/m3)	2.4E+00	(mg/m³)	4.0E-03
				1,2-Dichloroethene	NC (4)		1.5E-03	(mg/m3)	--		--	3.4E-02	(mg/m3)	6.0E-02	(mg/m³)	5.6E-01
				1,2-Dichloropropane	NC (4)		3.9E-05	(mg/m3)	--		--	8.4E-04	(mg/m3)	4.0E-03	(mg/m³)	2.1E-01
				1,3,5-Trimethylbenzene	NC (4)		3.7E-01	(mg/m3)	--		--	1.3E+00	(mg/m3)	--		--
				1,4-Dioxane	NC (4)		9.7E-04	(mg/m3)	7.7E-03	(mg/m³)-¹	7.5E-06	2.1E-02	(mg/m3)	3.0E+00	(mg/m³)	7.1E-03
				2-Butanone	NC (4)		1.4E-01	(mg/m3)	--		--	3.0E+00	(mg/m3)	5.0E+00	(mg/m³)	6.0E-01
				4-Methyl-2-pentanone	NC (4)		9.7E-01	(mg/m3)	--		--	2.1E+01	(mg/m3)	3.0E+00	(mg/m³)	7.0E+00
				Acetone	NC (4)		1.9E-01	(mg/m3)	--		--	4.2E+00	(mg/m3)	3.2E+00	(mg/m³)	1.3E+00
				Acrylonitrile	NC (4)		6.7E-03	(mg/m3)	6.8E-02	(mg/m³)-¹	4.5E-04	1.5E-01	(mg/m3)	3.5E-03	(mg/m³)	4.2E+01
				Benzene	NC (4)		5.7E-04	(mg/m3)	7.8E-03	(mg/m³)-¹	4.4E-06	1.2E-02	(mg/m3)	3.0E-02	(mg/m³)	4.2E-01
				Carbon tetrachloride	NC (4)		5.2E-04	(mg/m3)	1.5E-02	(mg/m³)-¹	7.9E-06	1.1E-02	(mg/m3)	2.5E-03	(mg/m³)	4.7E+00
				Chloroethane	NC (4)		1.0E+00	(mg/m3)	--		--	3.8E+00	(mg/m3)	1.0E+01	(mg/m³)	3.8E-01
				Chloroform	NC (4)		6.1E-05	(mg/m3)	2.3E-02	(mg/m³)-¹	1.4E-06	1.3E-03	(mg/m3)	3.0E-01	(mg/m³)	4.4E-03
				cis-1,2-Dichloroethene	NC (4)		2.5E-03	(mg/m3)	--		--	5.6E-02	(mg/m3)	6.0E-02	(mg/m³)	9.3E-01
				Ethylbenzene	NC (4)		9.6E-02	(mg/m3)	--		--	2.1E+00	(mg/m3)	1.0E+00	(mg/m³)	2.1E+00
				Ethyl methacrylate	NC (4)		3.4E-02	(mg/m3)	--		--	7.5E-01	(mg/m3)	3.2E-01	(mg/m³)	2.4E+00
				Isopropylbenzene	NC (4)		2.6E-02	(mg/m3)	--		--	9.2E-02	(mg/m3)	4.0E-01	(mg/m³)	2.3E-01
				Methylene Chloride	NC (4)		2.6E-02	(mg/m3)	4.7E-04	(mg/m³)-¹	1.2E-05	5.6E-01	(mg/m3)	3.0E+00	(mg/m³)	1.9E-01
				n-Propylbenzene	NC (4)		6.8E-02	(mg/m3)	--		--	2.5E-01	(mg/m3)	1.4E-01	(mg/m³)	1.8E+00
				n-Butylbenzene	NC (4)		2.7E-02	(mg/m3)	--		--	9.5E-02	(mg/m3)	1.4E-01	(mg/m³)	6.8E-01
				p-isopropyltoluene	NC (4)		1.0E-03	(mg/m3)	--		--	2.2E-02	(mg/m3)	4.0E-01	(mg/m³)	5.5E-02
				tert-Butylbenzene	NC (4)		2.0E-02	(mg/m3)	--		--	7.1E-02	(mg/m3)	1.4E-01	(mg/m³)	5.1E-01
				Tetrachloroethene	NC (4)		5.9E-05	(mg/m3)	5.9E-03	(mg/m³)-¹	3.5E-07	1.3E-03	(mg/m3)	3.5E-02	(mg/m³)	3.7E-02
				Tetrahydrofuran	NC (4)		7.4E-00	(mg/m3)	--		--	2.7E+01	(mg/m3)	3.0E-01	(mg/m³)	8.8E+01
				Toluene	NC (4)		9.4E-01	(mg/m3)	--		--	2.0E-01	(mg/m3)	5.0E+00	(mg/m³)	4.1E+00
				Trichloroethene	NC (4)		6.4E-05	(mg/m3)	2.0E-03	(mg/m³)-¹	1.3E-07	1.4E-03	(mg/m3)	6.0E-01	(mg/m³)	2.3E-03
				Vinyl chloride	NC (4)		9.9E-04	(mg/m3)	8.8E-03	(mg/m³)-¹	8.7E-06	2.2E-02	(mg/m3)	1.0E-01	(mg/m³)	2.2E-01
				Xylenes (total)	NC (4)		3.2E-01	(mg/m3)	--		--	7.0E+00	(mg/m3)	1.0E-01	(mg/m³)	7.0E+01
			Exp. Route Total								5.1E-04					2.3E+02
	Exposure Medium Total										2.2E-02					9.4E+02
Risk From Reference											0.0E+00					5.4E+01
Risk from Site											2.2E-02					8.9E+02
							Total of Receptor Risks Across All Media				2E-02	Total of Receptor Hazards Across All Media				9.4E+02
							Risks from Reference				1E-04					5.5E+01
							Risks from Site				2E-02					8.9E+02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene includes a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 33-M.

TABLE 3-33D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10')	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	*		*		6.2E-05	2.1E-04	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	*		*		3.7E-04	1.3E-04	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	1.1E-05	mg/kg-day	--		--	9.3E-05	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	*		*		2.6E-05	8.8E-05	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	*		*		3.3E-06	1.1E-04	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	3.2E-07	mg/kg-day	--		--	2.7E-06	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	1.5E-05	mg/kg-day	2.0E-02	(mg/kg-day)-1	2.9E-07	1.2E-04	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	2.5E-07	mg/kg-day	--		--	2.0E-06	mg/kg-day	7.0E-02	mg/kg/day	2.9E-05
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	*		*		6.3E-05	2.1E-05	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	1.4E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	2.0E-03	mg/kg/day	5.5E-02
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	*		*		1.4E-05	4.7E-05	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	8.1E-06	mg/kg-day	--		--	6.6E-05	mg/kg-day	4.0E-03	mg/kg/day	1.6E-02
				2-Methylnaphthalene	1.4E+01	(mg/kg)	9.6E-06	mg/kg-day	--		--	7.9E-05	mg/kg-day	4.0E-03	mg/kg/day	2.0E-02
				Naphthalene	1.3E+01	(mg/kg)	8.8E-06	mg/kg-day	--		--	7.2E-05	mg/kg-day	2.0E-02	mg/kg/day	3.6E-03
				C11-C22 Aromatics	7.2E+01	(mg/kg)	4.8E-05	mg/kg-day	--		--	3.9E-04	mg/kg-day	3.0E-02	mg/kg/day	1.3E-02
				Arsenic	7.1E+00	(mg/kg)	4.8E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.1E-06	3.9E-05	mg/kg-day	3.0E-04	mg/kg/day	1.3E-01
				Lead	1.3E+02	(mg/kg)	9.0E-05	mg/kg-day	--		--	7.3E-04	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	1.1E-04	mg/kg-day	--		--	9.3E-04	mg/kg-day	1.4E-01	mg/kg/day	6.7E-03
				Vanadium	1.6E+01	(mg/kg)	1.1E-05	mg/kg-day	--		--	8.7E-05	mg/kg-day	9.0E-03	mg/kg/day	9.6E-03
			Exp. Route Total								5.5E-04					2.7E-01
			Dermal Contact	Benzo(a)anthracene	4E+01	(mg/kg)	*		*		2.5E-05	7.6E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2E+01	(mg/kg)	*		*		1.5E-04	4.6E-05	mg/kg-day	--		--
				Benzo(e)pyrene	2E+01	(mg/kg)	4.7E-06	mg/kg-day	--		--	3.4E-05	mg/kg-day	--		--
				Benzo(b)fluoranthene	2E+01	(mg/kg)	*		*		1.1E-05	3.2E-05	mg/kg-day	--		--
				Benzo(k)fluoranthene	2E+01	(mg/kg)	*		*		1.3E-06	4.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	5E-01	(mg/kg)	1.0E-07	mg/kg-day	--		--	7.5E-07	mg/kg-day	--		--
				Carbazole	2E+01	(mg/kg)	4.6E-06	mg/kg-day	2.0E-02	(mg/kg-day)-1	9.3E-08	3.4E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	4E-01	(mg/kg)	7.8E-08	mg/kg-day	--		--	5.7E-07	mg/kg-day	7.0E-02	mg/kg/day	8.1E-06
				Dibenzo(a,h)anthracene	4E+00	(mg/kg)	*		*		2.5E-05	7.7E-06	mg/kg-day	--		--
				Dibenzofuran	2E+01	(mg/kg)	4.3E-06	mg/kg-day	--		--	3.1E-05	mg/kg-day	2.0E-03	mg/kg/day	1.6E-02
				Indeno(1,2,3-cd)Pyrene	8E+00	(mg/kg)	*		*		5.5E-06	1.7E-05	mg/kg-day	--		--
				1-Methylnaphthalene	1E+01	(mg/kg)	3.3E-06	mg/kg-day	--		--	2.4E-05	mg/kg-day	4.0E-03	mg/kg/day	6.0E-03
				2-Methylnaphthalene	1E+01	(mg/kg)	4.0E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	4.0E-03	mg/kg/day	7.2E-03
				Naphthalene	1E+01	(mg/kg)	3.6E-06	mg/kg-day	--		--	2.6E-05	mg/kg-day	2.0E-02	mg/kg/day	1.3E-03
				C11-C22 Aromatics	7E+01	(mg/kg)	1.5E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	3.0E-02	mg/kg/day	3.7E-03
				Arsenic	7E+00	(mg/kg)	4.5E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.8E-07	3.3E-06	mg/kg-day	3.0E-04	mg/kg/day	1.1E-02
				Lead	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	2E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.2E-04					4.5E-02
		Exposure Point Total									7.7E-04					3.2E-01
	Exposure Medium Total										7.7E-04					3.2E-01
Risk From Reference											9.7E-05					1.5E-01
Risk from Site											6.7E-04					1.7E-01

TABLE 3-33D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake Exposure Concentration		RfD R/C		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Wetland Soil	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		6.3E-07	2.1E-06	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		6.3E-06	2.1E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		7.8E-07	2.6E-06	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		5.5E-07	1.8E-06	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	1.0E-07	mg/kg-day	--		--	8.2E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	6.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.1E-06	4.9E-05	mg/kg-day	3.0E-04	mg/kg/day	1.6E-01
				Lead	6E+01	(mg/kg)	2.5E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	2.3E-04	mg/kg-day	--		--	1.9E-03	mg/kg-day	1.4E-01	mg/kg/day	1.4E-02
				Vanadium	1E+01	(mg/kg)	4.8E-06	mg/kg-day	--		--	3.9E-05	mg/kg-day	9.0E-03	mg/kg/day	4.4E-03
			Exp. Route Total								1.7E-05					1.8E-01
			Dermal Contact	Benzo(a)anthracene	6E-01	(mg/kg)	*		*		2.1E-07	4.1E-07	mg/kg-day	--		--
				Benzo(a)pyrene	6E-01	(mg/kg)	*		*		2.1E-06	4.1E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8E-01	(mg/kg)	*		*		2.6E-07	5.2E-07	mg/kg-day	--		--
				Indeno(1,2,3-cd)Pyrene	6E-01	(mg/kg)	*		*		1.8E-07	3.6E-07	mg/kg-day	--		--
				Perylene	3E-01	(mg/kg)	3.7E-08	mg/kg-day	--		--	1.6E-07	mg/kg-day	--		--
				Arsenic	2E+01	(mg/kg)	5.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.8E-07	2.2E-06	mg/kg-day	3.0E-04	mg/kg/day	7.4E-03
				Lead	6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	6E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								3.5E-06					7.4E-03
		Exposure Point Total									2.1E-05					1.9E-01
	Exposure Medium Total										2.1E-05					1.9E-01
Risk From Reference											9.8E-06					1.7E-01
Risk from Site											1.1E-05					1.8E-02
Medium Total											7.9E-04					5.1E-01
Surface Water	Surface Water	Group 5/6 Wetlands	Dermal Contact	1,4-Dioxane	5E-02	(mg/L)	2.3E-07	mg/kg-day	1.1E-02	(mg/kg-day)-1	2.6E-09	9.4E-07	mg/kg-day	1.0E-01	mg/kg/day	9.4E-06
				Methylene Chloride	5E-03	(mg/L)	2.6E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	1.9E-09	1.0E-06	mg/kg-day	6.0E-02	mg/kg/day	1.7E-05
				1,2,4-Trimethylbenzene	4E-03	(mg/L)	1.2E-05	mg/kg-day	--		--	4.7E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2E-03	(mg/L)	2.9E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	--		--
				Arsenic	7E-02	(mg/L)	6.3E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.5E-07	2.5E-06	mg/kg-day	3.0E-04	mg/kg/day	8.5E-03
				Cadmium	7E-03	(mg/L)	6.0E-08	mg/kg-day	--		--	2.4E-07	mg/kg-day	2.5E-05	mg/kg/day	9.7E-03
				Lead	1E-02	(mg/L)	1.4E-08	mg/kg-day	--		--	5.5E-08	mg/kg-day	NA (3)		--
				Manganese	6E-01	(mg/L)	5.3E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	1.9E-03	mg/kg/day	1.1E-02
				Vanadium	5E-03	(mg/L)	5.0E-08	mg/kg-day	--		--	2.0E-07	mg/kg-day	2.3E-04	mg/kg/day	8.5E-04
				Zinc	2E+00	(mg/L)	1.3E-05	mg/kg-day	--		--	5.3E-05	mg/kg-day	3.0E-01	mg/kg/day	1.8E-04
			Exp. Route Total								9.5E-07					3.1E-02
		Exposure Point Total									9.5E-07					3.1E-02
	Exposure Medium Total										9.5E-07					3.1E-02
Risk From Reference											0.0E+00					2.2E-02
Risk from Site											9.5E-07					8.5E-03

TABLE 3-33D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Group 5/6 Wetlands	Incidental Ingestion	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		5.2E-06	1.7E-06	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	2.5E-08	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.0E-08	2.0E-07	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	4.7E-06	mg/kg-day	--		--	3.8E-05	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	6.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.5E-05	5.2E-04	mg/kg-day	3.0E-04	mg/kg/day	1.7E+00
				Lead	2E+01	(mg/kg)	8.3E-06	mg/kg-day	--		--	6.8E-05	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	5.9E-05	mg/kg-day	--		--	4.8E-04	mg/kg-day	1.4E-01	mg/kg/day	3.5E-03
				Vanadium	9E+00	(mg/kg)	3.5E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	9.0E-03	mg/kg/day	3.2E-03
			Exp. Route Total								1.0E-04					1.7E+00
			Dermal Contact	Benzo(a)pyrene	5E-01	(mg/kg)	*		*		4.4E-06	8.5E-07	mg/kg-day	--		--
				Trichloroethene	6E-02	(mg/kg)	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Arsenic	2E+02	(mg/kg)	1.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.1E-05	5.9E-05	mg/kg-day	3.0E-04	mg/kg/day	2.0E-01
				Lead	2E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	9E+00	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.6E-05					2.0E-01
		Exposure Point Total									1.3E-04					1.9E+00
	Exposure Medium Total										1.3E-04					1.9E+00
Risk From Reference											1.3E-04					1.9E+00
Risk from Site											1.0E-08					0.0E+00
Medium Total											1.3E-04					1.9E+00
Air	Ambient Air	Site	Inhalation	1,2,4-Trimethylbenzene	3E-03	(mg/m3)	1.6E-04	mg/m^3	--		--	4.8E-04	mg/m^3	--		--
				1,3,5-Trimethylbenzene	1E-02	(mg/m3)	5.4E-04	mg/m^3	--		--	1.6E-03	mg/m^3	--		--
				Benzene	4E-03	(mg/m3)	2.2E-04	mg/m^3	7.8E-03	(mg/m^3)-1	1.7E-06	6.4E-04	mg/m^3	3.0E-02	mg/kg-day	2.1E-02
				Xylenes (total)	9E-02	(mg/m3)	5.0E-03	mg/m^3	--		--	1.5E-02	mg/m^3	1.0E-01	mg/kg/day	1.5E-01
			Exp. Route Total								1.7E-06					1.7E-01
		Exposure Point Total									1.7E-06					1.7E-01
	Exposure Medium Total										1.7E-06					1.7E-01
Risk From Reference																
Risk from Site											1.7E-06					1.7E-01
FUTURE SITE RESIDENTS ONLY																
Air	Indoor Air	Group 4	Inhalation	Tetrachloroethene	4E-06	mg/m2	1.3E-06	mg/m3	5.9E-03	(mg/m^3)-1	7.9E-09	3.9E-06	mg/m^3	3.5E-02	(mg/m^3)	1.1E-04
				Trichloroethene	3E-06	mg/m2	9.3E-07	mg/m3	2.0E-03	(mg/m^3)-1	1.9E-09	2.7E-06	mg/m^3	6.0E-01	(mg/m^3)	4.5E-06
			Exp. Route Total								9.8E-09					1.2E-04
	Exposure Medium Total										9.8E-09					1.2E-04
Risk From Reference																
Risk from Site											9.8E-09					1.2E-04
Medium Total											9.8E-09					1.2E-04

TABLE 3-33D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	5.2E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	1.3E-06	2.7E-04	mg/kg-day	9.0E-02	mg/kg/day	3.0E-03
				2,4-Dimethylphenol	2E-01	mg/L	3.0E-03	mg/kg-day	--		--	1.5E-02	mg/kg-day	2.0E-02	mg/kg-day	7.5E-01
				2-Methylphenol	1E+00	mg/L	1.6E-02	mg/kg-day	--		--	8.3E-02	mg/kg-day	5.0E-02	mg/kg-day	1.7E+00
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	3.4E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	5.0E-02	mg/kg-day	3.5E+00
				4-Methylphenol	3E-01	mg/L	4.4E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	5.0E-02	mg/kg-day	4.5E-01
				Aroclor 1254	1E-03	mg/L	2.0E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	7.9E-06	1.0E-04	mg/kg-day	2.0E-05	mg/kg/day	5.0E+00
				Alpha-BHC	5E-05	mg/L	7.7E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	4.9E-06	3.9E-06	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.0E-02	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.4E-04	5.1E-02	mg/kg-day	2.0E-02	mg/kg/day	2.5E+00
				Naphthalene	1E-02	mg/L	1.8E-04	mg/kg-day	--		--	9.1E-04	mg/kg-day	2.0E-02	mg/kg/day	4.6E-02
				Phenol	9E+00	mg/L	1.5E-01	mg/kg-day	--		--	7.8E-01	mg/kg-day	3.0E-01	mg/kg/day	2.6E+00
				1,1,1-Trichloroethane	5E-01	mg/L	8.0E-03	mg/kg-day	--		--	4.1E-02	mg/kg-day	7.0E-01	mg/kg/day	5.8E-02
				1,1,2-Trichloroethane	7E-03	mg/L	1.1E-04	mg/kg-day	5.7E-02	(mg/kg-day)-1	6.5E-06	5.8E-04	mg/kg-day	4.0E-03	mg/kg/day	1.4E-01
				1,1-Dichloroethane	4E+00	mg/L	5.9E-02	mg/kg-day	--		--	3.0E-01	mg/kg-day	2.0E-01	mg/kg/day	1.5E+00
				1,1-Dichloroethene	1E-01	mg/L	2.1E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	5.0E-02	mg/kg/day	2.2E-01
				1,2,4-Trimethylbenzene	1E+00	mg/L	2.3E-02	mg/kg-day	--		--	1.2E-01	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	7.3E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	6.6E-05	3.7E-03	mg/kg-day	2.0E-01	mg/kg/day	1.8E-02
				1,2-Dichloroethene	1E-01	mg/L	2.1E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	9.0E-03	mg/kg/day	1.2E+00
				1,2-Dichloropropane	4E-03	mg/L	5.9E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	4.0E-06	3.0E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	2.0E-02	mg/kg-day	--		--	1.0E-01	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	4.9E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	5.4E-04	2.5E-01	mg/kg-day	1.0E-01	mg/kg/day	2.5E+00
				2-Butanone	8E+01	mg/L	1.3E+00	mg/kg-day	--		--	6.4E+00	mg/kg-day	6.0E-01	mg/kg/day	1.1E+01
				4-Methyl-2-pentanone	2E+02	mg/L	3.1E+00	mg/kg-day	--		--	1.6E+01	mg/kg-day	8.0E-02	mg/kg/day	2.0E+02
				Acetone	7E+01	mg/L	1.2E+00	mg/kg-day	--		--	6.1E+00	mg/kg-day	9.0E-01	mg/kg/day	6.7E+00
				Acrylonitrile	1E+00	mg/L	2.1E-02	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.2E-02	1.1E-01	mg/kg-day	1.0E-03	mg/kg/day	1.1E+02
				Benzene	5E-02	mg/L	7.4E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	4.1E-05	3.7E-02	mg/kg-day	4.0E-03	mg/kg/day	9.3E-01
				Carbon tetrachloride	5E-02	mg/L	8.5E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	1.1E-04	4.3E-03	mg/kg-day	7.0E-04	mg/kg/day	6.2E+00
				Chloroethane	3E+00	mg/L	4.1E-02	mg/kg-day	--		--	2.1E-01	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	9.2E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.9E-06	4.7E-04	mg/kg-day	1.0E-02	mg/kg/day	4.7E-02
				cis-1,2-Dichloroethene	2E-01	mg/L	3.6E-03	mg/kg-day	--		--	1.8E-02	mg/kg-day	1.0E-02	mg/kg/day	1.8E+00
				Ethylbenzene	8E+00	mg/L	1.4E-01	mg/kg-day	--		--	7.0E-01	mg/kg-day	1.0E-01	mg/kg/day	7.0E+00
				Ethyl methacrylate	4E+00	mg/L	6.6E-02	mg/kg-day	--		--	3.3E-01	mg/kg-day	9.0E-02	mg/kg/day	3.7E+00
				Isopropylbenzene	8E-02	mg/L	1.3E-03	mg/kg-day	--		--	6.8E-03	mg/kg-day	1.0E-01	mg/kg/day	6.8E-02
				Methylene Chloride	2E+00	mg/L	3.6E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	2.7E-04	1.8E-01	mg/kg-day	6.0E-02	mg/kg/day	3.0E+00
				n-Propylbenzene	9E-02	mg/L	1.5E-03	mg/kg-day	--		--	7.6E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	1.5E-03	mg/kg-day	--		--	7.5E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	1.6E-03	mg/kg-day	--		--	8.0E-03	mg/kg-day	1.0E-01	mg/kg/day	8.0E-02
				tert-Butylbenzene	7E-02	mg/L	1.1E-03	mg/kg-day	--		--	5.6E-03	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	9.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	5.3E-05	5.0E-04	mg/kg-day	1.0E-02	mg/kg/day	5.0E-02
				Tetrahydrofuran	2E+01	mg/L	3.3E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	--		--
				Toluene	8E+01	mg/L	1.3E+00	mg/kg-day	--		--	6.5E+00	mg/kg-day	8.0E-02	mg/kg/day	8.1E-01
				Trichloroethene	6E-03	mg/L	9.8E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	3.9E-05	5.0E-04	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	1.2E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.7E-03	5.9E-03	mg/kg-day	3.0E-03	mg/kg/day	2.0E+00
				Xylenes (total)	3E+01	mg/L	4.6E-01	mg/kg-day	--		--	2.3E+00	mg/kg-day	2.0E-01	mg/kg/day	1.2E+01
				Antimony	1E-01	mg/L	1.6E-03	mg/kg-day	--		--	8.3E-03	mg/kg-day	4.0E-04	mg/kg/day	2.1E+01
				Arsenic	2E+00	mg/L	3.8E-02	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.7E-02	1.9E-01	mg/kg-day	3.0E-04	mg/kg/day	6.4E+02
				Barium	4E-01	mg/L	6.1E-03	mg/kg-day	--		--	3.1E-02	mg/kg-day	2.0E-01	mg/kg/day	1.5E-01
				Beryllium	6E-01	mg/L	9.2E-03	mg/kg-day	--		--	4.7E-02	mg/kg-day	2.0E-03	mg/kg/day	2.3E+01
				Cadmium	6E-02	mg/L	9.8E-04	mg/kg-day	--		--	5.0E-03	mg/kg-day	5.0E-04	mg/kg/day	1.0E+01
				Chromium	3E-02	mg/L	4.9E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	5.0E-04	mg/kg/day	5.0E+00
				Cobalt	1E-01	mg/L	2.3E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	--		--
				Lead	6E-02	mg/L	9.8E-04	mg/kg-day	--		--	5.0E-03	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	4.8E-01	mg/kg-day	--		--	2.4E+00	mg/kg-day	4.7E-02	mg/kg/day	5.2E+01
				Nickel	8E-02	mg/L	1.3E-03	mg/kg-day	--		--	6.6E-03	mg/kg-day	2.0E-02	mg/kg/day	3.3E-01
				Silver	8E-01	mg/L	1.3E-02	mg/kg-day	--		--	6.6E-02	mg/kg-day	5.0E-03	mg/kg/day	1.3E+01
				Thallium	5E-03	mg/L	7.9E-05	mg/kg-day	--		--	4.0E-04	mg/kg-day	8.0E-05	mg/kg/day	5.0E+00
				Vanadium	1E-02	mg/L	1.6E-04	mg/kg-day	--		--	8.3E-04	mg/kg-day	9.0E-03	mg/kg/day	9.2E-02
				Zinc	6E+01	mg/L	9.0E-01	mg/kg-day	--		--	4.6E+00	mg/kg-day	3.0E-01	mg/kg/day	1.5E+01
			Exp. Route Total								7.2E-02					1.2E+03

TABLE 3-33D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	2.9E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	6.9E-07	1.3E-04	mg/kg-day	9.0E-02	mg/kg/day	1.5E-03
				2,4-Dimethylphenol	2E-01	mg/L	3.6E-04	mg/kg-day	--		--	1.7E-03	mg/kg-day	2.0E-02	mg/kg/day	8.3E-02
				2-Methylphenol	1E+00	mg/L	1.7E-03	mg/kg-day	--		--	7.7E-03	mg/kg-day	5.0E-02	mg/kg/day	1.5E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	2.8E-03	mg/kg-day	--		--	1.3E-02	mg/kg-day	5.0E-02	mg/kg/day	2.6E-01
				4-Methylphenol	3E-01	mg/L	3.6E-04	mg/kg-day	--		--	1.7E-03	mg/kg-day	5.0E-02	mg/kg/day	3.3E-02
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Alpha-BHC	5E-05	mg/L	1.9E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.2E-06	8.8E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.2E-02	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.7E-04	5.6E-02	mg/kg-day	2.0E-02	mg/kg/day	2.8E+00
				Naphthalene	1E-02	mg/L	9.8E-05	mg/kg-day	--		--	4.5E-04	mg/kg-day	2.0E-02	mg/kg/day	2.3E-02
				Phenol	9E+00	mg/L	1.2E-02	mg/kg-day	--		--	5.3E-02	mg/kg-day	3.0E-01	mg/kg/day	1.8E-01
				1,1,1-Trichloroethane	5E-01	mg/L	1.3E-03	mg/kg-day	--		--	5.8E-03	mg/kg-day	7.0E-01	mg/kg/day	8.3E-03
				1,1,2-Trichloroethane	7E-03	mg/L	8.7E-06	mg/kg-day	5.7E-02	(mg/kg-day)-1	5.0E-07	4.0E-05	mg/kg-day	4.0E-03	mg/kg/day	1.0E-02
				1,1-Dichloroethane	4E+00	mg/L	3.8E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	2.0E-01	mg/kg/day	8.7E-02
				1,1-Dichloroethene	1E-01	mg/L	2.4E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	5.0E-02	mg/kg/day	2.2E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	3.9E-02	mg/kg-day	--		--	1.8E-01	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.9E-05	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.7E-06	1.3E-04	mg/kg-day	2.0E-01	mg/kg/day	6.7E-04
				1,2-Dichloroethene	1E-01	mg/L	1.5E-04	mg/kg-day	--		--	7.1E-04	mg/kg-day	9.0E-03	mg/kg/day	7.9E-02
				1,2-Dichloropropane	4E-03	mg/L	4.8E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.3E-07	2.2E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	1.9E-02	mg/kg-day	--		--	8.5E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.4E-04	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.6E-06	6.6E-04	mg/kg-day	1.0E-01	mg/kg/day	6.6E-03
				2-Butanone	8E+01	mg/L	1.1E-02	mg/kg-day	--		--	5.2E-02	mg/kg-day	6.0E-01	mg/kg/day	8.6E-02
				4-Methyl-2-pentanone	2E+02	mg/L	1.2E-01	mg/kg-day	--		--	5.5E-01	mg/kg-day	8.0E-02	mg/kg/day	6.9E+00
				Acetone	7E+01	mg/L	9.6E-03	mg/kg-day	--		--	4.4E-02	mg/kg-day	9.0E-01	mg/kg/day	4.9E-02
				Acrylonitrile	1E+00	mg/L	1.8E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	9.8E-05	8.3E-04	mg/kg-day	1.0E-03	mg/kg/day	8.3E-01
				Benzene	5E-02	mg/L	9.2E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	5.1E-06	4.2E-04	mg/kg-day	4.0E-03	mg/kg/day	1.1E-01
				Carbon tetrachloride	5E-02	mg/L	1.9E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	2.4E-05	8.6E-04	mg/kg-day	7.0E-04	mg/kg/day	1.2E+00
				Chloroethane	3E+00	mg/L	1.9E-03	mg/kg-day	--		--	8.7E-03	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	7.0E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.2E-07	3.2E-05	mg/kg-day	1.0E-02	mg/kg/day	3.2E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	2.6E-04	mg/kg-day	--		--	1.2E-03	mg/kg-day	1.0E-02	mg/kg/day	1.2E-01
				Ethylbenzene	8E+00	mg/L	6.8E-02	mg/kg-day	--		--	3.1E-01	mg/kg-day	1.0E-01	mg/kg/day	3.1E+00
				Ethyl methacrylate	4E+00	mg/L	9.3E-03	mg/kg-day	--		--	4.3E-02	mg/kg-day	9.0E-02	mg/kg/day	4.7E-01
				Isopropylbenzene	8E-02	mg/L	1.5E-03	mg/kg-day	--		--	6.7E-03	mg/kg-day	1.0E-01	mg/kg/day	6.7E-02
				Methylene Chloride	2E+00	mg/L	1.1E-03	mg/kg-day	7.5E-03	(mg/kg-day)-1	8.3E-06	5.1E-03	mg/kg-day	6.0E-02	mg/kg/day	8.5E-02
				n-Propylbenzene	9E-02	mg/L	2.2E-03	mg/kg-day	--		--	9.9E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	4.1E-03	mg/kg-day	--		--	1.9E-02	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	3.4E-03	mg/kg-day	--		--	1.6E-02	mg/kg-day	1.0E-01	mg/kg/day	1.6E-01
				tert-Butylbenzene	7E-02	mg/L	2.4E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	4.8E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.6E-05	2.2E-04	mg/kg-day	1.0E-02	mg/kg/day	2.2E-02
				Tetrahydrofuran	2E+01	mg/L	6.6E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.6E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	8.0E-02	mg/kg/day	2.1E+01
				Trichloroethene	6E-03	mg/L	1.4E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	5.6E-06	6.4E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	5.0E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.4E-05	2.3E-04	mg/kg-day	3.0E-03	mg/kg/day	7.6E-02
				Xylenes (total)	3E+01	mg/L	3.3E-01	mg/kg-day	--		--	1.5E+00	mg/kg-day	2.0E-01	mg/kg/day	7.5E+00
				Antimony	3E-01	mg/L	7.0E-06	mg/kg-day	--		--	4.2E-05	mg/kg-day	6.0E-05	mg/kg/day	7.0E-01
				Arsenic	2E+00	mg/L	1.6E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.4E-04	9.8E-04	mg/kg-day	3.0E-04	mg/kg/day	3.3E+00
				Barium	4E-01	mg/L	2.6E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	1.4E-02	mg/kg/day	1.1E-02
				Beryllium	6E-01	mg/L	3.9E-05	mg/kg-day	--		--	2.4E-04	mg/kg-day	1.4E-05	mg/kg/day	1.7E+01
				Cadmium	6E-02	mg/L	4.2E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	2.5E-05	mg/kg/day	1.0E+00
				Chromium	3E-02	mg/L	4.2E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	2.5E-05	mg/kg/day	1.0E+00
				Cobalt	1E-01	mg/L	3.9E-06	mg/kg-day	--		--	2.4E-05	mg/kg-day	--		--
				Lead	6E-02	mg/L	4.2E-07	mg/kg-day	--		--	2.5E-06	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	2.0E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	1.9E-03	mg/kg/day	6.5E+00
				Nickel	8E-02	mg/L	1.1E-06	mg/kg-day	--		--	6.8E-06	mg/kg-day	8.0E-04	mg/kg/day	8.4E-03
				Silver	8E-01	mg/L	3.4E-05	mg/kg-day	--		--	2.0E-04	mg/kg-day	2.0E-04	mg/kg/day	1.0E+00
				Thallium	5E-03	mg/L	3.4E-07	mg/kg-day	--		--	2.0E-06	mg/kg-day	8.0E-05	mg/kg/day	2.5E-02
				Vanadium	1E-02	mg/L	7.0E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	2.3E-04	mg/kg/day	1.8E-02
				Zinc	6E+01	mg/L	2.3E-03	mg/kg-day	--		--	1.4E-02	mg/kg-day	3.0E-01	mg/kg/day	4.6E-02
			Exp. Route Total								6.6E-04					7.6E+01

TABLE 3-33D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 4 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Shower Air	1,4-Dichlorobenzene	NC (4)		8.6E-04	(mg/m3)	--		--	3.1E-03	(mg/m3)	8.0E-01	(mg/m³)	3.9E-03
				2,4-Dimethylphenol	NC (4)		5.7E-04	(mg/m3)	--		--	2.1E-03	(mg/m3)	7.0E-02	(mg/m³)	2.9E-02
				2-Methylphenol	NC (4)		2.0E-03	(mg/m3)	--		--	7.3E-03	(mg/m3)	1.8E-01	(mg/m³)	4.2E-02
				3-Methylphenol/4-Methylphenol	NC (4)		3.6E-03	(mg/m3)	--		--	1.3E-02	(mg/m3)	1.8E-02	(mg/m³)	7.3E-01
				4-Methylphenol	NC (4)		4.6E-04	(mg/m3)	--		--	1.6E-03	(mg/m3)	1.8E-02	(mg/m³)	9.4E-02
				Aroclor 1254	NC (4)		NA	(mg/m3)	1.0E-01	(mg/m³)-¹	--	NA	(mg/m3)	7.0E-05	(mg/m³)	--
				Alpha-BHC	NC (4)		NA	(mg/m3)	1.8E+00	(mg/m³)-¹	--	NA	(mg/m3)	1.8E-03	(mg/m³)	--
				Bis(2-Ethylhexyl)phthalate	NC (4)		5.6E-05	(mg/m3)	2.4E-03	(mg/m³)-¹	1.3E-07	2.0E-04	(mg/m3)	7.0E-02	(mg/m³)	2.9E-03
				Naphthalene	NC (4)		2.4E-03	(mg/m3)	--		--	8.6E-03	(mg/m3)	3.0E-03	(mg/m³)	2.9E+00
				Phenol	NC (4)		6.8E-02	(mg/m3)	--		--	2.5E-02	(mg/m3)	2.0E-01	(mg/m³)	1.2E-01
				1,1,1-Trichloroethane	NC (4)		1.5E-01	(mg/m3)	--		--	5.2E-01	(mg/m3)	3.8E+00	(mg/m³)	1.4E-01
				1,1,2-Trichloroethane	NC (4)		1.7E-03	(mg/m3)	1.6E-02	(mg/m³)-¹	2.8E-05	6.2E-03	(mg/m3)	1.4E-02	(mg/m³)	4.4E-01
				1,1-Dichloroethane	NC (4)		1.2E+00	(mg/m3)	--		--	4.2E+00	(mg/m3)	5.0E-01	(mg/m³)	8.4E+00
				1,1-Dichloroethene	NC (4)		4.4E-02	(mg/m3)	--		--	1.6E-01	(mg/m3)	2.0E-01	(mg/m³)	7.9E-01
				1,2,4-Trimethylbenzene	NC (4)		4.2E-01	(mg/m3)	--		--	1.5E+00	(mg/m3)	--		--
				1,2-Dichloroethane	NC (4)		1.3E-02	(mg/m3)	2.6E-02	(mg/m³)-¹	3.3E-04	4.5E-02	(mg/m3)	2.4E+00	(mg/m³)	1.9E-02
				1,2-Dichloroethene	NC (4)		4.3E-02	(mg/m3)	--		--	1.6E-01	(mg/m3)	6.0E-02	(mg/m³)	2.6E+00
				1,2-Dichloropropane	NC (4)		1.1E-03	(mg/m3)	--		--	3.9E-03	(mg/m3)	4.0E-03	(mg/m³)	9.7E-01
				1,3,5-Trimethylbenzene	NC (4)		3.7E-01	(mg/m3)	--		--	1.3E+00	(mg/m3)	--		--
				1,4-Dioxane	NC (4)		2.7E-02	(mg/m3)	7.7E-03	(mg/m³)-¹	2.1E-04	9.8E-02	(mg/m3)	3.0E+00	(mg/m³)	3.3E-02
				2-Butanone	NC (4)		3.8E+00	(mg/m3)	--		--	1.4E+01	(mg/m3)	5.0E+00	(mg/m³)	2.8E+00
				4-Methyl-2-pentanone	NC (4)		2.7E+01	(mg/m3)	--		--	9.7E+01	(mg/m3)	3.0E+00	(mg/m³)	3.2E+01
				Acetone	NC (4)		5.4E+00	(mg/m3)	--		--	2.0E+01	(mg/m3)	3.2E+00	(mg/m³)	6.2E+00
				Acrylonitrile	NC (4)		1.9E-01	(mg/m3)	6.8E-02	(mg/m³)-¹	1.3E-02	6.7E-01	(mg/m3)	3.5E-03	(mg/m³)	1.9E+02
				Benzene	NC (4)		1.6E-02	(mg/m3)	7.8E-03	(mg/m³)-¹	1.2E-04	5.7E-02	(mg/m3)	3.0E-02	(mg/m³)	1.9E+00
				Carbon tetrachloride	NC (4)		1.5E-02	(mg/m3)	1.5E-02	(mg/m³)-¹	2.2E-04	5.3E-02	(mg/m3)	2.5E-03	(mg/m³)	2.2E-01
				Chloroethane	NC (4)		1.0E+00	(mg/m3)	--		--	3.8E+00	(mg/m3)	1.0E-01	(mg/m³)	3.8E-01
				Chloroform	NC (4)		1.7E-03	(mg/m3)	2.3E-02	(mg/m³)-¹	3.9E-05	6.1E-03	(mg/m3)	3.0E-01	(mg/m³)	2.0E-02
				cis-1,2-Dichloroethene	NC (4)		7.1E-02	(mg/m3)	--		--	2.6E-01	(mg/m3)	6.0E-02	(mg/m³)	4.3E+00
				Ethylbenzene	NC (4)		2.7E+00	(mg/m3)	--		--	9.7E+00	(mg/m3)	1.0E+00	(mg/m³)	9.7E+00
				Ethyl methacrylate	NC (4)		9.6E-01	(mg/m3)	--		--	3.4E+00	(mg/m3)	3.2E-01	(mg/m³)	1.1E+01
				Isopropylbenzene	NC (4)		2.6E-02	(mg/m3)	--		--	9.2E-02	(mg/m3)	4.0E-01	(mg/m³)	2.3E-01
				Methylene Chloride	NC (4)		7.2E-01	(mg/m3)	4.7E-04	(mg/m³)-¹	3.4E-04	2.6E+00	(mg/m3)	3.0E+00	(mg/m³)	8.6E-01
				n-Propylbenzene	NC (4)		6.8E-02	(mg/m3)	--		--	2.5E-01	(mg/m3)	1.4E-01	(mg/m³)	1.8E+00
				n-Butylbenzene	NC (4)		2.7E-02	(mg/m3)	--		--	9.5E-02	(mg/m3)	1.4E-01	(mg/m³)	6.8E-01
				p-Isopropyltoluene	NC (4)		2.8E-02	(mg/m3)	--		--	1.0E-01	(mg/m3)	4.0E-01	(mg/m³)	2.5E-01
				tert-Butylbenzene	NC (4)		2.0E-02	(mg/m3)	--		--	7.1E-02	(mg/m3)	1.4E-01	(mg/m³)	5.1E-01
				Tetrachloroethene	NC (4)		1.6E-03	(mg/m3)	5.9E-03	(mg/m³)-¹	9.7E-06	5.9E-03	(mg/m3)	3.5E-02	(mg/m³)	1.7E-01
				Tetrahydrofuran	NC (4)		7.4E+00	(mg/m3)	--		--	2.7E+01	(mg/m3)	3.0E-01	(mg/m³)	8.8E+01
				Toluene	NC (4)		2.6E+01	(mg/m3)	--		--	9.4E+01	(mg/m3)	5.0E+00	(mg/m³)	1.9E+01
				Trichloroethene	NC (4)		1.8E-03	(mg/m3)	2.0E-03	(mg/m³)-¹	3.6E-06	6.4E-03	(mg/m3)	6.0E-01	(mg/m³)	1.1E-02
				Vinyl chloride	NC (4)		2.8E-02	(mg/m3)	8.8E-03	(mg/m³)-¹	2.4E-04	1.0E-01	(mg/m3)	1.0E-01	(mg/m³)	1.0E+00
				Xylenes (total)	NC (4)		9.0E+00	(mg/m3)	--		--	3.2E+01	(mg/m3)	1.0E-01	(mg/m³)	3.2E+02
			Exp. Route Total								1.4E-02					7.3E+02
	Exposure Medium Total										8.6E-02					2060
Risk From Reference											0.0E+00					108
Risk from Site											8.6E-02					1953
							Total of Receptor Risks Across All Media				9E-02	Total of Receptor Hazards Across All Media				2063
							Risks from Reference				1E-04					110
							Risks from Site				9E-02					1953

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

* Cancer risks for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene includes a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for these compounds is shown on Table 33-N.

TABLE 3-33E

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 1&2 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 1-2	Ingestion	1,4-Dichlorobenzene	1E-02	mg/L	5.3E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	1.3E-06	4.9E-04	mg/kg-day	9.0E-02	mg/kg-day	5.5E-03
				2-Methylnaphthalene	8E-04	mg/L	4.0E-06	mg/kg-day	--		--	3.7E-05	mg/kg-day	4.0E-03	mg/kg-day	9.3E-03
				3-Methylphenol/4-Methylphenol	1E+01	mg/L	4.9E-02	mg/kg-day	--		--	4.5E-01	mg/kg-day	5.0E-02	mg/kg-day	8.9E+00
				4-Methylphenol	1E+01	mg/L	5.3E-02	mg/kg-day	--		--	4.9E-01	mg/kg-day	5.0E-02	mg/kg-day	9.8E+00
				Acetophenone	3E-02	mg/L	1.5E-04	mg/kg-day	--		--	1.4E-03	mg/kg-day	1.0E-01	mg/kg-day	1.4E-02
				Naphthalene	2E-01	mg/L	1.2E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	2.0E-02	mg/kg-day	5.4E-01
				N-Nitrosodi-n-butylamine	1E-03	mg/L	5.3E-06	mg/kg-day	5.4E+00	(mg/kg-day)-1	2.8E-05	4.8E-05	mg/kg-day	--		--
				N-Nitrosopyrrolidine	1E-02	mg/L	4.7E-05	mg/kg-day	2.1E+00	(mg/kg-day)-1	9.9E-05	4.3E-04	mg/kg-day	--		--
				o-Toluidine	3E-03	mg/L	1.5E-05	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.7E-06	1.4E-04	mg/kg-day	--		--
				Phenol	3E+00	mg/L	1.3E-02	mg/kg-day	--		--	1.2E-01	mg/kg-day	3.0E-01	mg/kg-day	3.9E-01
				Pyridine	4E-02	mg/L	2.0E-04	mg/kg-day	--		--	1.9E-03	mg/kg-day	1.0E-03	mg/kg-day	1.9E+00
				1,1-Dichloroethane	5E-01	mg/L	2.6E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	2.0E-01	mg/kg-day	1.2E-01
				1,2,4-Trimethylbenzene	3E+00	mg/L	1.3E-02	mg/kg-day	--		--	1.2E-01	mg/kg-day	--		--
				1,2-Dichloroethane	7E-03	mg/L	3.4E-05	mg/kg-day	9.1E-02	(mg/kg-day)-1	3.1E-06	3.1E-04	mg/kg-day	2.0E-01	mg/kg-day	1.5E-03
				1,2-Dichloroethene	2E-01	mg/L	7.3E-04	mg/kg-day	--		--	6.7E-03	mg/kg-day	9.0E-03	mg/kg-day	7.5E-01
				cis-1,2-Dichloroethene	5E-01	mg/L	2.2E-03	mg/kg-day	--		--	2.0E-02	mg/kg-day	1.0E-02	mg/kg-day	2.0E+00
				1,3-Dichloropropane	3E-03	mg/L	1.7E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.1E-06	1.5E-04	mg/kg-day	--		--
				1,2,4-Trichlorobenzene	3E-03	mg/L	1.2E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	1.0E-02	mg/kg-day	1.1E-02
				1,3,5-Trimethylbenzene	6E-01	mg/L	3.1E-03	mg/kg-day	--		--	2.9E-02	mg/kg-day	--		--
				1,4-Dioxane	8E-01	mg/L	4.0E-03	mg/kg-day	1.1E-02	(mg/kg-day)-1	4.4E-05	3.7E-02	mg/kg-day	1.0E-01	mg/kg-day	3.7E-01
				2-Butanone	3E+01	mg/L	1.3E-01	mg/kg-day	--		--	1.2E+00	mg/kg-day	6.0E-01	mg/kg-day	2.0E+00
				2-Hexanone	5E-01	mg/L	2.2E-02	mg/kg-day	--		--	2.0E-02	mg/kg-day	--		--
				4-Methyl-2-pentanone	1E+01	mg/L	6.3E-02	mg/kg-day	--		--	5.8E-01	mg/kg-day	8.0E-02	mg/kg-day	7.3E+00
				Acetone	2E+01	mg/L	1.0E-01	mg/kg-day	--		--	9.4E-01	mg/kg-day	9.0E-01	mg/kg-day	1.0E+00
				Benzene	4E-02	mg/L	1.8E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.0E-05	1.7E-03	mg/kg-day	4.0E-03	mg/kg-day	4.3E-01
				Chlorobenzene	3E-02	mg/L	1.4E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	2.0E-02	mg/kg-day	6.3E-02
				Chloroethane	4E+00	mg/L	2.1E-02	mg/kg-day	--		--	1.9E-01	mg/kg-day	--		--
				Chloroform	2E-03	mg/L	8.3E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.6E-07	7.6E-05	mg/kg-day	1.0E-02	mg/kg-day	7.6E-03
				Dichlorodifluoromethane	1E-01	mg/L	4.6E-04	mg/kg-day	--		--	4.3E-03	mg/kg-day	2.0E-01	mg/kg-day	2.1E-02
				Ethyl Ether	3E-01	mg/L	1.5E-03	mg/kg-day	--		--	1.3E-02	mg/kg-day	2.0E-01	mg/kg-day	6.7E-02
				Ethylbenzene	2E+00	mg/L	9.7E-03	mg/kg-day	--		--	8.9E-02	mg/kg-day	1.0E-01	mg/kg-day	8.9E-01
				Methylene Chloride	2E+00	mg/L	1.0E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.8E-05	9.6E-02	mg/kg-day	6.0E-02	mg/kg-day	1.6E+00
				n-Propylbenzene	3E-01	mg/L	1.3E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	--		--
				Styrene	2E-01	mg/L	1.2E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	2.0E-01	mg/kg-day	5.4E-02
				Tetrachloroethene	2E-02	mg/L	8.3E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	4.5E-05	7.6E-04	mg/kg-day	1.0E-02	mg/kg-day	7.6E-02
				Tetrahydrofuran	1E+01	mg/L	4.9E-02	mg/kg-day	--		--	4.5E-01	mg/kg-day	--		--
				Toluene	2E+01	mg/L	1.0E-01	mg/kg-day	--		--	9.4E-01	mg/kg-day	8.0E-02	mg/kg-day	1.2E+01
				Trichloroethene	8E-02	mg/L	3.7E-04	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.5E-04	3.4E-03	mg/kg-day	--		--
				Trichlorofluoromethane	4E-01	mg/L	2.0E-03	mg/kg-day	--		--	1.8E-02	mg/kg-day	3.0E-01	mg/kg-day	6.1E-02
				Vinyl chloride	4E-02	mg/L	1.7E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.6E-04	1.6E-03	mg/kg-day	3.0E-03	mg/kg-day	5.2E-01
				Xylenes (total)	5E-01	mg/L	2.4E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	2.0E-01	mg/kg-day	1.1E-01
				Antimony	5E-03	mg/L	2.5E-05	mg/kg-day	--		--	2.3E-04	mg/kg-day	4.0E-04	mg/kg/day	5.8E-01
				Arsenic	2E+00	mg/L	9.7E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.5E-02	8.9E-02	mg/kg-day	3.0E-04	mg/kg-day	3.0E+02
				Barium	2E+00	mg/L	7.7E-03	mg/kg-day	--		--	7.1E-02	mg/kg-day	2.0E-01	mg/kg-day	3.6E-01
				Beryllium	3E-02	mg/L	1.5E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	2.0E-03	mg/kg/day	6.7E-01
				Cadmium	4E-01	mg/L	1.8E-03	mg/kg-day	--		--	1.6E-02	mg/kg-day	5.0E-04	mg/kg-day	3.2E+01
				Cobalt	8E-02	mg/L	3.7E-04	mg/kg-day	--		--	3.4E-03	mg/kg-day	--		--
				Copper	2E-01	mg/L	8.7E-04	mg/kg-day	--		--	8.0E-03	mg/kg-day	--		--
				Lead	2E-01	mg/L	1.2E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	NA (3)		--
				Manganese	2E+01	mg/L	9.8E-02	mg/kg-day	--		--	9.0E-01	mg/kg-day	4.7E-02	mg/kg-day	1.9E+01
				Nickel	2E-01	mg/L	1.0E-03	mg/kg-day	--		--	9.4E-03	mg/kg-day	2.0E-02	mg/kg-day	4.7E-01
				Selenium	7E-02	mg/L	3.4E-04	mg/kg-day	--		--	3.1E-03	mg/kg-day	5.0E-03	mg/kg/day	6.3E-01
				Thallium	5E-03	mg/L	2.3E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	8.0E-05	mg/kg-day	2.6E+00
				Vanadium	3E-02	mg/L	1.5E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	9.0E-03	mg/kg/day	1.5E-01
			Exp. Route Total								1.5E-02					4.1E-02

TABLE 3-33E

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 1&2 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 1-2	Dermal Contact	1,4-Dichlorobenzene	1E-02	mg/L	3.1E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	7.5E-07	2.6E-04	mg/kg-day	9.0E-02	mg/kg/day	2.9E-03
				2-Methylnaphthalene	8E-04	mg/L	2.4E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	4.0E-03	mg/kg/day	4.9E-03
				3-Methylphenol/4-Methylphenol	1E+01	mg/L	4.2E-03	mg/kg-day	--		--	3.5E-02	mg/kg-day	5.0E-02	mg/kg/day	7.0E-01
				4-Methylphenol	1E+01	mg/L	4.7E-03	mg/kg-day	--		--	3.9E-02	mg/kg-day	5.0E-02	mg/kg/day	7.7E-01
				Acetophenone	3E-02	mg/L	1.2E-05	mg/kg-day	--		--	9.6E-05	mg/kg-day	1.0E-01	mg/kg/day	9.6E-04
				Naphthalene	2E-01	mg/L	6.8E-04	mg/kg-day	--		--	5.7E-03	mg/kg-day	2.0E-02	mg/kg/day	2.8E-01
				N-Nitrosodi-n-butylamine	1E-03	mg/L	3.0E-07	mg/kg-day	5.4E+00	(mg/kg-day)-1	1.6E-06	2.5E-06	mg/kg-day	--		--
				N-Nitrosopyrrolidine	1E-02	mg/L	2.7E-07	mg/kg-day	2.1E+00	(mg/kg-day)-1	5.6E-07	2.2E-06	mg/kg-day	--		--
				o-Toluidine	3E-03	mg/L	5.0E-07	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.2E-07	4.1E-06	mg/kg-day	--		--
				Phenol	3E+00	mg/L	1.0E-03	mg/kg-day	--		--	8.5E-03	mg/kg-day	3.0E-01	mg/kg/day	2.8E-02
				Pyridine	4E-02	mg/L	6.2E-06	mg/kg-day	--		--	5.1E-05	mg/kg-day	1.0E-03	mg/kg/day	5.1E-02
				1,1-Dichloroethane	5E-01	mg/L	1.8E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	2.0E-01	mg/kg/day	7.3E-03
				1,2,4-Trimethylbenzene	3E+00	mg/L	2.3E-02	mg/kg-day	--		--	1.9E-01	mg/kg-day	--		--
				1,2-Dichloroethane	7E-03	mg/L	1.4E-06	mg/kg-day	9.1E-02	(mg/kg-day)-1	1.3E-07	1.2E-05	mg/kg-day	2.0E-01	mg/kg/day	6.0E-05
				1,2-Dichloroethene	2E-01	mg/L	5.7E-05	mg/kg-day	--		--	4.7E-04	mg/kg-day	9.0E-03	mg/kg/day	5.2E-02
				cis-1,2-Dichloroethene	5E-01	mg/L	1.7E-04	mg/kg-day	--		--	1.4E-03	mg/kg-day	1.0E-02	mg/kg/day	1.4E-01
				1,2-Dichloropropane	3E-03	mg/L	1.5E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	9.9E-08	1.2E-05	mg/kg-day	--		--
				1,2,4-Trichlorobenzene	3E-03	mg/L	1.4E-05	mg/kg-day	--		--	1.2E-04	mg/kg-day	1.0E-02	mg/kg/day	1.2E-02
				1,3,5-Trimethylbenzene	6E-01	mg/L	3.1E-03	mg/kg-day	--		--	2.6E-02	mg/kg-day	--		--
				1,4-Dioxane	8E-01	mg/L	1.3E-05	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.4E-07	1.1E-04	mg/kg-day	1.0E-01	mg/kg/day	1.1E-03
				2-Butanone	3E+01	mg/L	1.3E-03	mg/kg-day	--		--	1.0E-02	mg/kg-day	6.0E-01	mg/kg/day	1.7E-02
				2-Hexanone	5E-01	mg/L	1.6E-04	mg/kg-day	--		--	1.4E-03	mg/kg-day	--		--
				4-Methyl-2-pentanone	1E+01	mg/L	2.6E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	8.0E-02	mg/kg/day	2.7E-01
				Acetone	2E+01	mg/L	8.8E-04	mg/kg-day	--		--	7.3E-03	mg/kg-day	9.0E-01	mg/kg/day	8.1E-03
				Benzene	4E-02	mg/L	2.5E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.4E-06	2.1E-04	mg/kg-day	4.0E-03	mg/kg/day	5.1E-02
				Chlorobenzene	3E-02	mg/L	4.3E-05	mg/kg-day	--		--	3.6E-04	mg/kg-day	2.0E-02	mg/kg/day	1.8E-02
				Chloroethane	4E+00	mg/L	1.0E-03	mg/kg-day	--		--	8.6E-03	mg/kg-day	--		--
				Chloroform	2E-03	mg/L	6.6E-07	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.0E-08	5.5E-06	mg/kg-day	1.0E-02	mg/kg/day	5.5E-04
				Dichlorodifluoromethane	1E-01	mg/L	4.9E-05	mg/kg-day	--		--	4.1E-04	mg/kg-day	2.0E-01	mg/kg/day	2.0E-03
				Ethyl Ether	3E-01	mg/L	2.9E-05	mg/kg-day	--		--	2.4E-04	mg/kg-day	2.0E-01	mg/kg/day	1.2E-03
				Ethylbenzene	2E+00	mg/L	5.1E-03	mg/kg-day	--		--	4.3E-02	mg/kg-day	1.0E-01	mg/kg/day	4.3E-01
				Methylene Chloride	2E+00	mg/L	3.4E-04	mg/kg-day	7.5E-03	(mg/kg-day)-1	2.6E-06	2.8E-03	mg/kg-day	6.0E-02	mg/kg/day	4.7E-02
				n-Propylbenzene	3E-01	mg/L	1.9E-03	mg/kg-day	--		--	1.6E-02	mg/kg-day	--		--
				Styrene	2E-01	mg/L	4.6E-04	mg/kg-day	--		--	3.8E-03	mg/kg-day	2.0E-01	mg/kg/day	1.9E-02
				Tetrachloroethene	2E-02	mg/L	4.3E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.3E-05	3.6E-04	mg/kg-day	1.0E-02	mg/kg/day	3.6E-02
				Tetrahydrofuran	1E+01	mg/L	1.0E-03	mg/kg-day	--		--	8.7E-03	mg/kg-day	--		--
				Toluene	2E+01	mg/L	3.1E-02	mg/kg-day	--		--	2.6E-01	mg/kg-day	8.0E-02	mg/kg/day	3.2E+00
				Trichloroethene	8E-02	mg/L	5.6E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.2E-05	4.7E-04	mg/kg-day	--		--
				Trichlorofluoromethane	4E-01	mg/L	3.4E-04	mg/kg-day	--		--	2.8E-03	mg/kg-day	3.0E-01	mg/kg/day	9.4E-03
				Vinyl chloride	4E-02	mg/L	7.7E-06	mg/kg-day	1.5E-00	(mg/kg-day)-1	1.2E-05	6.4E-05	mg/kg-day	3.0E-03	mg/kg/day	2.1E-02
				Xylenes (total)	5E-01	mg/L	1.8E-03	mg/kg-day	--		--	1.5E-02	mg/kg-day	2.0E-01	mg/kg/day	7.5E-02
				Antimony	5E-03	mg/L	8.7E-08	mg/kg-day	--		--	7.2E-07	mg/kg-day	6.0E-05	mg/kg/day	1.2E-02
				Arsenic	2E+00	mg/L	3.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.0E-05	2.8E-04	mg/kg-day	3.0E-04	mg/kg/day	9.3E-01
				Barium	2E+00	mg/L	2.7E-05	mg/kg-day	--		--	2.2E-04	mg/kg-day	1.4E-02	mg/kg/day	1.6E-02
				Beryllium	3E-02	mg/L	5.0E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	1.4E-05	mg/kg/day	3.0E-01
				Cadmium	4E-01	mg/L	6.0E-06	mg/kg-day	--		--	5.0E-05	mg/kg-day	2.5E-05	mg/kg/day	2.0E+00
				Cobalt	8E-02	mg/L	5.1E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	--		--
				Copper	2E-01	mg/L	3.0E-06	mg/kg-day	--		--	2.5E-05	mg/kg-day	--		--
				Lead	2E-01	mg/L	4.0E-07	mg/kg-day	--		--	3.3E-06	mg/kg-day	NA (3)		--
				Manganese	2E+01	mg/L	3.4E-04	mg/kg-day	--		--	2.8E-03	mg/kg-day	1.9E-03	mg/kg/day	1.5E-00
				Nickel	2E-01	mg/L	7.0E-07	mg/kg-day	--		--	5.8E-06	mg/kg-day	8.0E-04	mg/kg/day	7.3E-03
				Selenium	7E-02	mg/L	1.2E-06	mg/kg-day	--		--	9.7E-06	mg/kg-day	5.0E-03	mg/kg/day	1.9E-02
				Thallium	5E-03	mg/L	7.9E-08	mg/kg-day	--		--	6.5E-07	mg/kg-day	8.0E-05	mg/kg/day	8.2E-03
				Vanadium	3E-02	mg/L	5.0E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	2.3E-04	mg/kg/day	1.8E-02
			Exp. Route Total								1.2E-04					1.1E+01

TABLE 3-32E

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 1&2 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 1-2	Shower Air	1,4-Dichlorobenzene	NC (4)		1.1E-04	(mg/m3)	--		--	2.3E-03	(mg/m3)	8.0E-01	(mg/m³)	2.9E-03
				2-Methylnaphthalene	NC (4)		6.3E-06	(mg/m3)	--		--	1.4E-04	(mg/m3)	1.4E-01	(mg/m³)	9.8E-04
				3-Methylphenol/4-Methylphenol	NC (4)		1.7E-02	(mg/m3)	--		--	6.1E-02	(mg/m3)	1.8E-02	(mg/m³)	3.5E+00
				4-Methylphenol	NC (4)		1.9E-02	(mg/m3)	--		--	6.7E-02	(mg/m3)	1.8E-02	(mg/m³)	3.8E+00
				Acetophenone	NC (4)		5.2E-04	(mg/m3)	--		--	1.9E-03	(mg/m3)	--		--
				Naphthalene	NC (4)		1.9E-03	(mg/m3)	--		--	4.1E-02	(mg/m3)	3.0E-03	(mg/m³)	1.4E+01
				N-Nitrosodi-n-butylamine	NC (4)		1.9E-04	(mg/m3)	1.6E+00	(mg/m³)-¹	2.0E-04	6.7E-04	(mg/m3)	--		--
				N-Nitrosopyrrolidine	NC (4)		8.4E-07	(mg/m3)	6.1E-01	(mg/m³)-¹	5.1E-07	3.0E-06	(mg/m3)	--		--
				o-Toluidine	NC (4)		1.1E-05	(mg/m3)	--		--	3.8E-05	(mg/m3)	--		--
				Phenol	NC (4)		6.7E-05	(mg/m3)	--		--	1.5E-03	(mg/m3)	2.0E-01	(mg/m³)	7.4E-03
				Pyridine	NC (4)		8.7E-04	(mg/m3)	--		--	3.1E-03	(mg/m3)	3.5E-03	(mg/m³)	8.9E-01
				1,1-Dichloroethane	NC (4)		6.2E-03	(mg/m3)	--		--	1.3E-01	(mg/m3)	5.0E-01	(mg/m³)	2.7E-01
				1,2,4-Trimethylbenzene	NC (4)		7.9E-01	(mg/m3)	--		--	2.8E+00	(mg/m3)	--		--
				1,2-Dichloroethane	NC (4)		7.0E-05	(mg/m3)	2.6E-02	(mg/m³)-¹	1.8E-06	1.5E-03	(mg/m3)	2.4E+00	(mg/m³)	6.3E-04
				1,2-Dichloroethene	NC (4)		1.8E-03	(mg/m3)	--		--	3.9E-02	(mg/m3)	6.0E-02	(mg/m³)	6.5E-01
				cis-1,2-Dichloroethene	NC (4)		5.2E-03	(mg/m3)	--		--	1.1E-01	(mg/m3)	6.0E-02	(mg/m³)	1.9E+00
				1,2-Dichloropropane	NC (4)		3.6E-05	(mg/m3)	--		--	8.0E-04	(mg/m3)	4.0E-03	(mg/m³)	2.0E-01
				1,2,4-Trichlorobenzene	NC (4)		2.8E-05	(mg/m3)	--		--	6.2E-04	(mg/m3)	2.0E-01	(mg/m³)	3.1E-03
				1,3,5-Trimethylbenzene	NC (4)		2.0E-01	(mg/m3)	--		--	7.0E-01	(mg/m3)	--		--
				1,4-Dioxane	NC (4)		2.7E-04	(mg/m3)	7.7E-03	(mg/m³)-¹	2.1E-06	5.9E-03	(mg/m3)	3.0E+00	(mg/m³)	2.0E-03
				2-Butanone	NC (4)		4.8E-02	(mg/m3)	--		--	1.1E+00	(mg/m3)	5.0E+00	(mg/m³)	2.1E-01
				2-Hexanone	NC (4)		5.0E-02	(mg/m3)	--		--	1.8E-01	(mg/m3)	--		--
				4-Methyl-2-pentanone	NC (4)		6.6E-02	(mg/m3)	--		--	1.4E+00	(mg/m3)	3.0E+00	(mg/m³)	4.8E-01
				Acetone	NC (4)		5.6E-02	(mg/m3)	--		--	1.2E+00	(mg/m3)	3.2E+00	(mg/m³)	3.9E-01
				Benzene	NC (4)		4.8E-04	(mg/m3)	7.8E-03	(mg/m³)-¹	3.8E-06	1.1E-02	(mg/m3)	3.0E-02	(mg/m³)	3.5E-01
				Chlorobenzene	NC (4)		3.0E-04	(mg/m3)	--		--	6.7E-03	(mg/m3)	5.0E-02	(mg/m³)	1.3E-01
				Chloroethane	NC (4)		1.8E+00	(mg/m3)	--		--	6.5E+00	(mg/m3)	1.0E+01	(mg/m³)	6.5E-01
				Chloroform	NC (4)		1.8E-05	(mg/m3)	2.3E-02	(mg/m³)-¹	4.2E-07	4.0E-04	(mg/m3)	3.0E-01	(mg/m³)	1.3E-03
				Dichlorodifluoromethane	NC (4)		3.0E-02	(mg/m3)	--		--	1.1E-01	(mg/m3)	2.0E-01	(mg/m³)	5.3E-01
				Ethyl Ether	NC (4)		7.5E-03	(mg/m3)	--		--	2.7E-02	(mg/m3)	7.0E-01	(mg/m³)	3.9E-02
				Ethylbenzene	NC (4)		2.3E-02	(mg/m3)	--		--	5.0E-01	(mg/m3)	1.0E+00	(mg/m³)	5.0E-01
				Methylene Chloride	NC (4)		2.5E-02	(mg/m3)	4.7E-04	(mg/m³)-¹	1.2E-05	5.5E-01	(mg/m3)	3.0E+00	(mg/m³)	1.8E-01
				n-Propylbenzene	NC (4)		1.9E-01	(mg/m3)	--		--	7.0E-01	(mg/m3)	1.4E-01	(mg/m³)	5.0E+00
				Styrene	NC (4)		2.6E-03	(mg/m3)	--		--	5.8E-02	(mg/m3)	1.0E+00	(mg/m³)	5.8E-02
				Tetrachloroethene	NC (4)		1.7E-04	(mg/m3)	5.9E-03	(mg/m³)-¹	9.8E-07	3.6E-03	(mg/m3)	3.5E-02	(mg/m³)	1.0E-01
				Tetrahydrofuran	NC (4)		3.7E+00	(mg/m3)	--		--	1.3E+01	(mg/m3)	3.0E-01	(mg/m³)	4.4E+01
				Toluene	NC (4)		2.5E-01	(mg/m3)	--		--	5.5E+00	(mg/m3)	5.0E+00	(mg/m³)	1.1E+00
				Trichloroethene	NC (4)		8.1E-04	(mg/m3)	2.0E-03	(mg/m³)-¹	1.6E-06	1.8E-02	(mg/m3)	6.0E-01	(mg/m³)	2.9E-02
				Trichlorofluoromethane	NC (4)		1.2E-01	(mg/m3)	--		--	4.4E-01	(mg/m3)	--		--
				Vinyl chloride	NC (4)		4.9E-04	(mg/m3)	8.8E-03	(mg/m³)-¹	4.3E-06	1.1E-02	(mg/m3)	1.0E-01	(mg/m³)	1.1E-01
				Xylenes (total)	NC (4)		5.6E-03	(mg/m3)	--		--	1.2E-01	(mg/m3)	1.0E-01	(mg/m³)	1.2E+00
			Exp. Route Total								3.3E-04					8.0E+01
	Exposure Medium Total										1.6E-02					5.0E+02
Total of Receptor Risks Across All Media											1.6E-02	Total of Receptor Hazards Across All Media				5.0E+02
Risks from Reference											0E+00					4.0E+01
Risks from Site											2E-02					4.6E+02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

(4) Refer to Appendix I for supporting information.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33F

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 1&2 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 1-2	Ingestion	1,4-Dichlorobenzene	1E-02	mg/L	1.8E-04	mg/kg-day	2.4E-02	(mg/kg-day)-1	4.3E-06	9.1E-04	mg/kg-day	9.0E-02	mg/kg/day	1.0E-02
				2-Methylnaphthalene	8E-04	mg/L	1.4E-05	mg/kg-day	--		--	6.9E-05	mg/kg-day	4.0E-03	mg/kg/day	1.7E-02
				3-Methylphenol/4-Methylphenol	1E+01	mg/L	1.6E-01	mg/kg-day	--		--	8.3E-01	mg/kg-day	5.0E-02	mg/kg/day	1.7E+01
				4-Methylphenol	1E+01	mg/L	1.8E-01	mg/kg-day	--		--	9.1E-01	mg/kg-day	5.0E-02	mg/kg/day	1.8E+01
				Acetophenone	3E-02	mg/L	5.1E-04	mg/kg-day	--		--	2.6E-03	mg/kg-day	1.0E-01	mg/kg/day	2.6E-02
				Naphthalene	2E-01	mg/L	3.9E-03	mg/kg-day	--		--	2.0E-02	mg/kg-day	2.0E-02	mg/kg/day	1.0E+00
				N-Nitrosodi-n-butylamine	1E-03	mg/L	1.8E-05	mg/kg-day	5.4E+00	(mg/kg-day)-1	9.6E-05	9.0E-05	mg/kg-day	--		--
				N-Nitrosopyrrolidine	1E-02	mg/L	1.6E-04	mg/kg-day	2.1E+00	(mg/kg-day)-1	3.3E-04	8.0E-04	mg/kg-day	--		--
				o-Toluidine	3E-03	mg/L	5.2E-05	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.2E-05	2.6E-04	mg/kg-day	--		--
				Phenol	3E+00	mg/L	4.3E-02	mg/kg-day	--		--	2.2E-01	mg/kg-day	3.0E-01	mg/kg/day	7.2E-01
				Pyridine	4E-02	mg/L	6.9E-04	mg/kg-day	--		--	3.5E-03	mg/kg-day	1.0E-03	mg/kg/day	3.5E+00
				1,1-Dichloroethane	5E-01	mg/L	8.7E-03	mg/kg-day	--		--	4.4E-02	mg/kg-day	2.0E-01	mg/kg/day	2.2E-01
				1,2,4-Trimethylbenzene	3E+00	mg/L	4.3E-02	mg/kg-day	--		--	2.2E-01	mg/kg-day	--		--
				1,2-Dichloroethane	7E-02	mg/L	1.1E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	1.0E-05	5.7E-04	mg/kg-day	2.0E-01	mg/kg/day	2.9E-03
				1,2-Dichloroethene	2E-01	mg/L	2.5E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	9.0E-03	mg/kg/day	1.4E+00
				cis-1,2-Dichloroethene	5E-01	mg/L	7.4E-03	mg/kg-day	--		--	3.7E-02	mg/kg-day	1.0E-02	mg/kg/day	3.7E+00
				1,2-Dichloropropane	3E-03	mg/L	5.6E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.8E-06	2.8E-04	mg/kg-day	--		--
				1,2,4-Trichlorobenzene	2E-03	mg/L	4.1E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	1.0E-02	mg/kg/day	2.1E-02
				1,3,5-Trimethylbenzene	6E-01	mg/L	1.0E-02	mg/kg-day	--		--	5.2E-02	mg/kg-day	--		--
				1,4-Dioxane	8E-01	mg/L	1.4E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.5E-04	6.9E-02	mg/kg-day	1.0E-01	mg/kg/day	6.9E-01
				2-Butanone	3E+01	mg/L	4.4E-01	mg/kg-day	--		--	2.2E+00	mg/kg-day	6.0E-01	mg/kg/day	3.7E+00
				3-Hexanone	5E-01	mg/L	7.4E-03	mg/kg-day	--		--	3.7E-02	mg/kg-day	--		--
				4-Methyl-2-pentanone	1E+01	mg/L	2.1E-01	mg/kg-day	--		--	1.1E+00	mg/kg-day	8.0E-02	mg/kg/day	1.4E+01
				Acetone	2E+01	mg/L	3.4E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	9.0E-01	mg/kg/day	1.9E+00
				Benzene	4E-02	mg/L	6.2E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	3.4E-05	3.2E-03	mg/kg-day	4.0E-03	mg/kg/day	7.9E-01
				Chlorobenzene	3E-02	mg/L	4.6E-04	mg/kg-day	--		--	2.3E-03	mg/kg-day	2.0E-02	mg/kg/day	1.2E-01
				Chloroethane	4E+00	mg/L	7.1E-02	mg/kg-day	--		--	3.6E-01	mg/kg-day	--		--
				Chloroform	2E-03	mg/L	2.8E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	8.6E-07	1.4E-04	mg/kg-day	1.0E-02	mg/kg/day	1.4E-02
				Dichlorodifluoromethane	1E-01	mg/L	1.6E-03	mg/kg-day	--		--	7.9E-03	mg/kg-day	2.0E-01	mg/kg/day	3.9E-02
				Ethyl Ether	3E-01	mg/L	4.9E-03	mg/kg-day	--		--	2.5E-02	mg/kg-day	2.0E-01	mg/kg/day	1.2E-01
				Ethylbenzene	2E+00	mg/L	3.3E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	1.0E-01	mg/kg/day	1.7E+00
				Methylene Chloride	2E+00	mg/L	3.5E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	2.6E-04	1.8E-01	mg/kg-day	6.0E-02	mg/kg/day	3.0E+00
				n-Propylbenzene	3E-01	mg/L	4.3E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	--		--
				Styrene	2E-01	mg/L	3.9E-03	mg/kg-day	--		--	2.0E-02	mg/kg-day	2.0E-01	mg/kg/day	1.0E-01
				Tetrachloroethene	2E-02	mg/L	2.8E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.5E-04	1.4E-03	mg/kg-day	1.0E-02	mg/kg/day	1.4E-01
				Tetrahydrofuran	1E+01	mg/L	1.6E-01	mg/kg-day	--		--	8.3E-01	mg/kg-day	--		--
				Toluene	2E+01	mg/L	3.4E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	8.0E-02	mg/kg/day	2.2E+01
				Trichloroethene	8E-02	mg/L	1.2E-03	mg/kg-day	4.0E-01	(mg/kg-day)-1	5.0E-04	6.3E-03	mg/kg-day	--		--
				Trichlorofluoromethane	4E-01	mg/L	6.7E-03	mg/kg-day	--		--	3.4E-02	mg/kg-day	3.0E-01	mg/kg/day	1.1E-01
				Vinyl chloride	4E-02	mg/L	5.7E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.6E-04	2.9E-03	mg/kg-day	3.0E-03	mg/kg/day	9.7E-01
				Xylenes (total)	5E-01	mg/L	8.0E-03	mg/kg-day	--		--	4.1E-02	mg/kg-day	2.0E-01	mg/kg/day	2.0E-01
				Antimony	5E-03	mg/L	8.5E-05	mg/kg-day	--		--	4.3E-04	mg/kg-day	4.0E-04	mg/kg/day	1.1E+00
				Arsenic	2E+00	mg/L	3.3E-02	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.9E-02	1.7E-01	mg/kg-day	3.0E-04	mg/kg/day	5.5E+02
				Barium	2E-00	mg/L	2.6E-02	mg/kg-day	--		--	1.3E-01	mg/kg-day	2.0E-01	mg/kg/day	6.6E-01
				Beryllium	2E-02	mg/L	4.9E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	2.0E-03	mg/kg/day	1.2E+00
				Cadmium	4E-01	mg/L	5.9E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	5.0E-04	mg/kg/day	6.0E+01
				Cobalt	8E-02	mg/L	1.3E-03	mg/kg-day	--		--	6.3E-03	mg/kg-day	--		--
				Copper	2E-01	mg/L	2.9E-03	mg/kg-day	--		--	1.5E-02	mg/kg-day	--		--
				Lead	2E-01	mg/L	3.9E-03	mg/kg-day	--		--	2.0E-02	mg/kg-day	NA (3)		--
				Manganese	2E+01	mg/L	3.3E-01	mg/kg-day	--		--	1.7E+00	mg/kg-day	4.7E-02	mg/kg/day	3.6E+01
				Nickel	2E-01	mg/L	3.4E-03	mg/kg-day	--		--	1.7E-02	mg/kg-day	2.0E-02	mg/kg/day	8.7E-01
				Selenium	7E-02	mg/L	1.1E-03	mg/kg-day	--		--	5.8E-03	mg/kg-day	5.0E-03	mg/kg/day	1.2E+00
				Thallium	5E-03	mg/L	7.7E-05	mg/kg-day	--		--	3.9E-04	mg/kg-day	8.0E-05	mg/kg/day	4.9E+00
				Vanadium	3E-02	mg/L	4.9E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	9.0E-03	mg/kg/day	2.8E-01
			Exp. Route Total								5.2E-02					7.5E+02

TABLE 3-33F

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 1&2 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 1-2	Dermal Contact	1,4-Dichlorobenzene	1E-02	mg/L	9.9E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	2.4E-06	4.5E-04	mg/kg-day	9.0E-02	mg/kg-day	5.0E-03
				2-Methylnaphthalene	8E-04	mg/L	7.4E-06	mg/kg-day	--		--	2.6E-05	mg/kg-day	4.0E-03	mg/kg-day	6.5E-03
				3-Methylphenol/4-Methylphenol	1E+01	mg/L	1.3E-02	mg/kg-day	--		--	4.7E-02	mg/kg-day	5.0E-02	mg/kg-day	9.3E-01
				4-Methylphenol	1E+01	mg/L	1.5E-02	mg/kg-day	--		--	5.1E-02	mg/kg-day	5.0E-02	mg/kg-day	1.0E+00
				Acetophenone	3E-02	mg/L	3.7E-05	mg/kg-day	--		--	1.3E-04	mg/kg-day	1.0E-01	mg/kg-day	1.3E-03
				Naphthalene	2E-01	mg/L	2.1E-03	mg/kg-day	--		--	7.5E-03	mg/kg-day	2.0E-02	mg/kg-day	3.7E-01
				N-Nitrosodi-n-butylamine	1E-03	mg/L	9.4E-07	mg/kg-day	5.4E+00	(mg/kg-day)-1	5.1E-06	3.2E-06	mg/kg-day	--		--
				N-Nitrosopyrrolidine	1E-02	mg/L	8.4E-07	mg/kg-day	2.1E+00	(mg/kg-day)-1	1.8E-06	2.9E-06	mg/kg-day	--		--
				o-Toluidine	3E-03	mg/L	1.6E-06	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.7E-07	5.5E-06	mg/kg-day	--		--
				Phenol	3E+00	mg/L	3.2E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	3.0E-01	mg/kg-day	3.7E-02
				Pyridine	4E-02	mg/L	1.9E-05	mg/kg-day	--		--	6.8E-05	mg/kg-day	1.0E-03	mg/kg-day	6.8E-02
				1,1-Dichloroethane	5E-01	mg/L	5.6E-04	mg/kg-day	--		--	1.9E-03	mg/kg-day	2.0E-01	mg/kg-day	9.7E-03
				1,2,4-Trimethylbenzene	3E+00	mg/L	7.3E-02	mg/kg-day	--		--	2.5E-01	mg/kg-day	--		--
				1,2-Dichloroethane	7E-03	mg/L	4.5E-06	mg/kg-day	9.1E-02	(mg/kg-day)-1	4.1E-07	1.6E-05	mg/kg-day	2.0E-01	mg/kg-day	7.9E-05
				1,2-Dichloroethene	2E-01	mg/L	1.8E-04	mg/kg-day	--		--	6.2E-04	mg/kg-day	9.0E-03	mg/kg-day	6.9E-02
				cis-1,2-Dichloroethene	5E-01	mg/L	5.4E-04	mg/kg-day	--		--	1.9E-03	mg/kg-day	1.0E-02	mg/kg-day	1.9E-01
				1,2-Dichloropropane	3E-03	mg/L	4.6E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.1E-07	1.6E-05	mg/kg-day	--		--
				1,2,4-Trichlorobenzene	3E-03	mg/L	4.4E-05	mg/kg-day	--		--	1.5E-04	mg/kg-day	1.0E-02	mg/kg-day	1.5E-02
				1,3,5-Trimethylbenzene	6E-01	mg/L	9.9E-03	mg/kg-day	--		--	3.5E-02	mg/kg-day	--		--
				1,4-Dioxane	8E-01	mg/L	4.0E-05	mg/kg-day	1.1E-02	(mg/kg-day)-1	4.4E-07	1.4E-04	mg/kg-day	1.0E-01	mg/kg-day	1.4E-03
				2-Butanone	3E+01	mg/L	4.0E-03	mg/kg-day	--		--	1.4E-02	mg/kg-day	6.0E-01	mg/kg-day	2.3E-02
				2-Hexanone	5E-01	mg/L	5.1E-04	mg/kg-day	--		--	1.8E-03	mg/kg-day	--		--
				4-Methyl-2-pentanone	1E+01	mg/L	8.2E-03	mg/kg-day	--		--	2.9E-02	mg/kg-day	8.0E-02	mg/kg-day	3.6E-01
				Acetone	2E+01	mg/L	2.8E-03	mg/kg-day	--		--	9.7E-03	mg/kg-day	9.0E-01	mg/kg-day	1.1E-02
				Benzene	4E-02	mg/L	7.8E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	4.3E-06	2.7E-04	mg/kg-day	4.0E-03	mg/kg-day	6.8E-02
				Chlorobenzene	3E-02	mg/L	1.4E-04	mg/kg-day	--		--	4.7E-04	mg/kg-day	2.0E-02	mg/kg-day	2.4E-02
				Chloroethane	4E+00	mg/L	3.3E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	--		--
				Chloroform	2E-03	mg/L	2.1E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	6.4E-08	7.2E-06	mg/kg-day	1.0E-02	mg/kg-day	7.3E-04
				Dichlorodifluoromethane	1E-01	mg/L	1.6E-04	mg/kg-day	--		--	5.4E-04	mg/kg-day	2.0E-01	mg/kg-day	2.7E-03
				Ethyl Ether	3E-01	mg/L	9.3E-05	mg/kg-day	--		--	3.2E-04	mg/kg-day	2.0E-01	mg/kg-day	1.6E-03
				Ethylbenzene	2E+00	mg/L	1.6E-02	mg/kg-day	--		--	5.6E-02	mg/kg-day	1.0E-01	mg/kg-day	5.6E-01
				Methylene Chloride	2E+00	mg/L	1.1E-02	mg/kg-day	7.5E-03	(mg/kg-day)-1	8.1E-06	3.8E-03	mg/kg-day	6.0E-02	mg/kg-day	6.3E-02
				n-Propylbenzene	3E-01	mg/L	6.1E-03	mg/kg-day	--		--	2.1E-02	mg/kg-day	--		--
				Styrene	2E-01	mg/L	1.4E-03	mg/kg-day	--		--	5.1E-03	mg/kg-day	2.0E-01	mg/kg-day	2.5E-02
				Tetrachloroethene	2E-02	mg/L	1.4E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	7.3E-05	4.8E-04	mg/kg-day	1.0E-02	mg/kg-day	4.8E-02
				Tetrahydrofuran	1E+01	mg/L	3.3E-03	mg/kg-day	--		--	1.2E-02	mg/kg-day	--		--
				Toluene	2E+01	mg/L	9.8E-02	mg/kg-day	--		--	3.4E-01	mg/kg-day	8.0E-02	mg/kg-day	4.3E+00
				Trichloroethene	8E-02	mg/L	1.8E-04	mg/kg-day	4.0E-01	(mg/kg-day)-1	7.1E-05	6.2E-04	mg/kg-day	--		--
				Trichlorofluoromethane	4E-01	mg/L	1.1E-03	mg/kg-day	--		--	3.8E-03	mg/kg-day	3.0E-01	mg/kg-day	1.3E-02
				Vinyl chloride	4E-02	mg/L	2.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.7E-05	8.5E-05	mg/kg-day	3.0E-03	mg/kg-day	2.8E-02
				Xylenes (total)	5E-01	mg/L	5.7E-03	mg/kg-day	--		--	2.0E-02	mg/kg-day	2.0E-01	mg/kg-day	9.9E-02
				Antimony	5E-03	mg/L	3.6E-07	mg/kg-day	--		--	1.3E-06	mg/kg-day	6.0E-05	mg/kg/day	2.1E-02
				Arsenic	2E+00	mg/L	1.4E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.1E-04	4.9E-04	mg/kg-day	3.0E-04	mg/kg-day	1.6E+00
				Barium	2E+00	mg/L	1.1E-04	mg/kg-day	--		--	3.9E-04	mg/kg-day	1.4E-02	mg/kg-day	2.8E-02
				Beryllium	3E-02	mg/L	2.1E-06	mg/kg-day	--		--	7.3E-06	mg/kg-day	1.4E-05	mg/kg/day	5.2E-01
				Cadmium	4E-01	mg/L	2.5E-05	mg/kg-day	--		--	8.8E-05	mg/kg-day	2.5E-05	mg/kg/day	3.5E+00
				Cobalt	8E-02	mg/L	2.1E-06	mg/kg-day	--		--	7.5E-06	mg/kg-day	--		--
				Copper	2E-01	mg/L	1.3E-05	mg/kg-day	--		--	4.4E-05	mg/kg-day	--		--
				Lead	2E-01	mg/L	1.7E-06	mg/kg-day	--		--	5.9E-06	mg/kg-day	NA (3)		--
				Manganese	2E+01	mg/L	1.4E-03	mg/kg-day	--		--	4.9E-03	mg/kg-day	1.9E-03	mg/kg-day	2.6E+00
				Nickel	2E-01	mg/L	2.9E-06	mg/kg-day	--		--	1.0E-05	mg/kg-day	8.0E-04	mg/kg/day	1.3E-02
				Selenium	7E-02	mg/L	4.9E-06	mg/kg-day	--		--	1.7E-05	mg/kg-day	5.0E-03	mg/kg/day	3.4E-03
				Thallium	5E-03	mg/L	3.3E-07	mg/kg-day	--		--	1.2E-06	mg/kg-day	8.0E-05	mg/kg/day	1.4E-02
				Vanadium	3E-02	mg/L	2.1E-06	mg/kg-day	--		--	7.3E-06	mg/kg-day	2.3E-04	mg/kg/day	3.1E-02
			Exp. Route Total								4.1E-04					1.7E+01

TABLE 3-33F

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Area 1&2 Resident
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 1-2	Shower Air	1,4-Dichlorobenzene	NC (4)		2.9E-03	(mg/m3)	--		--	1.1E-02	(mg/m3)	8.0E-01	(mg/m³)	1.3E-02
				2-Methylnaphthalene	NC (4)		1.8E-04	(mg/m3)	--		--	6.3E-04	(mg/m3)	1.4E-01	(mg/m³)	4.5E-03
				3-Methylphenol/4-Methylphenol	NC (4)		1.7E-02	(mg/m3)	--		--	6.1E-02	(mg/m3)	1.8E-02	(mg/m³)	3.5E+00
				4-Methylphenol	NC (4)		1.9E-02	(mg/m3)	--		--	6.7E-02	(mg/m3)	1.8E-02	(mg/m³)	3.8E+00
				Acetophenone	NC (4)		5.2E-04	(mg/m3)	--		--	1.9E-03	(mg/m3)	--		--
				Naphthalene	NC (4)		5.2E-02	(mg/m3)	--		--	1.9E-01	(mg/m3)	3.0E-03	(mg/m³)	6.3E+01
				N-Nitrosodi-n-butylamine	NC (4)		1.9E-04	(mg/m3)	1.6E+00	(mg/m³)-¹	3.0E-04	6.7E-04	(mg/m3)	--		--
				N-Nitrosopyrrolidine	NC (4)		8.4E-07	(mg/m3)	6.1E-01	(mg/m³)-¹	5.1E-07	3.0E-06	(mg/m3)	--		--
				o-Toluidine	NC (4)		1.1E-05	(mg/m3)	--		--	3.8E-05	(mg/m3)	--		--
				Phenol	NC (4)		1.9E-03	(mg/m3)	--		--	6.8E-03	(mg/m3)	2.0E-01	(mg/m³)	3.4E-02
				Pyridine	NC (4)		8.7E-04	(mg/m3)	--		--	3.1E-03	(mg/m3)	3.5E-03	(mg/m³)	8.9E-01
				1,1-Dichloroethane	NC (4)		1.7E-01	(mg/m3)	--		--	6.2E-01	(mg/m3)	5.0E-01	(mg/m³)	1.2E+00
				1,2,4-Trimethylbenzene	NC (4)		7.9E-01	(mg/m3)	--		--	2.8E+00	(mg/m3)	--		--
				1,2-Dichloroethane	NC (4)		2.0E-03	(mg/m3)	2.6E-02	(mg/m³)-¹	5.1E-05	7.0E-03	(mg/m3)	2.4E+00	(mg/m³)	2.9E-03
				1,2-Dichloroethene	NC (4)		5.0E-02	(mg/m3)	--		--	1.8E-01	(mg/m3)	6.0E-02	(mg/m³)	3.0E+00
				cis-1,2-Dichloroethene	NC (4)		1.5E-01	(mg/m3)	--		--	5.2E-01	(mg/m3)	6.0E-02	(mg/m³)	8.7E+00
				1,2-Dichloropropane	NC (4)		1.0E-03	(mg/m3)	--		--	3.7E-03	(mg/m3)	4.0E-03	(mg/m³)	9.2E-01
				1,2,4-Trichlorobenzene	NC (4)		7.4E-04	(mg/m3)	--		--	2.7E-03	(mg/m3)	2.0E-01	(mg/m³)	1.3E-02
				1,3,5-Trimethylbenzene	NC (4)		2.0E-01	(mg/m3)	--		--	7.0E-01	(mg/m3)	--		--
				1,4-Dioxane	NC (4)		7.5E-03	(mg/m3)	7.7E-03	(mg/m³)-¹	5.8E-05	2.7E-02	(mg/m3)	3.0E+00	(mg/m³)	9.0E-03
				2-Butanone	NC (4)		1.3E+00	(mg/m3)	--		--	4.8E+00	(mg/m3)	5.0E+00	(mg/m³)	9.7E-01
				2-Hexanone	NC (4)		5.0E-02	(mg/m3)	--		--	1.8E-01	(mg/m3)	--		--
				4-Methyl-2-pentanone	NC (4)		1.8E+00	(mg/m3)	--		--	6.7E+00	(mg/m3)	3.0E+00	(mg/m³)	2.2E+00
				Acetone	NC (4)		1.6E+00	(mg/m3)	--		--	5.6E+00	(mg/m3)	3.2E+00	(mg/m³)	1.8E+00
				Benzene	NC (4)		1.3E-02	(mg/m3)	7.8E-03	(mg/m³)-¹	1.1E-04	4.8E-02	(mg/m3)	3.0E-02	(mg/m³)	1.6E+00
				Chlorobenzene	NC (4)		8.5E-03	(mg/m3)	--		--	3.1E-02	(mg/m3)	5.0E-02	(mg/m³)	6.1E-01
				Chloroethane	NC (4)		1.8E+00	(mg/m3)	--		--	6.5E+00	(mg/m3)	1.0E+01	(mg/m³)	6.5E-01
				Chloroform	NC (4)		5.1E-04	(mg/m3)	2.3E-02	(mg/m³)-¹	1.2E-05	1.8E-03	(mg/m3)	3.0E-01	(mg/m³)	6.1E-03
				Dichlorodifluoromethane	NC (4)		4.0E-02	(mg/m3)	--		--	1.4E-01	(mg/m3)	2.0E-01	(mg/m³)	7.2E-01
				Ethyl Ether	NC (4)		7.5E-03	(mg/m3)	--		--	2.7E-02	(mg/m3)	7.0E-01	(mg/m³)	3.9E-02
				Ethylbenzene	NC (4)		6.4E-01	(mg/m3)	--		--	2.3E+00	(mg/m3)	1.0E+00	(mg/m³)	2.3E+00
				Methylene Chloride	NC (4)		7.0E-01	(mg/m3)	4.7E-04	(mg/m³)-¹	3.3E-04	2.5E+00	(mg/m3)	3.0E+00	(mg/m³)	8.4E-01
				n-Propylbenzene	NC (4)		1.9E-01	(mg/m3)	--		--	7.0E-01	(mg/m3)	1.4E-01	(mg/m³)	5.0E+00
				Styrene	NC (4)		7.4E-02	(mg/m3)	--		--	2.7E-01	(mg/m3)	1.0E+00	(mg/m³)	2.7E-01
				Tetrachloroethene	NC (4)		4.6E-03	(mg/m3)	5.9E-03	(mg/m³)-¹	2.7E-05	1.7E-02	(mg/m3)	3.5E-02	(mg/m³)	4.8E-01
				Tetrahydrofuran	NC (4)		3.7E+00	(mg/m3)	--		--	1.3E+01	(mg/m3)	3.0E-01	(mg/m³)	4.4E+01
				Toluene	NC (4)		7.0E+00	(mg/m3)	--		--	2.5E+01	(mg/m3)	5.0E+00	(mg/m³)	5.1E+00
				Trichloroethene	NC (4)		2.3E-02	(mg/m3)	2.0E-03	(mg/m³)-¹	4.5E-05	8.1E-02	(mg/m3)	6.0E-01	(mg/m³)	1.4E-01
				Trichlorofluoromethane	NC (4)		1.2E-01	(mg/m3)	--		--	4.4E-01	(mg/m3)	--		--
				Vinyl chloride	NC (4)		1.4E-02	(mg/m3)	8.8E-03	(mg/m³)-¹	1.2E-04	4.9E-02	(mg/m3)	1.0E-01	(mg/m³)	4.9E-01
				Xylenes (total)	NC (4)		1.6E-01	(mg/m3)	--		--	5.6E-01	(mg/m3)	1.0E-01	(mg/m³)	5.6E+00
			Exp. Route Total								1.0E-03					1.6E+02
	Exposure Medium Total										5.3E-02					9.3E+02
Total of Receptor Risks Across All Media											5E-02	Total of Receptor Hazards Across All Media				9.3E+02
Risks from Reference											0E+00					7.3E+01
Risks from Site											5E-02					8.6E+02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

(4) Refer to Appendix I for supporting information.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 3, Upland	Benzo(a)anthracene	8.6E-07	--	6.2E-07	1E-06	--	--	--	--	--
			Benzo(a)pyrene	8.6E-06	--	6.2E-06	1E-05	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	6.6E-07	--	4.8E-07	1E-06	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	5.6E-06	--	3.1E-06	9E-06	Liver	2.1E-01	--	1.2E-01	3E-01
			Di-n-octylphthalate	--	--	--	--	Not available	1.1E-01	--	6.1E-02	2E-01
			Indeno(1,2,3-cd)Pyrene	5.6E-07	--	4.1E-07	1E-06	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	1.4E-02	--	1.0E-02	2E-02
			Toluene	--	--	--	--	Kidney	2.4E-02	--	0.0E+00	2E-02
			Tetrachloroethene	3.9E-06	--	0.0E+00	4E-06	Liver	7.4E-03	--	0.0E+00	7E-03
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	1.2E-02	--	0.0E+00	1E-02
			Arsenic	2.4E-06	--	3.9E-07	3E-06	Skin; cardiovascular system	5.4E-02	--	9.0E-03	6E-02
			Cadmium	--	--	--	--	--	1.0E-02	--	2.3E-03	1E-02
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	4.1E-03	--	0.0E+00	4E-03
			Chemical Total	**2.3E-05**	**0.0E+00**	**1.1E-05**	**3E-05**		**4.4E-01**	**0.0E+00**	**2.0E-01**	**6E-01**
		Exposure Point Total		2.3E-05	0.0E+00	1.1E-05	3E-05		4.4E-01	0.0E+00	2.0E-01	6E-01
	Exposure Medium Total			2.3E-05	0.0E+00	1.1E-05	3E-05		4.4E-01	0.0E+00	2.0E-01	6E-01
Medium Total				2.3E-05	0.0E+00	1.1E-05	3E-05		4.4E-01	0.0E+00	2.0E-01	6E-01
Soil	Wetland Soil	Groups 5 6, Wetlands	Benzo(a)anthracene	3.0E-07	--	1.4E-07	4E-07	--	--	--	--	--
			Benzo(a)pyrene	3.0E-06	--	1.4E-06	4E-06	--	--	--	--	--
			Benzo(b)fluoranthene	3.8E-07	--	1.8E-07	6E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	2.6E-07	--	1.3E-07	4E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	3.6E-06	--	4.2E-07	4E-06	Skin; cardiovascular system	8.2E-02	--	7.5E-03	9E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.8E-03	--	0.0E+00	7E-03
			Vanadium	--	--	--	--	Hair cysteine	2.2E-03	--	0.0E+00	2E-03
			Chemical Total	**7.5E-06**	**0.0E+00**	**2.3E-06**	**1E-05**		**9.1E-02**	**0.0E+00**	**7.5E-03**	**1E-01**
		Exposure Point Total		7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
	Exposure Medium Total			7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
Medium Total				7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01

TABLE 3-33G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Surface Water	Groups 5 6, Wetlands	1,4-Dioxane	--	--	1.3E-09	1E-09	Liver	--	--	4.3E-06	4E-06
			Methylene Chloride	--	--	9.9E-10	1E-09	Liver	--	--	7.9E-06	8E-06
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	4.9E-07	5E-07	Skin; cardiovascular system	--	--	3.9E-03	4E-03
			Cadmium	--	--	--	--	--	--	--	4.5E-03	4E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	5.2E-03	5E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	3.9E-04	4E-04
			Zinc	--	--	--	--	Blood	--	--	8.2E-05	8E-05
			Chemical Total	**0.0E+00**	**0.0E+00**	**4.9E-07**	**5E-07**		**0.0E+00**	**0.0E+00**	**1.4E-02**	**1E-02**
		Exposure Point Total		0.0E+00	0.0E+00	4.9E-07	5E-07		0.0E+00	0.0E+00	1.4E-02	1E-02
	Exposure Medium Total			0.0E+00	0.0E+00	4.9E-07	5E-07		0.0E+00	0.0E+00	1.4E-02	1E-02
Medium Total				0.0E+00	0.0E+00	4.9E-07	5E-07		0.0E+00	0.0E+00	1.4E-02	1E-02
Sediment	Sediment	Groups 5 6, Wetlands	Benzo(a)pyrene	2.5E-06	--	3.0E-06	5E-06	--	--	--	--	--
			Trichloroethene	4.0E-09	--	0.0E+00	4E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	3.8E-05	--	1.1E-05	5E-05	Skin; cardiovascular system	8.7E-01	--	2.0E-01	1E+00
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.7E-03	--	0.0E+00	2E-03
			Vanadium	--	--	--	--	Hair cysteine	1.6E-03	--	0.0E+00	2E-03
			Chemical Total	**4.0E-05**	**0.0E+00**	**1.4E-05**	**5E-05**		**8.7E-01**	**0.0E+00**	**2.0E-01**	**1E+00**
		Exposure Point Total		4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
	Exposure Medium Total			4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Medium Total				4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	6.4E-07	--	6E-07	Blood; immune system	--	2.1E-02	--	2E-02
			Xylenes (total)	--	--	--	--	Nervous system	--	1.5E-01	--	1E-01
			Chemical Total	**0.0E+00**	**6.4E-07**	**0.0E+00**	**6E-07**		**0.0E+00**	**1.7E-01**	**0.0E+00**	**2E-01**
		Exposure Point Total		0.0E+00	6.4E-07	0.0E+00	6E-07		0.0E+00	1.7E-01	0.0E+00	2E-01
	Exposure Medium Total			0.0E+00	6.4E-07	0.0E+00	6E-07		0.0E+00	1.7E-01	0.0E+00	2E-01
Medium Total				0.0E+00	6.4E-07	0.0E+00	6E-07		0.0E+00	1.7E-01	0.0E+00	2E-01
Groundwater	Indoor Air	Group 3	1,4-Dichlorobenzene	--	--	--	--	Liver	--	3.9E-05	--	4E-05
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	--	1.8E-04	--	2E-04
			2-Methylphenol	--	--	--	--	Whole body; nervous system	--	5.5E-04	--	5E-04
			3-Methylphenol 4-Methylphenol	--	--	--	--	Whole body; nervous system	--	8.4E-03	--	8E-03
			4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	--	--
			Naphthalene	--	--	--	--	Respiratory system	--	1.6E-02	--	2E-02
			Phenol	--	--	--	--	Alimentary; cardiovascular; nervous systems; kidney	--	6.7E-04	--	7E-04
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	0.0E+00	--	--
			1,1,2-Trichloroethane	--	--	--	--	Blood	--	--	--	--
			1,1-Dichloroethane	--	--	--	--	None observed	--	0.0E+00	--	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	0.0E+00	--	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	2.4E-08	--	2E-08	Liver	--	2.9E-06	--	3E-06
			1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	0.0E+00	--	--
			1,2-Dichloropropane	--	--	--	--	Nasal mucosa	--	3.7E-03	--	4E-03
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	--	0.0E+00	--	--	Not available	--	0.0E+00	--	--
			2-Butanone	--	--	--	--	Development fetus	--	2.0E-02	--	2E-02
			4-Methyl-2-pentanone	--	--	--	--	Development fetus	--	1.4E-01	--	1E-01
			Acetone	--	--	--	--	Kidney	--	2.9E-02	--	3E-02

TABLE 3-33G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Group 3	Acrylonitrile	--	3.0E-05	--	3E-05	Respiratory system	--	9.7E-01	--	1E+00
			Benzene	--	3.4E-07	--	3E-07	Blood; immune system	--	1.1E-02	--	1E-02
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloroform	--	--	--	--	Kidney; development fetus; alimentary system	--	--	--	--
			Chloroethane	--	--	--	--	Development fetus	--	8.4E-02	--	8E-02
			Ethylbenzene	--	--	--	--	Development fetus	--	8.3E-01	--	8E-01
			Ethyl methacrylate	--	--	--	--	Kidney	--	9.9E-02	--	1E-01
			Isopropylbenzene	--	--	--	--	Kidney adrenal gland	--	0.0E+00	--	--
			Methylene Chloride	--	6.1E-06	--	6E-06	Liver	--	3.3E-02	--	3E-02
			n-Propylbenzene	--	--	--	--	Not available	--	5.9E-02	--	6E-02
			n-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			tert-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney adrenal gland	--	2.5E-02	--	2E-02
			Tetrachloroethene	--	3.9E-08	--	4E-08	Nervous system; eyes; respiratory system	--	1.5E-03	--	1E-03
			Tetrahydrofuran	--	--	--	--	--	--	3.7E-01	--	4E-01
			Toluene	--	--	--	--	Nervous system	--	1.6E+00	--	2E+00
			Trichloroethene	--	1.5E-08	--	2E-08	Nervous system; eyes	--	1.0E-04	--	1E-04
			Vinyl chloride	--	3.4E-07	--	3E-07	Liver	--	3.0E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	2.4E+01	--	2E+01
			Chemical Total	**0.0E+00**	**3.7E-05**	**0.0E+00**	**4E-05**		**0.0E+00**	**2.9E+01**	**0.0E+00**	**3E+01**
		Exposure Point Total		0.0E+00	3.7E-05	0.0E+00	4E-05		0.0E+00	2.9E+01	0.0E+00	3E+01
	Exposure Medium Total			0.0E+00	3.7E-05	0.0E+00	4E-05		0.0E+00	2.9E+01	0.0E+00	3E+01
Medium Total				0.0E+00	3.7E-05	0.0E+00	4E-05		0.0E+00	2.9E+01	0.0E+00	3E+01
	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	3.7E-07	--	2.2E-07	6E-07	None observed	1.6E-03	8.4E-04	8.4E-04	3E-03
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	4.0E-01	6.4E-03	4.8E-02	5E-01
			2-Methylphenol	--	--	--	--	Whole body; nervous system	8.9E-01	4.2E-02	8.9E-02	1E+00
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	1.9E+00	7.3E-01	1.5E-01	3E+00
			4-Methylphenol	--	--	--	--	Whole body; nervous system	2.4E-01	9.4E-02	1.9E-02	4E-01
			Aroclor 1254	2.3E-06	--	0.0E+00	2E-06	Eyes; immune system	2.7E+00	--	0.0E+00	3E+00
			Alpha-BHC	1.4E-06	--	3.8E-07	2E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	4.2E-05	4.8E-09	5.4E-05	1E-04	Liver	1.4E+00	6.2E-04	1.6E+00	3E+00
			Naphthalene	--	--	--	--	Whole body	2.5E-02	6.3E-01	1.3E-02	7E-01
			Phenol	--	--	--	--	Development Fetus	1.4E+00	2.7E-02	1.0E-01	2E+00
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	3.1E-02	3.0E-02	4.7E-03	7E-02
			1,1,2-Trichloroethane	1.9E-06	9.8E-07	1.6E-07	3E-06	Blood	7.7E-02	9.6E-02	5.7E-03	2E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	8.1E-01	1.8E+00	5.0E-02	3E+00
			1,1-Dichloroethene	--	--	--	--	Liver	1.2E-01	1.7E-01	1.3E-02	3E-01
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	2.0E-05	1.2E-05	8.4E-07	3E-05	Kidney	9.9E-03	4.0E-03	3.9E-04	1E-02
			1,2-Dichloroethene	--	--	--	--	Liver	6.5E-01	5.6E-01	4.5E-02	1E+00
			1,2-Dichloropropane	1.2E-06	--	1.0E-07	1E-06	--	--	2.1E-01	--	2E-01
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.6E-04	7.5E-06	5.0E-07	2E-04	Liver	1.3E+00	7.1E-03	3.8E-03	1E+00
			2-Butanone	--	--	--	--	Whole body	5.7E+00	6.0E-01	5.0E-02	6E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.1E+02	7.0E+00	3.9E+00	1E+02
			Acetone	--	--	--	--	Kidney	3.6E+00	1.3E+00	2.8E-02	5E+00
			Acrylonitrile	3.4E-03	4.5E-04	3.1E-05	4E-03	Reproductive	5.8E+01	4.2E+01	4.8E-01	1E+02
			Benzene	1.2E-05	4.4E-06	1.6E-06	2E-05	Blood; immune system	5.0E-01	4.2E-01	6.1E-02	1E+00
			Carbon tetrachloride	3.3E-05	7.9E-06	7.7E-06	5E-05	Liver	3.3E+00	4.7E+00	7.0E-01	9E+00
			Chloroethane	--	--	--	--	--	--	3.8E-01	--	4E-01
			Chloroform	8.6E-07	1.4E-06	6.9E-08	2E-06	Liver	2.6E-02	4.4E-03	1.8E-03	3E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	9.8E-01	9.3E-01	6.9E-02	2E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	3.8E+00	2.1E+00	1.8E+00	8E+00
			Ethyl methacrylate	--	--	--	--	Kidney	2.0E+00	2.4E+00	2.7E-01	5E+00

TABLE 3-33G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 3-6	Isopropylbenzene	--	--	--	--	Kidney	3.7E-02	2.3E-01	3.8E-02	3E-01
			Methylene Chloride	8.0E-05	1.2E-05	2.6E-06	9E-05	Liver	1.6E+00	1.9E-01	4.9E-02	2E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			n-Butylbenzene	--	--	--	--	--	--	6.8E-01	--	7E-01
			p-Isopropyltoluene	--	--	--	--	Kidney	4.3E-02	5.5E-02	9.0E-02	2E-01
			tert-Butylbenzene	--	--	--	--	--	--	5.1E-01	--	5E-01
			Tetrachloroethene	1.6E-05	3.5E-07	8.2E-06	2E-05	Liver	2.7E-02	3.7E-02	1.3E-02	8E-02
			Tetrahydrofuran	--	--	--	--	--	--	8.8E-01	--	9E-01
			Toluene	--	--	--	--	Kidney	4.4E-01	4.1E+00	1.2E-01	6E-01
			Trichloroethene	1.2E-05	1.3E-07	1.8E-06	1E-05	--	--	2.3E-03	--	2E-03
			Vinyl chloride	5.2E-04	8.7E-06	2.4E-05	6E-04	Liver	1.1E+00	2.2E-01	4.4E-02	1E+00
			Xylenes (total)	--	--	--	--	Whole body	6.3E+00	7.0E-01	4.3E+00	8E+01
			Antimony	--	--	--	--	Blood; whole body	1.1E+01	--	2.3E-01	1E+01
			Arsenic	1.7E-02	--	5.8E-05	2E-02	Skin; cardiovascular system	3.5E+02	--	1.1E+00	3E+02
			Barium	--	--	--	--	Kidney	8.3E-02	--	3.7E-03	9E-02
			Beryllium	--	--	--	--	Intestines	1.3E+01	--	5.6E+00	2E+01
			Cadmium	--	--	--	--	--	5.4E+00	--	3.3E-01	6E+00
			Chromium	--	--	--	--	None observed	2.7E+00	--	3.3E-01	3E+00
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.8E-01	--	2.2E-00	3E+01
			Nickel	--	--	--	--	Whole body	1.8E-01	--	2.8E-03	2E-01
			Silver	--	--	--	--	Skin	7.2E+00	--	3.3E-01	7E+00
			Thallium	--	--	--	--	Blood	2.7E+00	--	8.4E-03	3E+00
			Vanadium	--	--	--	--	Hair cysteine	5.0E-02	--	6.0E-03	6E-02
			Zinc	--	--	--	--	Blood	8.2E+00	--	1.5E-02	8E+00
			Chemical Total	**2.1E-02**	**5.1E-04**	**1.9E-04**	**2E-02**		**6.7E+02**	**2.3E+02**	**3.6E+01**	**9E+02**
		Exposure Point Total		2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
	Exposure Medium Total			2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Medium Total				2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Receptor Total							**2E-02**				**Receptor III Total**	**1E+03**
Site Related Receptor Risk Total							**2E-02**					**9E+02**
Reference Related Receptor Risk Total							**6E-05**					**6E+01**

Shaded Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 3, Upland	Benzo(a)anthracene	1.8E-06	--	7.2E-07	3E-06	--	--	--	--	--
			Benzo(a)pyrene	1.8E-05	--	7.2E-06	3E-05	--	--	--	--	--
			Benzo(c)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.4E-06	--	5.5E-07	2E-06	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	1.4E-05	--	4.4E-06	2E-05	Liver	4.1E-01	--	1.2E-01	5E-01
			Di-n-octylphthalate	--	--	--	--	Not available	2.2E-01	--	6.1E-02	3E-01
			Indeno(1,2,3-cd)Pyrene	1.2E-06	--	4.7E-07	2E-06	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	2.7E-02	--	1.0E-02	4E-02
			Toluene	--	--	--	--	Kidney	4.9E-02	--	0.0E+00	5E-02
			Tetrachloroethene	9.8E-06	--	0.0E+00	1E-05	Liver	1.5E-02	--	0.0E+00	1E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	2.5E-02	--	0.0E+00	2E-02
			Arsenic	3.9E-06	--	3.6E-07	6E-06	Skin; cardiovascular system	1.1E-01	--	9.0E-03	1E-01
			Cadmium	--	--	--	--	--	2.1E-02	--	2.3E-03	2E-02
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	8.2E-03	--	0.0E+00	8E-03
			Chemical Total	**5.2E-05**	**0.0E+00**	**1.4E-05**	**7E-05**		**8.8E-01**	**0.0E+00**	**2.0E-01**	**1E+00**
		Exposure Point Total		5.2E-05	0.0E+00	1.4E-05	7E-05		8.8E-01	0.0E+00	2.0E-01	1E+00
	Exposure Medium Total			5.2E-05	0.0E+00	1.4E-05	7E-05		8.8E-01	0.0E+00	2.0E-01	1E+00
Medium Total				5.2E-05	0.0E+00	1.4E-05	7E-05		8.8E-01	0.0E+00	2.0E-01	1E+00
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)anthracene	6.3E-07	--	2.1E-07	8E-07	--	--	--	--	--
			Benzo(a)pyrene	6.3E-06	--	2.1E-06	8E-06	--	--	--	--	--
			Benzo(b)fluoranthene	7.8E-07	--	2.6E-07	1E-06	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	5.5E-07	--	1.8E-07	7E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	9.1E-06	--	7.8E-07	1E-05	Skin; cardiovascular system	1.6E-01	--	7.4E-03	2E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.4E-02	--	0.0E+00	1E-02
			Vanadium	--	--	--	--	Hair cysteine	4.4E-03	--	0.0E+00	4E-03
			Chemical Total	**1.7E-05**	**0.0E+00**	**3.5E-06**	**2E-05**		**1.8E-01**	**0.0E+00**	**7.4E-03**	**2E-01**
		Exposure Point Total		1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
	Exposure Medium Total			1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Medium Total				1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01

TABLE 3-33H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Groups 5/6, Wetlands	1,4-Dioxane	--	--	2.6E-09	3E-09	Liver	--	--	9.4E-06	9E-06
			Methylene Chloride	--	--	1.9E-09	2E-09	Liver	--	--	1.7E-05	2E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	9.5E-07	9E-07	Skin: cardiovascular system	--	--	8.5E-03	8E-03
			Cadmium	--	--	--	--	--	--	--	9.7E-03	1E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	1.1E-02	1E-02
			Vanadium	--	--	--	--	Hair cysteine	--	--	8.5E-04	9E-04
			Zinc	--	--	--	--	Blood	--	--	1.8E-04	2E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**9.5E-07**	**1E-06**		**0.0E+00**	**0.0E+00**	**3.1E-02**	**3E-02**
		Exposure Point Total		0.0E+00	0.0E+00	9.5E-07	1E-06		0.0E+00	0.0E+00	3.1E-02	3E-02
	Exposure Medium Total			0.0E+00	0.0E+00	9.5E-07	1E-06		0.0E+00	0.0E+00	3.1E-02	3E-02
Medium Total				0.0E+00	0.0E+00	9.5E-07	1E-06		0.0E+00	0.0E+00	3.1E-02	3E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	5.2E-06	--	4.4E-06	1E-05	--	--	--	--	--
			Trichloroethene	1.0E-08	--	0.0E+00	1E-08	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	9.5E-05	--	2.1E-05	1E-04	Skin: cardiovascular system	1.7E+00	--	2.0E-01	2E+00
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.5E-03	--	0.0E+00	3E-03
			Vanadium	--	--	--	--	Hair cysteine	3.2E-03	--	0.0E+00	3E-03
			Chemical Total	**1.0E-04**	**0.0E+00**	**2.6E-05**	**1E-04**		**1.7E+00**	**0.0E+00**	**2.0E-01**	**2E+00**
		Exposure Point Total		1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
	Exposure Medium Total			1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Medium Total				1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.7E-06	--	2E-06	Blood: immune system	--	2.1E-02	--	2E-02
			Xylenes (total)	--	--	--	--	Nervous system	--	1.5E-01	--	1E-01
			Chemical Total	**0.0E+00**	**1.7E-06**	**0.0E+00**	**2E-06**		**0.0E+00**	**1.7E-01**	**0.0E+00**	**2E-01**
		Exposure Point Total		0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
	Exposure Medium Total			0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Medium Total				0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01

TABLE 3-33H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Group 3	1,4-Dichlorobenzene	--	--	--	--	Liver	--	3.9E-05	--	4E-05
			2,4-Dimethylphenol	--	--	--	--	Blood: whole body	--	1.8E-04	--	2E-04
			2-Methylphenol	--	--	--	--	Whole body: nervous system	--	5.5E-04	--	5E-04
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	--	8.4E-03	--	8E-03
			4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	--	--
			Naphthalene	--	--	--	--	Respiratory system	--	1.6E-02	--	2E-02
			Phenol	--	--	--	--	Alimentary, cardiovascular, nervous systems; kidney	--	6.7E-04	--	7E-04
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	0.0E+00	--	--
			1,1,2-Trichloroethane	--	--	--	--	Blood	--	--	--	--
			1,1-Dichloroethane	--	--	--	--	None observed	--	0.0E+00	--	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	0.0E+00	--	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	6.3E-08	--	6E-08	Liver	--	2.9E-06	--	3E-06
			1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	0.0E+00	--	--
			1,2-Dichloropropane	--	--	--	--	Nasal mucosa	--	3.7E-03	--	4E-03
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	--	0.0E+00	--	--	Not available	--	0.0E+00	--	--
			2-Butanone	--	--	--	--	Development/fetus	--	2.0E-02	--	2E-02
			4-Methyl-2-pentanone	--	--	--	--	Development/fetus	--	1.4E-01	--	1E-01
			Acetone	--	--	--	--	Kidney	--	2.9E-02	--	3E-02
			Acrylonitrile	--	7.9E-05	--	8E-05	Respiratory system	--	9.7E-01	--	1E+00
			Benzene	--	9.1E-07	--	9E-07	Blood: immune system	--	1.1E-02	--	1E-02
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloroform	--	--	--	--	alimentary system	--	--	--	--
			Chloroethane	--	--	--	--	Development/fetus	--	8.4E-02	--	8E-02
			Ethylbenzene	--	--	--	--	Development/fetus	--	8.3E-01	--	8E-01
			Ethyl methacrylate	--	--	--	--	Kidney	--	9.9E-02	--	1E-01
			Isopropylbenzene	--	--	--	--	Kidney/adrenal gland	--	0.0E+00	--	--
			Methylene Chloride	--	1.6E-05	--	2E-05	Liver	--	3.3E-02	--	3E-02
			n-Propylbenzene	--	--	--	--	Not available	--	5.9E-02	--	6E-02
			n-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			tert-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney/adrenal gland	--	2.5E-02	--	2E-02
			Tetrachloroethene	--	1.0E-07	--	1E-07	Nervous system; eyes; respiratory system	--	1.5E-03	--	1E-03
			Tetrahydrofuran	--	--	--	--	--	--	3.7E-01	--	4E-01
			Toluene	--	--	--	--	Nervous system	--	1.6E+00	--	2E+00
			Trichloroethene	--	4.1E-08	--	4E-08	Nervous system; eyes	--	1.0E-04	--	1E-04
			Vinyl chloride	--	9.1E-07	--	9E-07	Liver	--	3.0E-03	--	3E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	2.4E+01	--	2E+01
			Chemical Total	**0.0E+00**	**9.7E-05**	**0.0E+00**	**1E-04**		**0.0E+00**	**2.9E+01**	**0.0E+00**	**3E+01**
		Exposure Point Total		0.0E+00	9.7E-05	0.0E+00	1E-04		0.0E+00	2.9E+01	0.0E+00	3E+01
	Exposure Medium Total			0.0E+00	9.7E-05	0.0E+00	1E-04		0.0E+00	2.9E+01	0.0E+00	3E+01
Medium Total				0.0E+00	9.7E-05	0.0E+00	1E-04		0.0E+00	2.9E+01	0.0E+00	3E+01

TABLE 3-33H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	1.3E-06	--	6.9E-07	2E-06	None observed	3.0E-03	3.9E-03	1.5E-03	8E-03
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	7.5E-01	2.9E-02	8.3E-02	9E-01
			2-Methylphenol	--	--	--	--	Whole body; nervous system	1.7E+00	4.2E-02	1.5E-01	2E+00
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	3.5E+00	7.3E-01	2.6E-01	4E+00
			4-Methylphenol	--	--	--	--	Whole body; nervous system	4.5E-01	9.4E-02	3.3E-02	6E-01
			Aroclor 1254	7.9E-06	--	0.0E+00	8E-06	Eyes; immune system	5.0E+00	--	0.0E+00	5E+00
			Alpha-BHC	4.9E-06	--	1.2E-06	6E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	1.4E-04	1.3E-07	1.7E-04	3E-04	Liver	2.5E+00	2.9E-03	2.8E+00	5E+00
			Naphthalene	--	--	--	--	Whole body	4.6E-02	2.9E+00	2.3E-02	3E+00
			Phenol	--	--	--	--	Development/Fetus	2.6E+00	1.2E-01	1.8E-01	3E+00
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	5.8E-02	1.4E-01	8.2E-03	2E-01
			1,1,2-Trichloroethane	6.5E-06	2.8E-05	5.0E-07	3E-05	Blood	1.4E-01	4.4E-01	1.0E-02	6E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	1.5E+00	8.4E+00	8.7E-02	1E+01
			1,1-Dichloroethene	--	--	--	--	Liver	2.2E-01	7.9E-01	2.2E-02	1E+00
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	6.6E-05	3.3E-04	2.7E-06	4E-04	Kidney	1.8E-02	1.9E-02	6.7E-04	4E-02
			1,2-Dichloroethene	--	--	--	--	Liver	1.2E+00	2.6E+00	7.9E-02	4E+00
			1,2-Dichloropropane	4.0E-06	--	3.3E-07	4E-06	--	--	9.7E-01	--	1E+00
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	5.4E-04	2.1E-04	1.6E-06	8E-04	Liver	2.5E+00	3.3E-02	6.6E-03	3E+00
			2-Butanone	--	--	--	--	Whole body	1.1E+01	2.8E+00	8.6E-02	1E+01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.0E+02	3.2E+01	6.9E+00	2E+02
			Acetone	--	--	--	--	Kidney	6.7E+00	6.2E+00	4.9E-02	1E+01
			Acrylonitrile	1.2E-02	1.3E-02	9.8E-05	2E-02	Reproductive	1.1E+02	1.9E+02	8.3E-01	3E+02
			Benzene	4.1E-05	1.2E-04	5.1E-06	2E-04	Blood; immune system	9.3E-01	1.9E+00	1.1E-01	3E+00
			Carbon tetrachloride	1.1E-04	2.2E-04	2.4E-05	4E-04	Liver	6.2E+00	2.2E+01	1.2E+00	3E+01
			Chloroethane	--	--	--	--	--	--	3.8E-01	--	4E-01
			Chloroform	2.9E-06	3.9E-05	2.2E-07	4E-05	Liver	4.7E-02	2.0E-02	3.2E-03	7E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	1.8E+00	4.3E+00	1.2E-01	6E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	7.0E+00	9.7E+00	3.1E+00	2E+01
			Ethyl methacrylate	--	--	--	--	Kidney	3.7E+00	1.1E+01	4.7E-01	2E+01
			Isopropylbenzene	--	--	--	--	Kidney	6.8E-02	2.3E-01	6.7E-02	4E-01
			Methylene Chloride	2.7E-04	3.4E-04	8.3E-06	6E-04	Liver	3.0E+00	8.6E-01	8.5E-02	4E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			n-Butylbenzene	--	--	--	--	--	--	6.8E-01	--	7E-01
			p-Isopropyltoluene	--	--	--	--	Kidney	8.0E-02	2.5E-01	1.6E-01	5E-01
			tert-Butylbenzene	--	--	--	--	--	--	5.1E-01	--	5E-01
			Tetrachloroethene	5.3E-05	9.7E-06	2.6E-05	9E-05	Liver	5.0E-02	1.7E-01	2.2E-02	2E-01
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	8.1E+01	1.9E+01	2.1E+01	1E+02
			Trichloroethene	3.9E-05	3.6E-06	5.6E-06	5E-05	--	--	1.1E-02	--	1E-02

TABLE 3-33H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	Vinyl chloride	1.7E-03	2.4E-04	7.4E-05	2E-03	Liver	2.0E+00	1.0E+00	7.6E-02	3E+00
			Xylenes (total)	--	--	--	--	Whole body	1.2E+01	3.2E+02	7.5E+00	3E+02
			Antimony	--	--	--	--	Blood; whole body	2.1E+01	--	7.0E-01	2E+01
			Arsenic	5.7E-02	--	2.4E-04	6E-02	Skin; cardiovascular system	6.4E+02	--	3.3E+00	6E+02
			Barium	--	--	--	--	Kidney	1.5E-01	--	1.1E-02	2E-01
			Beryllium	--	--	--	--	Intestines	2.3E+01	--	1.7E+01	4E+01
			Cadmium	--	--	--	--	--	1.0E+01	--	1.0E+00	1E+01
			Chromium	--	--	--	--	None observed	5.0E+00	--	1.0E+00	6E+00
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	5.2E+01	--	6.5E+00	6E+01
			Nickel	--	--	--	--	Whole body	3.3E-01	--	8.4E-03	3E-01
			Silver	--	--	--	--	Skin	1.3E+01	--	1.0E+00	1E+01
			Thallium	--	--	--	--	Blood	3.0E+00	--	2.5E-02	5E+00
			Vanadium	--	--	--	--	Hair cysteine	9.2E-02	--	1.8E-02	1E-01
			Zinc	--	--	--	--	Blood	1.5E+01	--	4.6E-02	2E+01
			Chemical Total	**7.2E-02**	**1.4E-02**	**6.6E-04**	**9E-02**		**1.2E+03**	**7.3E+02**	**7.6E+01**	**2E+03**
		Exposure Point Total		7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
	Exposure Medium Total			7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Medium Total				7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Receptor Total							**9E-02**				**Receptor HI Total**	**2E+03**
Site Related Receptor Risk Total							**9E-02**					**2E+03**
Reference Related Receptor Risk Total							**1E-04**					**1E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33I

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child-Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 4, Upland	Benzo(a)anthracene	3.0E-05	--	2.1E-05	5E-05	--	--	--	--	--
			Benzo(a)pyrene	1.8E-04	--	1.3E-04	3E-04	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.3E-05	--	9.1E-06	2E-05	--	--	--	--	--
			Benzo(k)fluoranthene	1.6E-06	--	1.2E-06	3E-06	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	1.2E-07	--	6.5E-08	2E-07	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	1.4E-05	--	8.1E-06	2E-05
			Dibenzo(a,h)anthracene	3.0E-05	--	2.3E-05	5E-05	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	2.8E-02	--	1.6E-02	4E-02
			Indeno(1,2,3-cd)Pyrene	6.6E-06	--	4.8E-06	1E-05	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	8.2E-03	--	6.0E-03	1E-02
			2-Methylnaphthalene	--	--	--	--	Lungs	9.8E-03	--	7.2E-03	2E-02
			Naphthalene	--	--	--	--	Whole body	1.8E-03	--	1.3E-03	3E-03
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	6.5E-03	--	3.7E-03	1E-02
			Arsenic	2.8E-06	--	4.7E-07	3E-06	Skin; cardiovascular system	6.5E-02	--	1.1E-02	8E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.3E-03	--	0.0E+00	3E-03
			Vanadium	--	--	--	--	Hair cysteine	4.8E-03	--	0.0E+00	5E-03
			Chemical Total	**2.6E-04**	**0.0E+00**	**1.9E-04**	**5E-04**		**1.4E-01**	**0.0E+00**	**4.5E-02**	**2E-01**
		Exposure Point Total		2.6E-04	0.0E+00	1.9E-04	5E-04		1.4E-01	0.0E+00	4.5E-02	2E-01
	Exposure Medium Total			2.6E-04	0.0E+00	1.9E-04	5E-04		1.4E-01	0.0E+00	4.5E-02	2E-01
Medium Total				2.6E-04	0.0E+00	1.9E-04	5E-04		1.4E-01	0.0E+00	4.5E-02	2E-01
Soil	Wetland Soil	Groups 5,6, Wetlands	Benzo(a)anthracene	3.0E-07	--	1.4E-07	4E-07	--	--	--	--	--
			Benzo(a)pyrene	3.0E-06	--	1.4E-06	4E-06	--	--	--	--	--
			Benzo(b)fluoranthene	3.8E-07	--	1.8E-07	6E-07	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	2.6E-07	--	1.3E-07	4E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	3.6E-06	--	4.2E-07	4E-06	Skin; cardiovascular system	8.2E-02	--	7.5E-03	9E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.8E-03	--	0.0E+00	7E-03
			Vanadium	--	--	--	--	Hair cysteine	2.2E-03	--	0.0E+00	2E-03
			Chemical Total	**7.5E-06**	**0.0E+00**	**2.3E-06**	**1E-05**		**9.1E-02**	**0.0E+00**	**7.5E-03**	**1E-01**
		Exposure Point Total		7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
	Exposure Medium Total			7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
Medium Total				7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
	Surface Water	Groups 5,6, Wetlands	1,4-Dioxane	--	--	1.3E-09	1E-09	Liver	--	--	4.3E-06	4E-06
			Methylene Chloride	--	--	9.9E-10	1E-09	Liver	--	--	7.9E-06	8E-06
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	4.9E-07	5E-07	Skin; cardiovascular system	--	--	3.9E-03	4E-03
			Cadmium	--	--	--	--	--	--	--	4.5E-03	4E-03
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	5.2E-03	5E-03
			Vanadium	--	--	--	--	Hair cysteine	--	--	3.9E-04	4E-04
			Zinc	--	--	--	--	Blood	--	--	8.2E-05	8E-05
			Chemical Total	**0.0E+00**	**0.0E+00**	**4.9E-07**	**5E-07**		**0.0E+00**	**0.0E+00**	**1.4E-02**	**1E-02**
		Exposure Point Total		0.0E+00	0.0E+00	4.9E-07	5E-07		0.0E+00	0.0E+00	1.4E-02	1E-02
	Exposure Medium Total			0.0E+00	0.0E+00	4.9E-07	5E-07		0.0E+00	0.0E+00	1.4E-02	1E-02
Medium Total				0.0E+00	0.0E+00	4.9E-07	5E-07		0.0E+00	0.0E+00	1.4E-02	1E-02

TABLE 3-33I

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5-6, Wetlands	Benzo(a)pyrene	2.5E-06	--	3.0E-06	5E-06	--	--	--	--	--
			Trichloroethene	4.0E-09	--	0.0E+00	4E-09	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	3.8E-05	--	1.1E-05	5E-05	Skin; cardiovascular system	8.7E-01	--	2.0E-01	1E+00
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.7E-03	--	0.0E+00	2E-03
			Vanadium	--	--	--	--	Hair; cysteine	1.6E-03	--	0.0E+00	2E-03
			Chemical Total	**4.0E-05**	**0.0E+00**	**1.4E-05**	**5E-05**		**8.7E-01**	**0.0E+00**	**2.0E-01**	**1E+00**
		Exposure Point Total		4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
	Exposure Medium Total			4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Medium Total				4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	6.4E-07	--	6E-07	Blood; immune system	--	2.1E-02	--	2E-02
			Xylenes (total)	--	--	--	--	Nervous system	--	1.5E-01	--	1E-01
			Chemical Total	**0.0E+00**	**6.4E-07**	**0.0E+00**	**6E-07**		**0.0E+00**	**1.7E-01**	**0.0E+00**	**2E-01**
		Exposure Point Total		0.0E+00	6.4E-07	0.0E+00	6E-07		0.0E+00	1.7E-01	0.0E+00	2E-01
	Exposure Medium Total			0.0E+00	6.4E-07	0.0E+00	6E-07		0.0E+00	1.7E-01	0.0E+00	2E-01
Medium Total				0.0E+00	6.4E-07	0.0E+00	6E-07		0.0E+00	1.7E-01	0.0E+00	2E-01
Groundwater	Indoor Air	Group 4	Tetrachloroethene	--	3.0E-09	--	3E-09	Nervous system; eyes; respiratory system	--	1.1E-04	--	1E-04
			Trichloroethane	--	7.0E-10	--	7E-10	Nervous system; eyes	--	4.5E-06	--	5E-06
			Chemical Total	**0.0E+00**	**3.7E-09**	**0.0E+00**	**4E-09**		**0.0E+00**	**1.2E-04**	**0.0E+00**	**1E-04**
		Exposure Point Total		0.0E+00	3.7E-09	0.0E+00	4E-09		0.0E+00	1.2E-04	0.0E+00	1E-04
	Exposure Medium Total			0.0E+00	3.7E-09	0.0E+00	4E-09		0.0E+00	1.2E-04	0.0E+00	1E-04
Medium Total				0.0E+00	3.7E-09	0.0E+00	4E-09		0.0E+00	1.2E-04	0.0E+00	1E-04
	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	3.7E-07	--	2.2E-07	6E-07	None observed	1.6E-03	8.4E-04	8.4E-04	3E-03
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	4.0E-01	6.4E-03	4.8E-02	5E-01
			2-Methylphenol	--	--	--	--	Whole body; nervous system	8.9E-01	4.2E-02	8.9E-02	1E+00
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	1.9E+00	7.3E-01	1.5E-01	3E+00
			4-Methylphenol	--	--	--	--	Whole body; nervous system	2.4E-01	9.4E-02	1.9E-02	4E-01
			Aroclor 1254	2.3E-06	--	0.0E+00	2E-06	Eyes; immune system	2.7E+00	--	0.0E+00	3E+00
			Alpha-BHC	1.4E-06	--	3.8E-07	2E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	4.2E-05	4.8E-09	5.4E-05	1E-04	Liver	1.4E+00	6.2E-04	1.6E+00	3E+00
			Naphthalene	--	--	--	--	Whole body	2.5E-02	6.3E-01	1.3E-02	7E-01
			Phenol	--	--	--	--	Development; Fetus	1.4E+00	2.7E-02	1.0E-01	2E+00
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	3.1E-02	3.0E-02	4.7E-03	7E-02
			1,1,2-Trichloroethane	1.9E-06	9.8E-07	1.6E-07	3E-06	Blood	7.7E-02	9.6E-02	5.7E-03	2E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	8.1E-01	1.8E+00	5.0E-02	3E+00
			1,1-Dichloroethene	--	--	--	--	Liver	1.2E-01	1.7E-01	1.3E-02	3E-01

TABLE 3-33I

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 3-6	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	2.0E-05	1.2E-05	8.4E-07	3E-05	Kidney	9.9E-03	4.0E-03	3.9E-04	1E-02
			1,2-Dichloroethene	--	--	--	--	Liver	6.5E-01	5.6E-01	4.5E-02	1E+00
			1,2-Dichloropropane	1.2E-06	--	1.0E-07	1E-06	--	--	2.1E-01	--	2E-01
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.6E-04	7.5E-06	5.0E-07	2E-04	Liver	1.3E+00	7.1E-03	3.8E-03	1E+00
			2-Butanone	--	--	--	--	Whole body	5.7E+00	6.0E-01	5.0E-02	6E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.1E+02	7.0E+00	3.9E+00	1E+02
			Acetone	--	--	--	--	Kidney	3.6E+00	1.3E+00	2.8E-02	5E+00
			Acrylonitrile	3.4E-03	4.5E-04	3.1E-05	4E-03	Reproductive	5.8E+01	4.2E+01	4.8E-01	1E+02
			Benzene	1.2E-05	4.4E-06	1.6E-06	2E-05	Blood; immune system	5.0E+01	4.2E+01	6.1E-02	1E+00
			Carbon tetrachloride	3.3E-05	7.9E-06	7.7E-06	5E-05	Liver	3.3E+00	4.7E+00	7.0E-01	9E+00
			Chloroethane	--	--	--	--	--	--	3.8E-01	--	4E-01
			Chloroform	8.6E-07	1.4E-06	6.9E-08	2E-06	Liver	2.6E-02	4.4E-03	1.8E-03	3E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	9.8E+01	9.3E+01	6.9E-02	2E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	3.8E+00	2.1E+00	1.8E+00	8E+00
			Ethyl methacrylate	--	--	--	--	Kidney	2.0E+00	2.4E+00	2.7E-01	5E+00
			Isopropylbenzene	--	--	--	--	Kidney	3.7E-02	2.3E-01	3.8E-02	3E-01
			Methylene Chloride	8.0E-05	1.2E-05	2.6E-06	9E-05	Liver	1.6E+00	1.9E-01	4.9E-02	2E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			n-Butylbenzene	--	--	--	--	--	--	6.8E-01	--	7E-01
			p-Isopropyltoluene	--	--	--	--	Kidney	4.3E-02	5.5E-02	9.0E-02	2E-01
			tert-Butylbenzene	--	--	--	--	--	--	5.1E-01	--	5E-01
			Tetrachloroethene	1.6E-05	3.5E-07	8.2E-06	2E-05	Liver	2.7E-02	3.7E-02	1.3E-02	8E-02
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	4.4E+01	4.1E+00	1.2E-01	6E+01
			Trichloroethene	1.2E-05	1.3E-07	1.8E-06	1E-05	--	--	2.3E-03	--	2E-03
			Vinyl chloride	5.2E-04	8.7E-06	2.4E-05	6E-04	Liver	1.1E+00	2.2E-01	4.4E-02	1E+00
			Xylenes (total)	--	--	--	--	Whole body	6.3E+00	7.0E+01	4.3E+00	8E+01
			Antimony	--	--	--	--	Blood; whole body	1.1E+01	--	2.3E-01	1E+01
			Arsenic	1.7E-02	--	5.8E-05	2E-02	Skin; cardiovascular system	3.5E+02	--	1.1E+00	3E+02
			Barium	--	--	--	--	Kidney	8.3E-02	--	3.7E-03	9E-02
			Beryllium	--	--	--	--	Intestines	1.3E+01	--	5.6E+00	2E+01
			Cadmium	--	--	--	--	--	5.4E+00	--	3.3E-01	6E+00
			Chromium	--	--	--	--	None observed	2.7E+00	--	3.3E-01	3E+00
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	2.8E+01	--	2.2E+00	3E+01
			Nickel	--	--	--	--	Whole body	1.8E-01	--	2.8E-03	2E-01
			Silver	--	--	--	--	Skin	7.2E+00	--	3.3E-01	7E+00
			Thallium	--	--	--	--	Blood	2.7E+00	--	8.4E-03	3E+00
			Vanadium	--	--	--	--	Hair cysteine	5.0E-02	--	6.0E-03	6E-02
			Zinc	--	--	--	--	Blood	8.2E+00	--	1.5E-02	8E+00
			Chemical Total	**2.1E-02**	**5.1E-04**	**1.9E-04**	**2E-02**		**6.7E+02**	**2.3E+02**	**3.6E+01**	**9E+02**
		Exposure Point Total		2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
	Exposure Medium Total			2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Medium Total				2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Receptor Total							**2E-02**				**Receptor HI Total**	**9E+02**
Site Related Receptor Risk Total							**2E-02**					**9E+02**
Reference Related Receptor Risk Total							**1E-04**					**6E+01**

Shaded Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 4. Upland	Benzo(a)anthracene	6.2E-05	--	2.5E-05	9E-05	--	--	--	--	--
			Benzo(a)pyrene	3.7E-04	--	1.5E-04	5E-04	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	2.6E-05	--	1.1E-05	4E-05	--	--	--	--	--
			Benzo(k)fluoranthene	3.3E-06	--	1.3E-06	5E-06	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	2.9E-07	--	9.3E-08	4E-07	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	2.9E-05	--	8.1E-06	4E-05
			Dibenzo(a,h)anthracene	6.3E-05	--	2.5E-05	9E-05	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	5.5E-02	--	1.6E-02	7E-02
			Indeno(1,2,3-cd)Pyrene	1.4E-05	--	5.5E-06	2E-05	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	1.6E-02	--	6.0E-03	2E-02
			2-Methylnaphthalene	--	--	--	--	Lungs	2.0E-02	--	7.2E-03	3E-02
			Naphthalene	--	--	--	--	Whole body	3.6E-03	--	1.3E-03	5E-03
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	1.3E-02	--	3.7E-03	2E-02
			Arsenic	7.1E-06	--	6.8E-07	8E-06	Skin; cardiovascular system	1.3E-01	--	1.1E-02	1E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.7E-03	--	0.0E+00	7E-03
			Vanadium	--	--	--	--		9.6E-03	--	0.0E+00	1E-02
			Chemical Total	**5.5E-04**	**0.0E+00**	**2.2E-04**	**7.7E-04**		**2.7E-01**	**0.0E+00**	**4.5E-02**	**3.2E-01**
		Exposure Point Total		5.5E-04	0.0E+00	2.2E-04	8E-04		2.7E-01	0.0E+00	4.5E-02	3E-01
	Exposure Medium Total			5.5E-04	0.0E+00	2.2E-04	8E-04		2.7E-01	0.0E+00	4.5E-02	3E-01
Medium Total				5.5E-04	0.0E+00	2.2E-04	8E-04		2.7E-01	0.0E+00	4.5E-02	3E-01

TABLE 3-33J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)anthracene	6.3E-07	--	2.1E-07	8E-07	--	--	--	--	--
			Benzo(a)pyrene	6.3E-06	--	2.1E-06	8E-06	--	--	--	--	--
			Benzo(b)fluoranthene	7.8E-07	--	2.6E-07	1E-06	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	5.5E-07	--	1.8E-07	7E-07	--	--	--	--	--
			Perylene	--	--	--	--	--	--	--	--	--
			Arsenic	9.1E-06	--	7.8E-07	1E-05	Skin; cardiovascular system	1.6E-01	--	7.4E-03	2E-01
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.4E-02	--	0.0E+00	1E-02
			Vanadium	--	--	--	--	Hair cysteine	4.4E-03	--	0.0E+00	4E-03
			Chemical Total	**1.7E-05**	**0.0E+00**	**3.5E-06**	**2E-05**		**1.8E-01**	**0.0E+00**	**7.4E-03**	**2E-01**
		Exposure Point Total		1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
	Exposure Medium Total			1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Medium Total				1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Surface Water	Surface Water	Groups 5/6, Wetlands	1,4-Dioxane	--	--	2.6E-09	3E-09	Liver	--	--	9.4E-06	9E-06
			Methylene Chloride	--	--	1.9E-09	2E-09	Liver	--	--	1.7E-05	2E-05
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	--	--	9.5E-07	9E-07	Skin; cardiovascular system	--	--	8.5E-03	8E-03
			Cadmium	--	--	--	--	--	--	--	9.7E-03	1E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	1.1E-02	1E-02
			Vanadium	--	--	--	--	Hair cysteine	--	--	8.5E-04	9E-04
			Zinc	--	--	--	--	Blood	--	--	1.8E-04	2E-04
			Chemical Total	**0.0E+00**	**0.0E+00**	**9.5E-07**	**1E-06**		**0.0E+00**	**0.0E+00**	**3.1E-02**	**3E-02**
		Exposure Point Total		0.0E+00	0.0E+00	9.5E-07	1E-06		0.0E+00	0.0E+00	3.1E-02	3E-02
	Exposure Medium Total			0.0E+00	0.0E+00	9.5E-07	1E-06		0.0E+00	0.0E+00	3.1E-02	3E-02
Medium Total				0.0E+00	0.0E+00	9.5E-07	1E-06		0.0E+00	0.0E+00	3.1E-02	3E-02

TABLE 3-33J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	5.2E-06	--	4.4E-06	1E-05	--	--	--	--	--
			Trichloroethene	1.0E-08	--	0.0E+00	1E-08	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Arsenic	9.5E-05	--	2.1E-05	1E-04	Skin; cardiovascular system	1.7E+00	--	2.0E-01	2E+00
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.5E-03	--	0.0E+00	3E-03
			Vanadium	--	--	--	--	Hair cysteine	3.2E-03	--	0.0E+00	3E-03
			Chemical Total	**1.0E-04**	**0.0E+00**	**2.6E-05**	**1E-04**		**1.7E+00**	**0.0E+00**	**2.0E-01**	**2E+00**
		Exposure Point Total		1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
	Exposure Medium Total			1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Medium Total				1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Air	Ambient Air	Site	1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Benzene	--	1.7E-06	--	2E-06	Blood; immune system	--	2.1E-02	--	2E-02
			Xylenes (total)	--	--	--	--	Nervous system	--	1.5E-01	--	1E-01
			Chemical Total	**0.0E+00**	**1.7E-06**	**0.0E+00**	**2E-06**		**0.0E+00**	**1.7E-01**	**0.0E+00**	**2E-01**
		Exposure Point Total		0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
	Exposure Medium Total			0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Medium Total				0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Groundwater	Indoor Air	Group 4, Upland	Tetrachloroethene	--	7.9E-09	--	8E-09	Nervous system; eyes; respiratory system	--	1.1E-04	--	1E-04
			Trichloroethene	--	1.9E-09	--	2E-09	Nervous system; eyes	--	4.5E-06	--	5E-06
			Chemical Total	**0.0E+00**	**9.8E-09**	**0.0E+00**	**1E-08**		**0.0E+00**	**1.2E-04**	**0.0E+00**	**1E-04**
		Exposure Point Total		0.0E+00	9.8E-09	0.0E+00	1E-08		0.0E+00	1.2E-04	0.0E+00	1E-04
	Exposure Medium Total			0.0E+00	9.8E-09	0.0E+00	1E-08		0.0E+00	1.2E-04	0.0E+00	1E-04
Medium Total				0.0E+00	9.8E-09	0.0E+00	1E-08		0.0E+00	1.2E-04	0.0E+00	1E-04

TABLE 3-33J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	1.3E-06	--	6.9E-07	2E-06	None observed	3.0E-03	3.9E-03	1.5E-03	8E-03
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	7.5E-01	2.9E-02	8.3E-02	9E-01
			2-Methylphenol	--	--	--	--	Whole body; nervous system	1.7E+00	4.2E-02	1.5E-01	2E+00
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	3.5E+00	7.3E-01	2.6E-01	4E+00
			4-Methylphenol	--	--	--	--	Whole body; nervous system	4.5E-01	9.4E-02	3.3E-02	6E-01
			Aroclor 1254	7.9E-06	--	0.0E+00	8E-06	Eyes; immune system	5.0E+00	--	0.0E+00	5E+00
			Alpha-BHC	4.9E-06	--	1.2E-06	6E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	1.4E-04	1.3E-07	1.7E-04	3E-04	Liver	2.5E+00	2.9E-03	2.8E+00	5E+00
			Naphthalene	--	--	--	--	Whole body	4.6E-02	2.9E+00	2.3E-02	3E+00
			Phenol	--	--	--	--	Development/Fetus	2.6E+00	1.2E-01	1.8E-01	3E+00
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	5.8E-02	1.4E-01	8.2E-03	2E-01
			1,1,2-Trichloroethane	6.5E-06	2.8E-05	5.0E-07	3E-05	Blood	1.4E-01	4.4E-01	1.0E-02	6E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	1.5E+00	8.4E+00	8.7E-02	1E+01
			1,1-Dichloroethene	--	--	--	--	Liver	2.2E-01	7.9E-01	2.2E-02	1E+00
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	6.6E-05	3.3E-04	2.7E-06	4E-04	Kidney	1.8E-02	1.9E-02	6.7E-04	4E-02
			1,2-Dichloroethene	--	--	--	--	Liver	1.2E+00	2.6E+00	7.9E-02	4E+00
			1,2-Dichloropropane	4.0E-06	--	3.3E-07	4E-06	--	--	9.7E-01	--	1E+00
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	5.4E-04	2.1E-04	1.6E-06	8E-04	Liver	2.5E+00	3.3E-02	6.6E-03	3E+00
			2-Butanone	--	--	--	--	Whole body	1.1E+01	2.8E+00	8.6E-02	1E+01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.0E+02	3.2E+01	6.9E+00	2E+02
			Acetone	--	--	--	--	Kidney	6.7E+00	6.2E+00	4.9E-02	1E+01
			Acrylonitrile	1.2E-02	1.3E-02	9.8E-05	2E-02	Reproductive	1.1E+02	1.9E+02	8.3E-01	3E+02
			Benzene	4.1E-05	1.2E-04	5.1E-06	2E-04	Blood; immune system	9.3E-01	1.9E+00	1.1E-01	3E+00
			Carbon tetrachloride	1.1E-04	2.2E-04	2.4E-05	4E-04	Liver	6.2E+00	2.2E+01	1.2E+00	3E+01
			Chloroethane	--	--	--	--	--	--	3.8E-01	--	4E-01
			Chloroform	2.9E-06	3.9E-05	2.2E-07	4E-05	Liver	4.7E-02	2.0E-02	3.2E-03	7E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	1.8E+00	4.3E+00	1.2E-01	6E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	7.0E+00	9.7E+00	3.1E+00	2E+01
			Ethyl methacrylate	--	--	--	--	Kidney	3.7E+00	1.1E+01	4.7E-01	2E+01
			Isopropylbenzene	--	--	--	--	Kidney	6.8E-02	2.3E-01	6.7E-02	4E-01
			Methylene Chloride	2.7E-04	3.4E-04	8.3E-06	6E-04	Liver	3.0E+00	8.6E-01	8.5E-02	4E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			n-Butylbenzene	--	--	--	--	--	--	6.8E-01	--	7E-01
			p-Isopropyltoluene	--	--	--	--	Kidney	8.0E-02	2.5E-01	1.6E-01	5E-01

TABLE 3-33J

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	tert-Butylbenzene	--	--	--	--	--	--	5.1E-01	--	5E-01
			Tetrachloroethene	5.3E-05	9.7E-06	2.6E-05	9E-05	Liver	5.0E-02	1.7E-01	2.2E-02	2E-01
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	8.1E+01	1.9E+01	2.1E+01	1E+02
			Trichloroethene	3.9E-05	3.6E-06	5.6E-06	5E-05	--	--	1.1E-02	--	1E-02
			Vinyl chloride	1.7E-03	2.4E-04	7.4E-05	2E-03	Liver	2.0E+00	1.0E+00	7.6E-02	3E+00
			Xylenes (total)	--	--	--	--	Whole body	1.2E+01	3.2E+02	7.5E+00	3E+02
			Antimony	--	--	--	--	Blood, whole body	2.1E+01	--	7.0E-01	2E+01
			Arsenic	5.7E-02	--	2.4E-04	6E-02	Skin, cardiovascular system	6.4E+02	--	3.3E+00	6E+02
			Barium	--	--	--	--	Kidney	1.5E-01	--	1.1E-02	2E-01
			Beryllium	--	--	--	--	Intestines	2.3E+01	--	1.7E+01	4E+01
			Cadmium	--	--	--	--	--	1.0E+01	--	1.0E+00	1E+01
			Chromium	--	--	--	--	None observed	5.0E+00	--	1.0E+00	6E+00
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	5.2E+01	--	6.5E+00	6E+01
			Nickel	--	--	--	--	Whole body	3.3E-01	--	8.4E-03	3E-01
			Silver	--	--	--	--	Skin	1.3E+01	--	1.0E+00	1E+01
			Thallium	--	--	--	--	Blood	5.0E+00	--	2.5E-02	5E+00
			Vanadium	--	--	--	--	Hair cysteine	9.2E-02	--	1.8E-02	1E-01
			Zinc	--	--	--	--	Blood	1.5E+01	--	4.6E-02	2E+01
			Chemical Total	**7.2E-02**	**1.4E-02**	**6.6E-04**	**9E-02**		**1.2E+03**	**7.3E+02**	**7.6E+01**	**2E+03**
		Exposure Point Total		7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
	Exposure Medium Total			7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Medium Total				7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Receptor Total							**9E-02**				**Receptor HI Total**	**2E+03**
Site Related Receptor Risk Total							**9E-02**					**2E+03**
Reference Related Receptor Risk Total							**2E-04**					**1E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33K

RISK SUMMARY

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 1 2 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 1 & 2	1,4-Dichlorobenzene	1.3E-06	--	7.5E-07	2E-06	None observed	5.5E-03	2.9E-03	2.9E-03	1E-02
			2-Methylnaphthalene	--	--	--	--	Lungs	9.3E-03	9.8E-04	4.9E-03	2E-02
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	8.9E+00	3.5E+00	7.0E-01	1E+01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	9.8E+00	3.8E+00	7.7E-01	1E+01
			Acetophenone	--	--	--	--	Whole body	1.4E-02	--	9.6E-04	1E-02
			Naphthalene	--	--	--	--	Whole body	5.4E-01	1.4E+01	2.8E-01	1E+01
			N-Nitrosodi-n-butylamine	2.8E-05	3.0E-04	1.6E-06	3E-04	--	--	--	--	--
			N-Nitrosopyrrolidine	9.9E-05	5.1E-07	5.6E-07	1E-04	--	--	--	--	--
			o-Toluidine	3.7E-06	--	1.2E-07	4E-06	--	--	--	--	--
			Phenol	--	--	--	--	Development Fetus	3.9E-01	7.4E-03	2.8E-02	4E-01
			Pyridine	--	--	--	--	Liver	1.9E+00	8.9E-01	5.1E-02	3E+00
			1,1-Dichloroethane	--	--	--	--	Nervous system	1.2E-01	2.7E-01	7.3E-03	4E-01
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	3.1E-06	1.8E-06	1.3E-07	5E-06	Kidney	1.5E-03	6.3E-04	6.0E-05	2E-03
			1,2-Dichloroethene	--	--	--	--	Liver	7.5E-01	6.5E-01	5.2E-02	1E+00
			cis-1,2-Dichloroethene	--	--	--	--	Blood	2.0E+00	1.9E+00	1.4E-01	4E+00
			1,2-Dichloropropane	1.1E-06	--	9.9E-08	1E-06	--	--	2.0E-01	--	2E-01
			1,2,4-Trichlorobenzene	--	--	--	--	Kidney	1.1E-02	3.1E-03	1.2E-02	3E-02
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	4.4E-05	2.1E-06	1.4E-07	5E-05	Liver	3.7E-01	2.0E-03	1.1E-03	4E-01
			2-Butanone	--	--	--	--	Whole body	2.0E+00	2.1E-01	1.7E-02	2E+00
			2-Hexanone	--	--	--	--	--	--	--	--	--
			4-Methyl-2-pentanone	--	--	--	--	Whole body	7.3E+00	4.8E-01	2.7E-01	8E+00
			Acetone	--	--	--	--	Kidney	1.0E+00	3.9E-01	8.1E-03	1E+00
			Benzene	1.0E-05	3.8E-06	1.4E-06	2E-05	Blood; immune system	4.3E-01	3.5E-01	5.1E-02	8E-01
			Chlorobenzene	--	--	--	--	Liver	6.3E-02	1.3E-01	1.8E-02	2E-01
			Chloroethane	--	--	--	--	--	--	6.5E-01	--	6E-01
			Chloroform	2.6E-07	4.2E-07	2.0E-08	7E-07	Liver	7.6E-03	1.3E-03	5.5E-04	9E-03
			Dichlorodifluoromethane	--	--	--	--	Whole body	2.1E-02	5.3E-01	2.0E-03	6E-01
			Ethyl Ether	--	--	--	--	Whole body	6.7E-02	3.9E-02	1.2E-03	1E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	8.9E-01	5.0E-01	4.3E-01	2E+00

TABLE 3-33K

RISK SUMMARY

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 1 2 Resident
Receptor Age: Child Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 1 & 2	Methylene Chloride	7.8E-05	1.2E-05	2.6E-06	9E-05	Liver	1.6E+00	1.8E-01	4.7E-02	2E+00
			n-Propylbenzene	--	--	--	--	--	--	5.0E+00	--	5E+00
			Styrene	--	--	--	--	Blood; liver	5.4E-02	5.8E-02	1.9E-02	1E-01
			Tetrachloroethene	4.5E-05	9.8E-07	2.3E-05	7E-05	Liver	7.6E-02	1.0E-01	3.6E-02	2E-01
			Tetrahydrofuran	--	--	--	--	--	--	4.4E+01	--	4E+01
			Toluene	--	--	--	--	Kidney	1.2E+01	1.1E+00	3.2E+00	2E+01
			Trichloroethene	1.5E-04	1.6E-06	2.2E-05	2E-04	--	--	2.9E-02	--	3E-02
			Trichlorofluoromethane	--	--	--	--	Whole body	6.1E-02	--	9.4E-03	7E-02
			Vinyl chloride	2.6E-04	4.3E-06	1.2E-05	3E-04	Liver	5.2E-01	1.1E-01	2.1E-02	7E-01
			Xylenes (total)	--	--	--	--	Whole body	1.1E-01	1.2E+00	7.5E-02	1E+00
			Antimony	--	--	--	--	Blood; whole body	5.8E-01	--	1.2E-02	6E-01
			Arsenic	1.5E-02	--	5.0E-05	1E-02	Skin; cardiovascular system	3.0E+02	--	9.3E-01	3E+02
			Barium	--	--	--	--	Kidney	3.6E-01	--	1.6E-02	4E-01
			Beryllium	--	--	--	--	Intestines	6.7E-01	--	3.0E-01	1E+00
			Cadmium	--	--	--	--	--	3.2E+01	--	2.0E+00	3E+01
			Cobalt	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	1.9E+01	--	1.5E+00	2E+01
			Nickel	--	--	--	--	Whole body	4.7E-01	--	7.3E-03	5E-01
			Selenium	--	--	--	--	Cardiovascular, alimentary and nervous systems	6.3E-01	--	1.9E-03	6E-01
			Thallium	--	--	--	--	Blood	2.6E+00	--	8.2E-03	3E+00
			Vanadium	--	--	--	--	Hair cysteine	1.5E-01	--	1.8E-02	2E-01
			Chemical Total	**1.5E-02**	**3.3E-04**	**1.2E-04**	**2E-02**		**4.1E+02**	**8.0E+01**	**1.1E+01**	**5E+02**
		Exposure Point Total		1.5E-02	3.3E-04	1.2E-04	2E-02		4.1E+02	8.0E+01	1.1E+01	5E+02
	Exposure Medium Total			1.5E-02	3.3E-04	1.2E-04	2E-02		4.1E+02	8.0E+01	1.1E+01	5E+02
Medium Total				1.5E-02	3.3E-04	1.2E-04	2E-02		4.1E+02	8.0E+01	1.1E+01	5E+02
Receptor Total							**2E-02**				**Receptor III Total**	**5E+02**
Site Related Receptor Risk Total							**2E-02**					**5E+02**
Reference Related Receptor Risk Total							**0E+00**					**4E+01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33L

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 1 2 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 1 & 2	1,4-Dichlorobenzene	4.3E-06	--	2.4E-06	7E-06	None observed	1.0E-02	1.3E-02	5.0E-03	3E-02
			2-Methylnaphthalene	--	--	--	--	Lungs	1.7E-02	4.5E-03	6.5E-03	3E-02
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	1.7E+01	3.5E+00	9.3E-01	2E+01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	1.8E+01	3.8E+00	1.0E+00	2E+01
			Acetophenone	--	--	--	--	Whole body	2.6E-02	--	1.3E-03	3E-02
			Naphthalene	--	--	--	--	Whole body	1.0E+00	6.3E+01	3.7E-01	6E+01
			N-Nitrosodi-n-butylamine	9.6E-05	3.0E-04	5.1E-06	4E-04	--	--	--	--	--
			N-Nitrosopyrrolidine	3.3E-04	5.1E-07	1.8E-06	3E-04	--	--	--	--	--
			o-Toluidine	1.2E-05	--	3.7E-07	1E-05	--	--	--	--	--
			Phenol	--	--	--	--	Development/Fetus	7.2E-01	3.4E-02	3.7E-02	8E-01
			Pyridine	--	--	--	--	Liver	3.5E+00	8.9E-01	6.8E-02	4E+00
			1,1-Dichloroethane	--	--	--	--	Nervous system	2.2E-01	1.2E+00	9.7E-03	1E+00
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	1.0E-05	5.1E-05	4.1E-07	6E-05	Kidney	2.9E-03	2.9E-03	7.9E-05	6E-03
			1,2-Dichloroethene	--	--	--	--	Liver	1.4E+00	3.0E+00	6.9E-02	4E+00
			cis-1,2-Dichloroethene	--	--	--	--	Blood	3.7E+00	8.7E+00	1.9E-01	1E+01
			1,2-Dichloropropane	3.8E-06	--	3.1E-07	4E-06	--	--	9.2E-01	--	9E-01
			1,2,4-Trichlorobenzene	--	--	--	--	Kidney	2.1E-02	1.3E-02	1.5E-02	5E-02
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.5E-04	5.8E-05	4.4E-07	2E-04	Liver	6.9E-01	9.0E-03	1.4E-03	7E-01
			2-Butanone	--	--	--	--	Whole body	3.7E+00	9.7E-01	2.3E-02	5E+00
			2-Hexanone	--	--	--	--	--	--	--	--	--
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.4E+01	2.2E+00	3.6E-01	2E+01
			Acetone	--	--	--	--	Kidney	1.9E+00	1.8E+00	1.1E-02	4E+00
			Benzene	3.4E-05	1.1E-04	4.3E-06	1E-04	Blood; immune system	7.9E-01	1.6E+00	6.8E-02	2E+00
			Chlorobenzene	--	--	--	--	Liver	1.2E-01	6.1E-01	2.4E-02	8E-01
			Chloroethane	--	--	--	--	--	--	6.5E-01	--	6E-01
			Chloroform	8.6E-07	1.2E-05	6.4E-08	1E-05	Liver	1.4E-02	6.1E-03	7.3E-04	2E-02
			Dichlorodifluoromethane	--	--	--	--	Whole body	3.9E-02	7.2E-01	2.7E-03	8E-01
			Ethyl Ether	--	--	--	--	Whole body	1.2E-01	3.9E-02	1.6E-03	2E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	1.7E+00	2.3E+00	5.6E-01	5E+00
			Methylene Chloride	2.6E-04	3.3E-04	8.1E-06	6E-04	Liver	3.0E+00	8.4E-01	6.3E-02	4E+00
			n-Propylbenzene	--	--	--	--	--	--	5.0E+00	--	5E+00
			Styrene	--	--	--	--	Blood; liver	1.0E-01	2.7E-01	2.5E-02	4E-01
			Tetrachloroethene	1.5E-04	2.7E-05	7.3E-05	3E-04	Liver	1.4E-01	4.8E-01	4.8E-02	7E-01
			Tetrahydrofuran	--	--	--	--	--	--	4.4E+01	--	4E+01
			Toluene	--	--	--	--	Kidney	2.2E-01	5.1E+00	4.3E+00	3E+01
			Trichloroethene	5.0E-04	4.5E-05	7.1E-05	6E-04	--	--	1.4E-01	--	1E-01
			Trichlorofluoromethane	--	--	--	--	Whole body	1.1E-01	--	1.3E-02	1E-01

TABLE 3-33L

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 1 2 Resident
Receptor Age: Child-Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 1 & 2	Vinyl chloride	8.6E-04	1.2E-04	3.7E-05	1E-03	Liver	9.7E-01	4.9E-01	2.8E-02	1E+00
			Xylenes (total)	--	--	--	--	Whole body	2.0E-01	5.6E+00	9.9E-02	6E+00
			Antimony	--	--	--	--	Blood; whole body	1.1E+00	--	2.1E-02	1E+00
			Arsenic	4.9E-02	--	2.1E-04	5E-02	Skin; cardiovascular system	5.5E+02	--	1.6E+00	6E+02
			Barium	--	--	--	--	Kidney	6.6E-01	--	2.8E-02	7E-01
			Beryllium	--	--	--	--	Intestines	1.2E+00	--	5.2E-01	2E+00
			Cadmium	--	--	--	--	--	6.0E+01	--	3.5E+00	6E+01
			Cobalt	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.6E+01	--	2.6E+00	4E+01
			Nickel	--	--	--	--	Whole body	8.7E-01	--	1.3E-02	9E-01
			Selenium	--	--	--	--	Cardiovascular, alimentary and nervous systems	1.2E+00	--	3.4E-03	1E+00
			Thallium	--	--	--	--	Blood	4.9E+00	--	1.4E-02	5E+00
			Vanadium	--	--	--	--	Hair cysteine	2.8E-01	--	3.1E-02	3E-01
			Chemical Total	**5.2E-02**	**1.0E-03**	**4.1E-04**	**5E-02**		**7.5E+02**	**1.6E+02**	**1.7E+01**	**9E+02**
		Exposure Point Total		5.2E-02	1.0E-03	4.1E-04	5E-02		7.5E+02	1.6E+02	1.7E+01	9E+02
	Exposure Medium Total			5.2E-02	1.0E-03	4.1E-04	5E-02		7.5E+02	1.6E+02	1.7E+01	9E+02
Medium Total				5.2E-02	1.0E-03	4.1E-04	5E-02		7.5E+02	1.6E+02	1.7E+01	9E+02
Receptor Total							**5E-02**				**Receptor III Total**	**9E+02**
Site Related Receptor Risk Total							**5E-02**					**9E+02**
Reference Related Receptor Risk Total							**0E+00**					**7E+01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-33M
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 3
Exposure Medium:	Upland Soil (0-10')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	1.10	1 through <2	15	100	150	1	25550	1.00E-06	0.73	10	3.1E-07
		1.10	2 through <7	15	100	150	5	25550	1.00E-06	0.73	3	4.7E-07
		1.10	7 through <10	28	50	150	3	25550	1.00E-06	0.73	3	7.6E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*8.6E-07*
	Benzo(a)pyrene	1.10	1 through <2	15	100	150	1	25550	1.00E-06	7.3	10	3.1E-06
		1.10	2 through <7	15	100	150	5	25550	1.00E-06	7.3	3	4.7E-06
		1.10	7 through <10	28	50	150	3	25550	1.00E-06	7.3	3	7.6E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*8.6E-06*
	Benzo(b)fluoranthene	0.840	1 through <2	15	100	150	1	25550	1.00E-06	0.73	10	2.4E-07
		0.840	2 through <7	15	100	150	5	25550	1.00E-06	0.73	3	3.6E-07
		0.840	7 through <10	28	50	150	3	25550	1.00E-06	0.73	3	5.8E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*6.6E-07*
	Indeno(1,2,3-cd)pyrene	0.720	1 through <2	15	100	150	1	25550	1.00E-06	0.73	10	2.1E-07
		0.720	2 through <7	15	100	150	5	25550	1.00E-06	0.73	3	3.1E-07
		0.720	7 through <10	28	50	150	3	25550	1.00E-06	0.73	3	5.0E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*5.6E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**1.1E-05**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	1.10	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	2.3E-07
		1.10	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.73	3	3.4E-07
		1.10	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	0.73	3	5.0E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*6.2E-07*
	Benzo(a)pyrene	1.10	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	7.3	10	2.3E-06
		1.10	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	7.3	3	3.4E-06
		1.10	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	7.3	3	5.0E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*6.2E-06*
	Benzo(b)fluoranthene	0.840	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	1.7E-07
		0.840	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.73	3	2.6E-07
		0.840	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	0.73	3	3.8E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*4.8E-07*
	Indeno(1,2,3-cd)pyrene	0.720	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	1.5E-07
		0.720	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.73	3	2.2E-07
		0.720	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	0.73	3	3.3E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.1E-07*
	CUMULATIVE RISK: Dermal Contact with Soil													**7.7E-06**
CUMULATIVE RISK, Group 3, Upland Soil (0-10') : Future Site Resident														**1.8E-05**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE J-33M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 4
Exposure Medium:	Upland Soil (0-10')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	38.0	1 through <2	15	100	150	1	25550	1.00E-06	0.73	10	1.1E-05
		38.0	2 through <7	15	100	150	5	25550	1.00E-06	0.73	3	1.6E-05
		38.0	7 through <10	28	50	150	3	25550	1.00E-06	0.73	3	2.6E-06
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene											*3.0E-05*
	Benzo(a)pyrene	22.8	1 through <2	15	100	150	1	25550	1.00E-06	7.3	10	6.5E-05
		22.8	2 through <7	15	100	150	5	25550	1.00E-06	7.3	3	9.8E-05
		22.8	7 through <10	28	50	150	3	25550	1.00E-06	7.3	3	1.6E-05
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene											*1.8E-04*
	Benzo(b)fluoranthene	16.1	1 through <2	15	100	150	1	25550	1.00E-06	0.73	10	4.6E-06
		16.1	2 through <7	15	100	150	5	25550	1.00E-06	0.73	3	6.9E-06
		16.1	7 through <10	28	50	150	3	25550	1.00E-06	0.73	3	1.1E-06
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene											*1.3E-05*
	Benzo(k)fluoranthene	20.3	1 through <2	15	100	150	1	25550	1.00E-06	0.073	10	5.8E-07
		20.3	2 through <6	15	100	150	5	25550	1.00E-06	0.073	3	8.7E-07
		20.3	7 through <10	28	50	150	3	25550	1.00E-06	0.073	3	1.4E-07
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(k)fluoranthene											*1.6E-06*
	Dibenzo(a,h)anthracene	3.88	1 through <2	15	100	150	1	25550	1.00E-06	7.3	10	1.1E-05
		3.88	2 through <6	15	100	150	5	25550	1.00E-06	7.3	3	1.7E-05
		3.88	7 through <10	28	50	150	3	25550	1.00E-06	7.3	3	2.7E-06
	CUMULATIVE RISK - Incidental Ingestion of Soil:Dibenzo(a,h)anthracene											*3.0E-05*
	Indeno(1,2,3-cd)pyrene	8.49	1 through <2	15	100	150	1	25550	1.00E-06	0.73	10	2.4E-06
		8.49	2 through <7	15	100	150	5	25550	1.00E-06	0.73	3	3.6E-06
		8.49	7 through <10	28	50	150	3	25550	1.00E-06	0.73	3	5.8E-07
	CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene											*6.6E-06*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**2.6E-04**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	38.0	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	7.9E-06
		38.0	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.73	3	1.2E-05
		38.0	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	0.73	3	1.7E-06
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene													*2.1E-05*
	Benzo(a)pyrene	22.8	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	7.3	10	4.7E-05
		22.8	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	7.3	3	7.1E-05
		22.8	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	7.3	3	1.0E-05
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene													*1.3E-04*
	Benzo(b)fluoranthene	16.1	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	3.3E-06
		16.1	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.73	3	5.0E-06
		16.1	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	0.73	3	7.3E-07
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene													*9.1E-06*
	Benzo(k)fluoranthene	20.3	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.073	10	4.2E-07
		20.3	2 through <6	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.073	3	6.3E-07
		20.3	7 through <10	28	5700	0.13	0.07	150	3	25550	1.00E-06	0.073	3	1.5E-07
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(k)fluoranthene													*1.2E-06*
	Dibenzo(a,h)anthracene	3.88	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	7.3	10	8.1E-06
		3.88	2 through <6	15	2800	0.13	0.2	150	5	25550	1.00E-06	7.3	3	1.2E-05
		3.88	7 through <10	28	5700	0.13	0.07	150	3	25550	1.00E-06	7.3	3	2.8E-06
	CUMULATIVE RISK - Dermal Contact with Soil:Dibenzo(a,h)anthracene													*2.3E-05*
	Indeno(1,2,3-cd)pyrene	8.49	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	1.8E-06
		8.49	2 through <7	15	2800	0.13	0.2	150	5	25550	1.00E-06	0.73	3	2.6E-06
		8.49	7 through <10	28	3636	0.13	0.07	150	3	25550	1.00E-06	0.73	3	3.9E-07
	CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene													*4.8E-06*
	CUMULATIVE RISK: Dermal Contact with Soil													**1.9E-04**
CUMULATIVE RISK, Group 4, Upland Soil (0-10') : Future Site Resident														**4.5E-04**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor; SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion: Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact: Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 5
Exposure Medium:	Wetland Soil (0-1')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	0.640	1 through <2	15	100	90	1	25550	1.00E-06	0.73	10	1.1E-07
		0.640	2 through <7	15	100	90	5	25550	1.00E-06	0.73	3	1.6E-07
		0.640	7 through <10	28	50	90	3	25550	1.00E-06	0.73	3	2.6E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*3.0E-07*
	Benzo(a)pyrene	0.640	1 through <2	15	100	90	1	25550	1.00E-06	7.3	10	1.1E-06
		0.640	2 through <7	15	100	90	5	25550	1.00E-06	7.3	3	1.6E-06
		0.640	7 through <10	28	50	90	3	25550	1.00E-06	7.3	3	2.6E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*3.0E-06*
	Benzo(b)fluoranthene	0.800	1 through <2	15	100	90	1	25550	1.00E-06	0.73	10	1.4E-07
		0.800	2 through <7	15	100	90	5	25550	1.00E-06	0.73	3	2.1E-07
		0.800	7 through <10	28	50	90	3	25550	1.00E-06	0.73	3	3.3E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*3.8E-07*
	Indeno(1,2,3-cd)pyrene	0.560	1 through <2	15	100	90	1	25550	1.00E-06	0.73	10	9.6E-08
		0.560	2 through <7	15	100	90	5	25550	1.00E-06	0.73	3	1.4E-07
		0.560	7 through <10	28	50	90	3	25550	1.00E-06	0.73	3	2.3E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*2.6E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**3.9E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	0.640	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	0.73	10	4.3E-08
		0.640	2 through <7	15	2026	0.13	0.15	90	5	25550	1.00E-06	0.73	3	6.5E-08
		0.640	7 through <10	28	3522	0.13	0.15	90	3	25550	1.00E-06	0.73	3	3.6E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*1.4E-07*
	Benzo(a)pyrene	0.640	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	7.3	10	4.3E-07
		0.640	2 through <7	15	2026	0.13	0.15	90	5	25550	1.00E-06	7.3	3	6.5E-07
		0.640	7 through <10	28	3522	0.13	0.15	90	3	25550	1.00E-06	7.3	3	3.6E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*1.4E-06*
	Benzo(b)fluoranthene	0.800	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	0.73	10	5.4E-08
		0.800	2 through <7	15	2026	0.13	0.15	90	5	25550	1.00E-06	0.73	3	8.1E-08
		0.800	7 through <10	28	3522	0.13	0.15	90	3	25550	1.00E-06	0.73	3	4.5E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*1.8E-07*
	Indeno(1,2,3-cd)pyrene	0.560	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	0.73	10	3.8E-08
		0.560	2 through <7	15	2026	0.13	0.15	90	5	25550	1.00E-06	0.73	3	5.7E-08
		0.560	7 through <10	28	3522	0.13	0.15	90	3	25550	1.00E-06	0.73	3	3.2E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*1.3E-07*
	CUMULATIVE RISK: Dermal Contact with Soil													**1.9E-06**
CUMULATIVE RISK, Group 5, Wetland Soil (0-1') : Future Site Resident														**5.8E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33M, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURES
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Groups 5&6
Exposure Medium:	Sediment (0-1')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Sediment	Benzo(a)pyrene	0.53	1 through <2	15	100	90	1	25550	1.00E-06	7.3	10	9.1E-07
		0.53	2 through <7	15	100	90	5	25550	1.00E-06	7.3	3	1.4E-06
		0.53	7 through <10	28	50	90	3	25550	1.00E-06	7.3	3	2.2E-07
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene											*2.5E-06*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**2.5E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Sediment	Benzo(a)pyrene	0.53	1 through <2	15	2218	0.13	0.34	90	1	25550	1.00E-06	7.3	10	8.9E-07
		0.53	2 through <7	15	2218	0.13	0.34	90	5	25550	1.00E-06	7.3	3	1.3E-06
		0.53	7 through <10	28	4046	0.13	0.33	90	3	25550	1.00E-06	7.3	3	7.6E-07
	CUMULATIVE RISK - Dermal Contact with Sediment:Benzo(a)pyrene													*3.0E-06*
	CUMULATIVE RISK: Dermal Contact with Soil													**3.0E-06**
CUMULATIVE RISK, Groups 5&6, Sediment (0-1') : Future Site Resident														**5.5E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33N
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 3
Exposure Medium:	Upland Soil (0-10')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	1.10	1 through <2	15	200	150	1	25550	1.00E-06	0.73	10	6.3E-07
		1.10	2 through <6	15	200	150	4	25550	1.00E-06	0.73	3	7.5E-07
		1.10	6 through <16	45	100	150	10	25550	1.00E-06	0.73	3	3.1E-07
		1.10	16-31	70	100	150	15	25550	1.00E-06	0.73	1	1.0E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*1.8E-06*
	Benzo(a)pyrene	1.10	1 through <2	15	200	150	1	25550	1.00E-06	7.3	10	6.3E-06
		1.10	2 through <6	15	200	150	4	25550	1.00E-06	7.3	3	7.5E-06
		1.10	6 through <16	45	100	150	10	25550	1.00E-06	7.3	3	3.1E-06
		1.10	16-31	70	100	150	15	25550	1.00E-06	7.3	1	1.0E-06
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*1.8E-05*
	Benzo(b)fluoranthene	0.840	1 through <2	15	200	150	1	25550	1.00E-06	0.73	10	4.8E-07
		0.840	2 through <6	15	200	150	4	25550	1.00E-06	0.73	3	5.8E-07
		0.840	6 through <16	45	100	150	10	25550	1.00E-06	0.73	3	2.4E-07
		0.840	16-31	70	100	150	15	25550	1.00E-06	0.73	1	7.7E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*1.4E-06*
	Indeno(1,2,3-cd)pyrene	0.720	1 through <2	15	200	150	1	25550	1.00E-06	0.73	10	4.1E-07
		0.720	2 through <6	15	200	150	4	25550	1.00E-06	0.73	3	4.9E-07
		0.720	6 through <16	45	100	150	10	25550	1.00E-06	0.73	3	2.1E-07
		0.720	16-31	70	100	150	15	25550	1.00E-06	0.73	1	6.6E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*1.2E-06*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**2.2E-05**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	1.10	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	2.3E-07
		1.10	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.73	3	2.7E-07
		1.10	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.73	3	1.6E-07
		1.10	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.73	1	5.2E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*7.2E-07*
	Benzo(a)pyrene	1.10	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	7.3	10	2.3E-06
		1.10	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	7.3	3	2.7E-06
		1.10	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	7.3	3	1.6E-06
		1.10	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	7.3	1	5.2E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*7.2E-06*
	Benzo(b)fluoranthene	0.840	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	1.7E-07
		0.840	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.73	3	2.1E-07
		0.840	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.73	3	1.2E-07
		0.840	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.73	1	4.0E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*5.5E-07*
	Indeno(1,2,3-cd)pyrene	0.720	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	1.5E-07
		0.720	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.73	3	1.8E-07
		0.720	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.73	3	1.1E-07
		0.720	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.73	1	3.4E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*4.7E-07*
	CUMULATIVE RISK: Dermal Contact with Soil													**8.9E-06**
CUMULATIVE RISK, Group 3, Upland Soil (0-10') : Future Site Resident														**3.1E-05**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 4
Exposure Medium:	Upland Soil (0-10')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	38.0	1 through <2	15	200	150	1	25550	1.00E-06	0.73	10	2.2E-05
		38.0	2 through <6	15	200	150	4	25550	1.00E-06	0.73	3	2.6E-05
		38.0	6 through <16	45	100	150	10	25550	1.00E-06	0.73	3	1.1E-05
		38.0	16-31	70	100	150	15	25550	1.00E-06	0.73	1	3.5E-06
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene											*6.2E-05*
	Benzo(a)pyrene	22.8	1 through <2	15	200	150	1	25550	1.00E-06	7.3	10	1.3E-04
		22.8	2 through <6	15	200	150	4	25550	1.00E-06	7.3	3	1.6E-04
		22.8	6 through <16	45	100	150	10	25550	1.00E-06	7.3	3	6.5E-05
		22.8	16-31	70	100	150	15	25550	1.00E-06	7.3	1	2.1E-05
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene											*3.7E-04*
	Benzo(b)fluoranthene	16.1	1 through <2	15	200	150	1	25550	1.00E-06	0.73	10	9.2E-06
		16.1	2 through <6	15	200	150	4	25550	1.00E-06	0.73	3	1.1E-05
		16.1	6 through <16	45	100	150	10	25550	1.00E-06	0.73	3	4.6E-06
		16.1	16-31	70	100	150	15	25550	1.00E-06	0.73	1	1.5E-06
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene											*2.6E-05*
	Benzo(k)fluoranthene	20.3	1 through <2	15	200	150	1	25550	1.00E-06	0.073	10	1.2E-06
		20.3	2 through <6	15	200	150	4	25550	1.00E-06	0.073	3	1.4E-06
		20.3	6 through <16	45	100	150	10	25550	1.00E-06	0.073	3	5.8E-07
		20.3	16-31	70	100	150	15	25550	1.00E-06	0.073	1	1.9E-07
	CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(k)fluoranthene											*3.3E-06*
	Dibenzo(a,h)anthracene	3.88	1 through <2	15	200	150	1	25550	1.00E-06	7.3	10	2.2E-05
		3.88	2 through <6	15	200	150	4	25550	1.00E-06	7.3	3	2.7E-05
		3.88	6 through <16	45	100	150	10	25550	1.00E-06	7.3	3	1.1E-05
		3.88	16-31	70	100	150	15	25550	1.00E-06	7.3	1	3.6E-06
	CUMULATIVE RISK - Incidental Ingestion of Soil:Dibenzo(a,h)anthracene											*6.3E-05*
	Indeno(1,2,3-cd)pyrene	8.49	1 through <2	15	200	150	1	25550	1.00E-06	0.73	10	4.9E-06
		8.49	2 through <6	15	200	150	4	25550	1.00E-06	0.73	3	5.8E-06
		8.49	6 through <16	45	100	150	10	25550	1.00E-06	0.73	3	2.4E-06
		8.49	16-31	70	100	150	15	25550	1.00E-06	0.73	1	7.8E-07
	CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene											*1.4E-05*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**5.4E-04**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	38.0	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	7.9E-06
		38.0	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.73	3	9.5E-06
		38.0	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.73	3	5.6E-06
		38.0	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.73	1	1.8E-06
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene													*2.5E-05*
	Benzo(a)pyrene	22.8	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	7.3	10	4.7E-05
		22.8	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	7.3	3	5.7E-05
		22.8	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	7.3	3	3.4E-05
		22.8	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	7.3	1	1.1E-05
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene													*1.5E-04*
	Benzo(b)fluoranthene	16.1	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	3.3E-06
		16.1	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.73	3	4.0E-06
		16.1	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.73	3	2.4E-06
		16.1	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.73	1	7.7E-07
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene													*1.1E-05*
	Benzo(k)fluoranthene	20.3	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.073	10	4.2E-07
		20.3	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.073	3	5.1E-07
		20.3	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.073	3	3.0E-07
		20.3	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.073	1	9.7E-08
	CUMULATIVE RISK - Dermal Contact with Soil:Benzo(k)fluoranthene													*1.3E-06*
	Dibenzo(a,h)anthracene	3.88	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	7.3	10	8.1E-06
		3.88	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	7.3	3	9.7E-06
		3.88	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	7.3	3	5.8E-06
		3.88	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	7.3	1	1.8E-06
	CUMULATIVE RISK - Dermal Contact with Soil:Dibenzo(a,h)anthracene													*2.5E-05*
	Indeno(1,2,3-cd)pyrene	8.49	1 through <2	15	2800	0.13	0.2	150	1	25550	1.00E-06	0.73	10	1.8E-06
		8.49	2 through <6	15	2800	0.13	0.2	150	4	25550	1.00E-06	0.73	3	2.1E-06
		8.49	6 through <16	45	5700	0.13	0.07	150	10	25550	1.00E-06	0.73	3	1.3E-06
		8.49	16-31	70	5700	0.13	0.07	150	15	25550	1.00E-06	0.73	1	4.0E-07
	CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene													*5.5E-06*
	CUMULATIVE RISK: Dermal Contact with Soil													**2.2E-04**
CUMULATIVE RISK, Group 4, Upland Soil (0-10') : Future Site Resident														7.6E-04

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion: Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact: Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Group 5
Exposure Medium:	Wetland Soil (0-1')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Soil	Benzo(a)anthracene	0.640	1 through <2	15	200	90	1	25550	1.00E-06	0.73	10	2.2E-07
		0.640	2 through <6	15	200	90	4	25550	1.00E-06	0.73	3	2.6E-07
		0.640	6 through <16	45	100	90	10	25550	1.00E-06	0.73	3	1.1E-07
		0.640	16-31	70	100	90	15	25550	1.00E-06	0.73	1	3.5E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)anthracene										*6.3E-07*
	Benzo(a)pyrene	0.640	1 through <2	15	200	90	1	25550	1.00E-06	7.3	10	2.2E-06
		0.640	2 through <6	15	200	90	4	25550	1.00E-06	7.3	3	2.6E-06
		0.640	6 through <16	45	100	90	10	25550	1.00E-06	7.3	3	1.1E-06
		0.640	16-31	70	100	90	15	25550	1.00E-06	7.3	1	3.5E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*6.3E-06*
	Benzo(b)fluoranthene	0.800	1 through <2	15	200	90	1	25550	1.00E-06	0.73	10	2.7E-07
		0.800	2 through <6	15	200	90	4	25550	1.00E-06	0.73	3	3.3E-07
		0.800	6 through <16	45	100	90	10	25550	1.00E-06	0.73	3	1.4E-07
		0.800	16-31	70	100	90	15	25550	1.00E-06	0.73	1	4.4E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(b)fluoranthene										*7.8E-07*
	Indeno(1,2,3-cd)pyrene	0.560	1 through <2	15	200	90	1	25550	1.00E-06	0.73	10	1.9E-07
		0.560	2 through <6	15	200	90	4	25550	1.00E-06	0.73	3	2.3E-07
		0.560	6 through <16	45	100	90	10	25550	1.00E-06	0.73	3	9.6E-08
		0.560	16-31	70	100	90	15	25550	1.00E-06	0.73	1	3.1E-08
		CUMULATIVE RISK - Incidental Ingestion of Soil:Indeno(1,2,3-cd)pyrene										*5.5E-07*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**8.2E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Soil	Benzo(a)anthracene	0.640	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	0.73	10	4.3E-08
		0.640	2 through <6	15	2026	0.13	0.15	90	4	25550	1.00E-06	0.73	3	5.2E-08
		0.640	6 through <16	45	4241	0.13	0.14	90	10	25550	1.00E-06	0.73	3	8.5E-08
		0.640	16-31	70	4241	0.13	0.14	90	15	25550	1.00E-06	0.73	1	2.7E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)anthracene												*2.1E-07*
	Benzo(a)pyrene	0.640	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	7.3	10	4.3E-07
		0.640	2 through <6	15	2026	0.13	0.15	90	4	25550	1.00E-06	7.3	3	5.2E-07
		0.640	6 through <16	45	4241	0.13	0.14	90	10	25550	1.00E-06	7.3	3	8.5E-07
		0.640	16-31	70	4241	0.13	0.14	90	15	25550	1.00E-06	7.3	1	2.7E-07
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(a)pyrene												*2.1E-06*
	Benzo(b)fluoranthene	0.800	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	0.73	10	5.4E-08
		0.800	2 through <6	15	2026	0.13	0.15	90	4	25550	1.00E-06	0.73	3	6.5E-08
		0.800	6 through <16	45	4241	0.13	0.14	90	10	25550	1.00E-06	0.73	3	1.1E-07
		0.800	16-31	70	4241	0.13	0.14	90	15	25550	1.00E-06	0.73	1	3.4E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Benzo(b)fluoranthene												*2.6E-07*
	Indeno(1,2,3-cd)pyrene	0.560	1 through <2	15	2026	0.13	0.15	90	1	25550	1.00E-06	0.73	10	3.8E-08
		0.560	2 through <6	15	2026	0.13	0.15	90	4	25550	1.00E-06	0.73	3	4.6E-08
		0.560	6 through <16	45	4241	0.13	0.14	90	10	25550	1.00E-06	0.73	3	7.4E-08
		0.560	16-31	70	4241	0.13	0.14	90	15	25550	1.00E-06	0.73	1	2.4E-08
		CUMULATIVE RISK - Dermal Contact with Soil:Indeno(1,2,3-cd)pyrene												*1.8E-07*
	CUMULATIVE RISK: Dermal Contact with Soil													**2.7E-06**
CUMULATIVE RISK, Group 5, Wetland Soil (0-1') : Future Site Resident														**1.1E-05**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-33N, CONTINUED
CALCULATION OF CANCER RISKS FOR COPCS WITH A MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point:	Groups 5&6
Exposure Medium:	Sediment (0-1')
Receptor:	Future Site Resident

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	IR (mg/day)	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Incidental Ingestion of Sediment	Benzo(a)pyrene	0.53	1 through <2	15	200	90	1	25550	1.00E-06	7.3	10	1.8E-06
		0.53	2 through <6	15	200	90	4	25550	1.00E-06	7.3	3	2.2E-06
		0.53	6 through <16	45	100	90	10	25550	1.00E-06	7.3	3	9.1E-07
		0.53	16-31	70	100	90	15	25550	1.00E-06	7.3	1	2.9E-07
		CUMULATIVE RISK - Incidental Ingestion of Soil:Benzo(a)pyrene										*5.2E-06*
	CUMULATIVE RISK: Incidental Ingestion of Soil											**5.2E-06**

Exposure Pathway	COPC	EPC (mg/kg)	Age (years)	BW (kg)	SA (cm2)	ABSd (unitless)	AF mg/cm^2	EF (days/year)	ED (years)	AT (days)	CF (kg/mg)	SF (mg/kg-d)-1	ADAF (unitless)	Risk
Dermal Contact with Sediment	Benzo(a)pyrene	0.53	1 through <2	15	2218	0.13	0.34	90	1	25550	1.00E-06	7.3	10	8.9E-07
		0.53	2 through <6	15	2218	0.13	0.34	90	4	25550	1.00E-06	7.3	3	1.1E-06
		0.53	6 through <16	45	4927	0.13	0.32	90	10	25550	1.00E-06	7.3	3	1.9E-06
		0.53	16-31	70	4927	0.13	0.32	90	15	25550	1.00E-06	7.3	1	6.0E-07
		CUMULATIVE RISK - Dermal Contact with Sediment:Benzo(a)pyrene												*4.4E-06*
	CUMULATIVE RISK: Dermal Contact with Soil													**4.4E-06**
CUMULATIVE RISK, Groups 5&6, Sediment (0-1') : Future Site Resident														**9.6E-06**

Notes:
COPC = chemical of potential concern; BW = body weight; IR = soil or sediment ingestion rate; EF = exposure frequency; ED = exposure duration; AT = averaging time; CF = units conversion factor;
SA = skin surface area; AF =skin-soil adherence factor; ABSd = dermal absorption fraction; SF = oral/dermal cancer slope factor; ADAF = age-dependent adjustment factor (USEPA 2005);
Risk = Incremental lifetime cancer risk.

Incidental Ingestion Risk = EPC * IR * EF * ED * CF * SF * ADAF *1/BW * 1/AT
Dermal Contact Risk = EPC * SA * AF * ABSd * EF * ED * CF * SF * ADAF *1/BW * 1/AT

TABLE 3-34A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Upland Soil (0-10' bgs)	Group 3 Upland Area	Incidental Ingestion	Benzo(a)anthracene	1.1E+00	(mg/kg)	3.0E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.2E-08	3.2E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	3.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.2E-07	3.2E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	2.1E-08	mg/kg-day	--		--	2.2E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	2.3E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.7E-08	2.5E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	4.2E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.8E-07	4.4E-04	mg/kg-day	2.0E-02	mg/kg/day	2.2E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	4.4E-05	mg/kg-day	--		--	4.7E-04	mg/kg-day	4.0E-02	mg/kg/day	1.2E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	2.0E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.5E-08	2.1E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	2.8E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	2.0E-02	mg/kg/day	1.5E-03
				Toluene	7.1E+02	(mg/kg)	2.0E-05	mg/kg-day	--		--	2.1E-04	mg/kg-day	8.0E-02	mg/kg/day	2.6E-03
				Tetrachloroethene	2.7E+01	(mg/kg)	7.5E-07	mg/kg-day	5.4E-01	(mg/kg-day)-1	4.0E-07	7.9E-06	mg/kg-day	1.0E-02	mg/kg/day	7.9E-04
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	1.6E-05	mg/kg-day	--		--	1.7E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	5.5E-06	mg/kg-day	--		--	5.9E-05	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	2.5E-05	mg/kg-day	--		--	2.6E-04	mg/kg-day	2.0E-01	mg/kg/day	1.3E-03
				Arsenic	5.9E+00	(mg/kg)	1.6E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.4E-07	1.7E-06	mg/kg-day	3.0E-04	mg/kg/day	5.8E-03
				Cadmium	3.8E+00	(mg/kg)	1.1E-07	mg/kg-day	--		--	1.1E-06	mg/kg-day	1.0E-03	mg/kg/day	1.1E-03
				Lead	7.3E+01	(mg/kg)	2.0E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	3.7E-07	mg/kg-day	--		--	3.9E-06	mg/kg-day	9.0E-03	mg/kg/day	4.4E-04
			Exp. Route Total								1.5E-06					4.7E-02
			Dermal Contact	Benzo(a)anthracene	1.1E+00	(mg/kg)	5.2E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	3.8E-08	5.5E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	5.2E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.8E-07	5.5E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	3.6E-08	mg/kg-day	--		--	3.8E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	4.0E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.9E-08	4.2E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	5.5E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	7.7E-07	5.8E-04	mg/kg-day	2.0E-02	mg/kg/day	2.9E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	5.8E-05	mg/kg-day	--		--	6.2E-04	mg/kg-day	4.0E-02	mg/kg/day	1.5E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	3.4E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.5E-08	3.6E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	4.7E-06	mg/kg-day	--		--	5.0E-05	mg/kg-day	2.0E-02	mg/kg/day	2.5E-03
				Toluene	7.1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	2.7E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	5.9E+00	(mg/kg)	6.5E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.7E-08	6.8E-07	mg/kg-day	3.0E-04	mg/kg/day	2.3E-03
				Cadmium	3.8E+00	(mg/kg)	1.4E-09	mg/kg-day	--		--	1.5E-08	mg/kg-day	2.5E-05	mg/kg/day	5.9E-04
				Lead	7.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.3E-06					5.0E-02
	Exposure Medium Total										2.8E-06					9.7E-02
Risk From Reference											3.4E-07					1.2E-02
Risk from Site											2.5E-06					8.5E-02

TABLE 3-34A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Fugitive Dust	Group 3 Soil	Inhalation	Benzo(a)anthracene	8.1E-10	mg/m³	1.0E-11	mg/m³	1.1E-01	(mg/m³)-¹	1.1E-12	1.1E-10	mg/m³	--	--	--
				Benzo(a)pyrene	8.1E-10	mg/m³	1.0E-11	mg/m3	1.1E+00	(mg/m³)-¹	1.1E-11	1.1E-10	mg/m3	--	--	--
				Benzo(e)pyrene	5.6E-10	mg/m³	7.2E-12	mg/m3	--	--	--	7.7E-11	mg/m3	--	--	--
				Benzo(b)fluoranthene	6.2E-10	mg/m³	8.0E-12	mg/m3	1.1E-01	(mg/m³)-¹	8.8E-13	8.5E-11	mg/m3	--	--	--
				Bis(2-ethylhexyl)phthalate	1.1E-06	mg/m³	1.4E-08	mg/m3	2.4E-03	(mg/m³)-¹	3.4E-11	1.5E-07	mg/m3	7.0E-02	(mg/m³)	2.2E-06
				Di-n-octylphthalate	1.2E-06	mg/m³	1.5E-08	mg/m3	--	--	--	1.6E-07	mg/m3	1.4E-01	(mg/m³)	1.2E-06
				Indeno(1,2,3-cd)Pyrene	5.3E-10	mg/m³	6.8E-12	mg/m3	1.1E-01	(mg/m³)-¹	7.5E-13	7.3E-11	mg/m3	--	--	--
				Naphthalene	1.3E-03	mg/m³	1.7E-05	mg/m3	--	--	--	1.8E-04	mg/m3	3.0E-03	(mg/m³)	6.0E-02
				Toluene	2.5E-01	mg/m³	3.2E-03	mg/m3	--	--	--	3.4E-02	mg/m3	5.0E+00	(mg/m³)	6.9E-03
				Tetrachloroethene	1.7E-02	mg/m³	2.2E-04	mg/m3	5.9E-03	(mg/m³)-¹	1.3E-06	2.3E-03	mg/m3	3.5E-02	(mg/m³)	6.6E-02
				1,2,4-Trimethylbenzene	6.5E-02	mg/m³	8.4E-04	mg/m3	--	--	--	8.9E-03	mg/m3	--	--	--
				1,3,5-Trimethylbenzene	2.1E-02	mg/m³	2.8E-04	mg/m3	--	--	--	2.9E-03	mg/m3	--	--	--
				Xylenes (total)	2.1E-01	mg/m³	2.7E-03	mg/m3	--	--	--	2.8E-02	mg/m3	1.0E-01	(mg/m³)	2.8E-01
				Arsenic	4.3E-09	mg/m³	5.6E-11	mg/m3	4.3E+00	(mg/m³)-¹	2.4E-10	5.9E-10	mg/m3	3.0E-05	(mg/m³)	2.0E-05
				Cadmium	2.8E-09	mg/m³	3.6E-11	mg/m3	1.8E+00	(mg/m³)-¹	6.5E-11	3.8E-10	mg/m3	--	--	--
				Lead	5.4E-08	mg/m³	6.9E-10	mg/m3	--	--	--	7.4E-09	mg/m3	NA (2)	--	--
				Vanadium	9.9E-09	mg/m³	1.3E-10	mg/m3	--	--	--	1.4E-09	mg/m3	--	--	--
			Exp. Route Total								1.3E-06					4.1E-01
Medium Total											4.1E-06					5.1E-01
Risk From Reference											2.4E-10					6.0E-02
Risk from Site											4.1E-06					4.5E-01

TABLE 3-24A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	1.8E-06	mg/kg-day	2.4E-02	(mg/kg-day)-1	4.3E-08	1.9E-05	mg/kg-day	9.0E-02	mg/kg/day	2.1E-04
				2,4-Dimethylphenol	2E-01	mg/L	1.0E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	2.0E-02	mg/kg/day	5.4E-02
				2-Methylphenol	1E+00	mg/L	5.7E-04	mg/kg-day	--		--	6.0E-03	mg/kg-day	5.0E-02	mg/kg/day	1.2E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	1.2E-03	mg/kg-day	--		--	1.3E-02	mg/kg-day	5.0E-02	mg/kg/day	2.5E-01
				4-Methylphenol	3E-01	mg/L	1.5E-04	mg/kg-day	--		--	1.6E-03	mg/kg-day	5.0E-02	mg/kg/day	3.2E-02
				Aroclor 1254	1E-03	mg/L	6.8E-07	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.7E-07	7.2E-06	mg/kg-day	2.0E-05	mg/kg/day	3.6E-01
				Alpha-BHC	5E-05	mg/L	2.7E-08	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.7E-07	2.8E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	3.5E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	4.8E-06	3.7E-03	mg/kg-day	2.0E-02	mg/kg/day	1.8E-01
				Naphthalene	1E-02	mg/L	6.2E-06	mg/kg-day	--		--	6.6E-05	mg/kg-day	2.0E-02	mg/kg/day	3.3E-03
				Phenol	9E+00	mg/L	5.3E-03	mg/kg-day	--		--	5.6E-02	mg/kg-day	3.0E-01	mg/kg/day	1.9E-01
				1,1,1-Trichloroethane	5E-01	mg/L	2.8E-04	mg/kg-day	--		--	2.9E-03	mg/kg-day	7.0E-01	mg/kg/day	4.2E-03
				1,1,2-Trichloroethane	7E-03	mg/L	3.9E-06	mg/kg-day	5.7E-02	(mg/kg-day)-1	2.2E-07	4.2E-05	mg/kg-day	4.0E-03	mg/kg/day	1.0E-02
				1,1-Dichloroethane	4E+00	mg/L	2.0E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	2.0E-01	mg/kg/day	1.1E-01
				1,1-Dichloroethene	1E-01	mg/L	7.4E-05	mg/kg-day	--		--	7.8E-04	mg/kg-day	5.0E-02	mg/kg/day	1.6E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	7.9E-04	mg/kg-day	--		--	8.4E-03	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.5E-05	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.3E-06	2.7E-04	mg/kg-day	2.0E-01	mg/kg/day	1.3E-03
				1,2-Dichloroethene	1E-01	mg/L	7.4E-05	mg/kg-day	--		--	7.8E-04	mg/kg-day	9.0E-03	mg/kg/day	8.7E-02
				1,2-Dichloropropane	4E-03	mg/L	2.0E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.4E-07	2.2E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	6.8E-04	mg/kg-day	--		--	7.2E-03	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.7E-03	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.9E-05	1.8E-02	mg/kg-day	1.0E-01	mg/kg/day	1.8E-01
				2-Butanone	8E+01	mg/L	4.4E-02	mg/kg-day	--		--	4.6E-01	mg/kg-day	6.0E-01	mg/kg/day	7.7E-01
				4-Methyl-2-pentanone	2E+02	mg/L	1.1E-01	mg/kg-day	--		--	1.1E+00	mg/kg-day	8.0E-02	mg/kg/day	1.4E+01
				Acetone	7E+01	mg/L	4.1E-02	mg/kg-day	--		--	4.4E-01	mg/kg-day	9.0E-01	mg/kg/day	4.9E-01
				Acrylonitrile	1E+00	mg/L	7.4E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	4.0E-04	7.8E-03	mg/kg-day	1.0E-03	mg/kg/day	7.8E+00
				Benzene	5E-02	mg/L	2.5E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.4E-06	2.7E-04	mg/kg-day	4.0E-03	mg/kg/day	6.8E-02
				Carbon tetrachloride	5E-02	mg/L	2.9E-05	mg/kg-day	1.3E-01	(mg/kg-day)-1	3.8E-06	3.1E-04	mg/kg-day	7.0E-04	mg/kg/day	4.5E-01
				Chloroethane	3E+00	mg/L	1.4E-03	mg/kg-day	--		--	1.5E-02	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	3.2E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	1.0E-07	3.4E-05	mg/kg-day	1.0E-02	mg/kg/day	3.4E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	1.2E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	1.0E-02	mg/kg/day	1.3E-01
				Ethylbenzene	8E+00	mg/L	4.8E-03	mg/kg-day	--		--	5.0E-02	mg/kg-day	1.0E-01	mg/kg/day	5.0E-01
				Ethyl methacrylate	4E+00	mg/L	2.3E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	9.0E-02	mg/kg/day	2.7E-01
				Isopropylbenzene	8E-02	mg/L	4.6E-05	mg/kg-day	--		--	4.9E-04	mg/kg-day	1.0E-01	mg/kg/day	4.9E-03
				Methylene Chloride	2E+00	mg/L	1.2E-03	mg/kg-day	7.5E-03	(mg/kg-day)-1	9.3E-06	1.3E-02	mg/kg-day	6.0E-02	mg/kg/day	2.2E-01
				n-Propylbenzene	9E-02	mg/L	5.2E-05	mg/kg-day	--		--	5.5E-04	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	5.1E-05	mg/kg-day	--		--	5.4E-04	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	5.4E-05	mg/kg-day	--		--	5.8E-04	mg/kg-day	1.0E-01	mg/kg/day	5.8E-03
				tert-Butylbenzene	7E-02	mg/L	3.8E-05	mg/kg-day	--		--	4.0E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	3.4E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.8E-06	3.6E-05	mg/kg-day	1.0E-02	mg/kg/day	3.6E-03
				Tetrahydrofuran	2E+01	mg/L	1.1E-02	mg/kg-day	--		--	1.2E-01	mg/kg-day	--		--
				Toluene	8E+01	mg/L	4.4E-02	mg/kg-day	--		--	4.7E-01	mg/kg-day	8.0E-02	mg/kg/day	5.9E+00
				Trichloroethene	6E-03	mg/L	3.4E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.4E-06	3.6E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	4.0E-05	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.9E-05	4.3E-04	mg/kg-day	3.0E-03	mg/kg/day	1.4E-01
				Xylenes (total)	3E+01	mg/L	1.6E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	2.0E-01	mg/kg/day	8.5E-01
				Antimony	1E-01	mg/L	5.7E-05	mg/kg-day	--		--	6.0E-04	mg/kg-day	4.0E-04	mg/kg/day	1.5E+00
				Arsenic	2E+00	mg/L	1.3E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.0E-03	1.4E-02	mg/kg-day	3.0E-04	mg/kg/day	4.6E+01
				Barium	4E-01	mg/L	2.1E-04	mg/kg-day	--		--	2.2E-03	mg/kg-day	2.0E-01	mg/kg/day	1.1E-02
				Beryllium	6E-01	mg/L	3.2E-04	mg/kg-day	--		--	3.4E-03	mg/kg-day	2.0E-03	mg/kg/day	1.7E+00
				Cadmium	6E-02	mg/L	3.4E-05	mg/kg-day	--		--	3.6E-04	mg/kg-day	5.0E-04	mg/kg/day	7.2E-01
				Chromium	3E-02	mg/L	1.7E-05	mg/kg-day	--		--	1.8E-04	mg/kg-day	5.0E-04	mg/kg/day	3.6E-01
				Cobalt	1E-01	mg/L	7.9E-05	mg/kg-day	--		--	8.4E-04	mg/kg-day	--		--
				Lead	6E-02	mg/L	3.4E-05	mg/kg-day	--		--	3.6E-04	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.6E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	4.7E-02	mg/kg/day	3.7E+00
				Nickel	8E-02	mg/L	4.5E-05	mg/kg-day	--		--	4.8E-04	mg/kg-day	2.0E-02	mg/kg/day	2.4E-02
				Silver	8E-01	mg/L	4.5E-04	mg/kg-day	--		--	4.8E-03	mg/kg-day	5.0E-03	mg/kg/day	9.6E-01
				Thallium	5E-02	mg/L	2.7E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	8.0E-05	mg/kg/day	3.6E-01
				Vanadium	1E-03	mg/L	5.7E-06	mg/kg-day	--		--	6.0E-05	mg/kg-day	9.0E-03	mg/kg/day	6.7E-03
				Zinc	6E+01	mg/L	3.1E-02	mg/kg-day	--		--	3.3E-01	mg/kg-day	3.0E-01	mg/kg/day	1.1E+00
			Exp. Route Total								2.4E-03					9.0E-01

TABLE 3-34A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	2.2E-07	mg/kg-day	2.4E-02	(mg/kg-day)-1	5.3E-09	2.4E-06	mg/kg-day	9.0E-02	mg/kg/day	2.6E-05
				2,4-Dimethylphenol	2E-01	mg/L	2.8E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	2.0E-02	mg/kg/day	1.5E-03
				2-Methylphenol	1E+00	mg/L	1.3E-05	mg/kg-day	--		--	1.4E-04	mg/kg-day	5.0E-02	mg/kg/day	2.7E-03
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	2.2E-05	mg/kg-day	--		--	2.3E-04	mg/kg-day	5.0E-02	mg/kg/day	4.6E-03
				4-Methylphenol	3E-01	mg/L	2.8E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	5.0E-02	mg/kg/day	5.9E-04
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Alpha-BHC	5E-05	mg/L	1.5E-09	mg/kg-day	6.3E+00	(mg/kg-day)-1	9.3E-09	1.6E-08	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	9.3E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.3E-06	9.9E-04	mg/kg-day	2.0E-02	mg/kg/day	5.0E-02
				Naphthalene	1E-02	mg/L	7.6E-07	mg/kg-day	--		--	8.0E-06	mg/kg-day	2.0E-02	mg/kg/day	4.0E-04
				Phenol	9E+00	mg/L	8.9E-05	mg/kg-day	--		--	9.5E-04	mg/kg-day	3.0E-01	mg/kg/day	3.2E-03
				1,1,1-Trichloroethane	5E-01	mg/L	9.7E-06	mg/kg-day	--		--	1.0E-04	mg/kg-day	7.0E-01	mg/kg/day	1.5E-04
				1,1,2-Trichloroethane	7E-03	mg/L	6.7E-08	mg/kg-day	5.7E-02	(mg/kg-day)-1	3.8E-09	7.1E-07	mg/kg-day	4.0E-03	mg/kg/day	1.8E-04
				1,1-Dichloroethane	4E+00	mg/L	2.9E-05	mg/kg-day	--		--	3.1E-04	mg/kg-day	2.0E-01	mg/kg/day	1.5E-03
				1,1-Dichloroethene	1E-01	mg/L	1.9E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	5.0E-02	mg/kg/day	3.9E-04
				1,2,4-Trimethylbenzene	1E+00	mg/L	3.0E-04	mg/kg-day	--		--	3.2E-03	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.2E-07	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.0E-08	2.4E-06	mg/kg-day	2.0E-01	mg/kg/day	1.2E-05
				1,2-Dichloroethene	1E-01	mg/L	1.2E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	9.0E-03	mg/kg/day	1.4E-03
				1,2-Dichloropropane	4E-03	mg/L	3.7E-08	mg/kg-day	6.8E-02	(mg/kg-day)-1	2.5E-09	4.0E-07	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	1.4E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.1E-06	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.2E-08	1.2E-05	mg/kg-day	1.0E-01	mg/kg/day	1.2E-04
				2-Butanone	8E+01	mg/L	8.7E-05	mg/kg-day	--		--	9.2E-04	mg/kg-day	6.0E-01	mg/kg/day	1.5E-03
				4-Methyl-2-pentanone	2E+02	mg/L	9.2E-04	mg/kg-day	--		--	9.8E-03	mg/kg-day	8.0E-02	mg/kg/day	1.2E-01
				Acetone	7E+01	mg/L	7.4E-05	mg/kg-day	--		--	7.9E-04	mg/kg-day	9.0E-01	mg/kg/day	8.8E-04
				Acrylonitrile	1E+00	mg/L	1.4E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	7.6E-07	1.5E-05	mg/kg-day	1.0E-03	mg/kg/day	1.5E-02
				Benzene	5E-02	mg/L	7.1E-07	mg/kg-day	5.5E-02	(mg/kg-day)-1	3.9E-08	7.5E-06	mg/kg-day	4.0E-03	mg/kg/day	1.9E-03
				Carbon tetrachloride	5E-02	mg/L	1.4E-06	mg/kg-day	1.3E-01	(mg/kg-day)-1	1.9E-07	1.5E-05	mg/kg-day	7.0E-04	mg/kg/day	2.2E-02
				Chloroethane	3E+00	mg/L	1.5E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	5.4E-08	mg/kg-day	3.1E-02	(mg/kg-day)-1	1.7E-09	5.7E-07	mg/kg-day	1.0E-02	mg/kg/day	5.7E-05
				cis-1,2-Dichloroethene	2E-01	mg/L	2.0E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	1.0E-02	mg/kg/day	2.1E-03
				Ethylbenzene	8E+00	mg/L	5.2E-04	mg/kg-day	--		--	5.5E-03	mg/kg-day	1.0E-01	mg/kg/day	5.5E-02
				Ethyl methacrylate	4E+00	mg/L	7.2E-05	mg/kg-day	--		--	7.6E-04	mg/kg-day	9.0E-02	mg/kg/day	8.4E-03
				Isopropylbenzene	8E-02	mg/L	1.1E-05	mg/kg-day	--		--	1.2E-04	mg/kg-day	1.0E-01	mg/kg/day	1.2E-03
				Methylene Chloride	2E+00	mg/L	8.5E-06	mg/kg-day	7.5E-03	(mg/kg-day)-1	6.4E-08	9.0E-05	mg/kg-day	6.0E-02	mg/kg/day	1.5E-03
				n-Propylbenzene	9E-02	mg/L	1.7E-05	mg/kg-day	--		--	1.8E-04	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	3.2E-05	mg/kg-day	--		--	3.4E-04	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	2.6E-05	mg/kg-day	--		--	2.8E-04	mg/kg-day	1.0E-01	mg/kg/day	2.8E-03
				tert-Butylbenzene	7E-02	mg/L	1.8E-05	mg/kg-day	--		--	1.9E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	3.7E-07	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.0E-07	3.9E-06	mg/kg-day	1.0E-02	mg/kg/day	3.9E-04
				Tetrahydrofuran	2E+01	mg/L	5.1E-05	mg/kg-day	--		--	5.4E-04	mg/kg-day	--		--
				Toluene	8E+01	mg/L	2.8E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	8.0E-02	mg/kg/day	3.7E-01
				Trichloroethene	6E-03	mg/L	1.1E-07	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.3E-08	1.1E-06	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	3.8E-07	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.7E-07	4.0E-06	mg/kg-day	3.0E-03	mg/kg/day	1.3E-03
				Xylenes (total)	3E+01	mg/L	2.5E-03	mg/kg-day	--		--	2.7E-02	mg/kg-day	2.0E-01	mg/kg/day	1.3E-01
				Antimony	1E-01	mg/L	3.7E-09	mg/kg-day	--		--	4.0E-08	mg/kg-day	6.0E-05	mg/kg/day	6.6E-04
				Arsenic	2E+00	mg/L	8.7E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.3E-07	9.2E-07	mg/kg-day	3.0E-04	mg/kg/day	3.1E-03
				Barium	4E-01	mg/L	1.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	1.4E-02	mg/kg/day	1.0E-05
				Beryllium	6E-01	mg/L	2.1E-08	mg/kg-day	--		--	2.2E-07	mg/kg-day	1.4E-05	mg/kg/day	1.6E-02
				Cadmium	6E-02	mg/L	2.2E-09	mg/kg-day	--		--	2.4E-08	mg/kg-day	2.5E-05	mg/kg/day	9.5E-04
				Chromium	3E-02	mg/L	2.2E-09	mg/kg-day	--		--	2.4E-08	mg/kg-day	2.5E-05	mg/kg/day	9.5E-04
				Cobalt	1E-01	mg/L	2.1E-09	mg/kg-day	--		--	2.2E-08	mg/kg-day	--		--
				Lead	6E-02	mg/L	2.2E-10	mg/kg-day	--		--	2.4E-09	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.1E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	1.9E-03	mg/kg/day	6.1E-03
				Nickel	8E-02	mg/L	6.0E-10	mg/kg-day	--		--	6.3E-09	mg/kg-day	8.0E-04	mg/kg/day	7.9E-06
				Silver	8E-01	mg/L	1.8E-08	mg/kg-day	--		--	1.9E-07	mg/kg-day	2.0E-04	mg/kg/day	9.5E-04
				Thallium	5E-03	mg/L	1.8E-10	mg/kg-day	--		--	1.9E-09	mg/kg-day	8.0E-05	mg/kg/day	2.4E-05
				Vanadium	1E-02	mg/L	3.7E-10	mg/kg-day	--		--	4.0E-09	mg/kg-day	2.3E-04	mg/kg/day	1.7E-05
				Zinc	6E+01	mg/L	1.2E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	3.0E-01	mg/kg/day	4.4E-05
			Exp. Route Total								3.1E-06					8.4E-01
	Exposure Medium Total										2.4E-03					9.1E+01
Risk From Reference											0.0E+00					4.9E+00
Risk from Site											2.4E-03					8.6E+01

TABLE 3-34A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Air	Indoor Air	Group 3	Inhalation	1,4-Dichlorobenzene	3E-05	mg/m3	6.1E-07	mg/m3	--	--	--	6.5E-06	mg/m3	8.0E-01	(mg/m³)	8.1E-06
				2,4-Dimethylphenol	1E-05	mg/m3	2.5E-07	mg/m3	--	--	--	2.6E-06	mg/m3	7.0E-02	(mg/m³)	3.8E-05
				2-Methylphenol	1E-04	mg/m3	1.9E-06	mg/m3	--	--	--	2.0E-05	mg/m3	1.8E-01	(mg/m³)	1.1E-04
				3-Methylphenol/4-Methylphenol	2E-04	mg/m3	2.9E-06	mg/m3	--	--	--	3.1E-05	mg/m3	1.8E-02	(mg/m³)	1.8E-03
				Naphthalene	5E-05	mg/m3	9.6E-07	mg/m3	--	--	--	1.0E-05	mg/m3	3.0E-03	(mg/m³)	3.4E-03
				Phenol	1E-04	mg/m3	2.6E-06	mg/m3	--	--	--	2.8E-05	mg/m3	2.0E-01	(mg/m³)	1.4E-04
				1,2,4-Trimethylbenzene	8E-02	mg/m3	1.6E-03	mg/m3	--	--	--	1.7E-02	mg/m3	--	--	--
				1,2-Dichloroethane	7E-06	mg/m3	1.4E-07	mg/m3	2.6E-02	(mg/m³)-¹	3.6E-09	1.5E-06	mg/m3	2.4E+00	(mg/m³)	6.0E-07
				1,2-Dichloropropane	2E-05	mg/m3	2.9E-07	mg/m3	--	--	--	3.1E-06	mg/m3	4.0E-03	(mg/m³)	7.6E-04
				1,3,5-Trimethylbenzene	2E-02	mg/m3	4.5E-04	mg/m3	--	--	--	4.8E-03	mg/m3	--	--	--
				2-Butanone	1E-01	mg/m3	2.0E-03	mg/m3	--	--	--	2.1E-02	mg/m3	5.0E+00	(mg/m³)	4.2E-03
				4-Methyl-2-pentanone	4E-01	mg/m3	8.3E-03	mg/m3	--	--	--	8.8E-02	mg/m3	3.0E+00	(mg/m³)	2.9E-02
				Acetone	1E-01	mg/m3	1.8E-03	mg/m3	--	--	--	1.9E-02	mg/m3	3.2E+00	(mg/m³)	6.1E-03
				Acrylonitrile	4E-03	mg/m3	6.7E-05	mg/m3	6.8E-02	(mg/m³)-¹	4.5E-06	7.1E-04	mg/m3	3.5E-03	(mg/m³)	2.0E-01
				Benzene	4E-04	mg/m3	6.7E-06	mg/m3	7.8E-03	(mg/m³)-¹	5.2E-08	7.1E-05	mg/m3	3.0E-02	(mg/m³)	2.4E-03
				Chloroethane	9E-01	mg/m3	1.6E-02	mg/m3	--	--	--	1.7E-01	mg/m3	1.0E+01	(mg/m³)	1.7E-02
				Ethylbenzene	9E-01	mg/m3	1.6E-02	mg/m3	--	--	--	1.7E-01	mg/m3	1.0E+00	(mg/m³)	1.7E-01
				Ethyl methacrylate	3E-02	mg/m3	6.1E-04	mg/m3	--	--	--	6.5E-03	mg/m3	3.2E-01	(mg/m³)	2.1E-02
				Methylene Chloride	1E-01	mg/m3	2.0E-03	mg/m3	4.7E-04	(mg/m³)-¹	9.3E-07	2.1E-02	mg/m3	3.0E+00	(mg/m³)	7.0E-03
				n-Propylbenzene	9E-03	mg/m3	1.6E-04	mg/m3	--	--	--	1.7E-03	mg/m3	1.4E-01	(mg/m³)	1.2E-02
				p-Isopropyltoluene	1E-02	mg/m3	1.9E-04	mg/m3	--	--	--	2.1E-03	mg/m3	4.0E-01	(mg/m³)	5.1E-03
				Tetrachloroethene	5E-05	mg/m3	1.0E-06	mg/m3	5.9E-03	(mg/m³)-¹	6.0E-09	1.1E-05	mg/m3	3.5E-02	(mg/m³)	3.1E-04
				Tetrahydrofuran	1E-01	mg/m3	2.2E-03	mg/m3	--	--	--	2.3E-02	mg/m3	3.0E-01	(mg/m³)	7.7E-02
				Toluene	8E+00	mg/m3	1.6E-01	mg/m3	--	--	--	1.7E+00	mg/m3	5.0E+00	(mg/m³)	3.3E-01
				Trichloroethene	6E-05	mg/m3	1.2E-06	mg/m3	2.0E-03	(mg/m³)-¹	2.4E-09	1.3E-05	mg/m3	6.0E-01	(mg/m³)	2.1E-05
				Vinyl chloride	3E-04	mg/m3	6.0E-06	mg/m3	4.4E-03	(mg/m³)-¹	2.6E-08	6.3E-05	mg/m3	1.0E-01	(mg/m³)	6.3E-04
				Xylenes (total)	3E+00	mg/m3	4.8E-02	mg/m3	--	--	--	5.1E-01	mg/m3	1.0E-01	(mg/m³)	5.1E+00
			Exp. Route Total								5.6E-06					6.0E+00
	Exposure Medium Total										5.6E-06					6.0E+00
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											5.6E-06					6.0E+00
Total of Receptor Risks Across All Media											2E-03	Total of Receptor Hazards Across All Media				1.E+02
Risks from Reference											3E-07					5.E+00
Risks from Site											2E-03					9.E+01

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil	Group 3		Benzo(a)anthracene	1.1E+00	(mg/kg)	2.2E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.7E-07	6.5E-07	mg/kg-day	--		--
	(0-10' bgs)	Upland Area		Benzo(a)pyrene	1.1E+00	(mg/kg)	2.3E-07	mg/kg-day	7.2E+00	(mg/kg-day)-1	1.7E-06	6.5E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	1.6E-07	mg/kg-day	--		--	4.5E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	1.8E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.3E-07	4.9E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	3.1E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	4.4E-06	8.8E-04	mg/kg-day	2.0E-02	mg/kg/day	4.4E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	3.4E-04	mg/kg-day	--		--	9.4E-04	mg/kg-day	4.0E-02	mg/kg/day	2.3E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	1.5E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.1E-07	4.2E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	2.1E-05	mg/kg-day	--		--	5.9E-05	mg/kg-day	2.0E-02	mg/kg/day	2.9E-03
			Incidental Ingestion	Toluene	7.1E+02	(mg/kg)	1.5E-04	mg/kg-day	--		--	4.2E-04	mg/kg-day	8.0E-02	mg/kg/day	5.2E-03
				Tetrachloroethene	2.7E+01	(mg/kg)	5.7E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.1E-06	1.6E-05	mg/kg-day	1.0E-02	mg/kg/day	1.6E-03
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	1.2E-04	mg/kg-day	--		--	3.5E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	4.2E-05	mg/kg-day	--		--	1.2E-04	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	1.9E-04	mg/kg-day	--		--	5.3E-04	mg/kg-day	2.0E-01	mg/kg/day	2.6E-03
				Arsenic	5.9E+00	(mg/kg)	1.2E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.9E-06	3.5E-06	mg/kg-day	3.0E-04	mg/kg/day	1.2E-02
				Cadmium	3.8E+00	(mg/kg)	8.0E-07	mg/kg-day	--		--	2.2E-06	mg/kg-day	1.0E-03	mg/kg/day	2.2E-03
				Lead	7.3E+01	(mg/kg)	1.5E-05	mg/kg-day	--		--	4.3E-05	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	2.8E-06	mg/kg-day	--		--	7.9E-06	mg/kg-day	9.0E-03	mg/kg/day	8.8E-04
			Exp. Route Total								1.1E-05					9.5E-02
				Benzo(a)anthracene	1.1E+00	(mg/kg)	2.0E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.4E-07	5.5E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	2.0E-07	mg/kg-day	7.2E+00	(mg/kg-day)-1	1.4E-06	5.5E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	1.4E-07	mg/kg-day	--		--	3.8E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	1.5E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.1E-07	4.2E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	2.1E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	2.9E-06	5.8E-04	mg/kg-day	2.0E-02	mg/kg/day	2.9E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	2.2E-04	mg/kg-day	--		--	6.2E-04	mg/kg-day	4.0E-02	mg/kg/day	1.5E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	1.3E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	9.5E-08	3.6E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	1.8E-05	mg/kg-day	--		--	5.0E-05	mg/kg-day	2.0E-02	mg/kg/day	2.5E-03
			Dermal Contact	Toluene	7.1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	2.7E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	5.9E+00	(mg/kg)	2.4E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.7E-07	6.8E-07	mg/kg-day	3.0E-04	mg/kg/day	2.3E-03
				Cadmium	3.8E+00	(mg/kg)	5.3E-09	mg/kg-day	--		--	1.5E-08	mg/kg-day	2.5E-05	mg/kg/day	5.9E-04
				Lead	7.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								5.1E-06					5.0E-02
	Exposure Medium Total										1.6E-05					1.4E-01
Risk From Reference											2.5E-06					1.9E-02
Risk from Site											1.4E-05					1.3E-01

TABLE 3-34B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Fugitive Dust	Group 3 Soil	Inhalation	Benzo(a)anthracene	8.1E-10	mg/m³	4.0E-11	mg/m³	1.1E-01	(mg/m³)-¹	4.4E-12	1.1E-10	mg/m³	--	--	--
				Benzo(a)pyrene	8.1E-10	mg/m³	4.0E-11	mg/m3	1.1E+00	(mg/m³)-¹	4.4E-11	1.1E-10	mg/m3	--	--	--
				Benzo(e)pyrene	5.6E-10	mg/m³	2.7E-11	mg/m3	--	--	--	7.7E-11	mg/m3	--	--	--
				Benzo(b)fluoranthene	6.2E-10	mg/m³	3.0E-11	mg/m3	1.1E-01	(mg/m³)-¹	3.3E-12	8.5E-11	mg/m3	--	--	--
				Bis(2-ethylhexyl)phthalate	1.1E-06	mg/m³	5.4E-08	mg/m3	2.4E-03	(mg/m³)-¹	1.3E-10	1.5E-07	mg/m3	7.0E-02	(mg/m³)	2.2E-06
				Di-n-octylphthalate	1.2E-06	mg/m³	5.8E-08	mg/m3	--	--	--	1.6E-07	mg/m3	1.4E-01	(mg/m³)	1.2E-06
				Indeno(1,2,3-cd)Pyrene	5.3E-10	mg/m³	2.6E-11	mg/m3	1.1E-01	(mg/m³)-¹	2.8E-12	7.3E-11	mg/m3	--	--	--
				Naphthalene	1.3E-03	mg/m³	6.4E-05	mg/m3	--	--	--	1.8E-04	mg/m3	2.0E-03	(mg/m³)	6.0E-02
				Toluene	2.5E-01	mg/m³	1.2E-02	mg/m3	--	--	--	3.4E-02	mg/m3	5.0E+00	(mg/m³)	6.9E-03
				Tetrachloroethene	1.7E-02	mg/m³	8.3E-04	mg/m3	5.9E-03	(mg/m³)-¹	4.9E-06	2.3E-03	mg/m3	3.5E-02	(mg/m³)	6.6E-02
				1,2,4-Trimethylbenzene	6.5E-02	mg/m³	3.2E-03	mg/m3	--	--	--	8.9E-03	mg/m3	--	--	--
				1,3,5-Trimethylbenzene	2.1E-02	mg/m³	1.1E-03	mg/m3	--	--	--	2.9E-03	mg/m3	--	--	--
				Xylenes (total)	2.1E-01	mg/m³	1.0E-02	mg/m3	--	--	--	2.8E-02	mg/m3	1.0E-01	(mg/m³)	2.8E-01
				Arsenic	4.3E-09	mg/m³	2.1E-10	mg/m3	4.3E+00	(mg/m³)-¹	9.1E-10	5.9E-10	mg/m3	3.0E-03	(mg/m³)	2.0E-03
				Cadmium	2.8E-09	mg/m³	1.4E-10	mg/m3	1.8E+00	(mg/m³)-¹	2.5E-10	3.8E-10	mg/m3	--	--	--
				Lead	5.4E-08	mg/m³	2.6E-09	mg/m3	--	--	--	7.4E-09	mg/m3	NA (2)		--
				Vanadium	9.9E-09	mg/m³	4.8E-10	mg/m3	--	--	--	1.4E-09	mg/m3	--	--	--
			Exp. Route Total								4.9E-06					4.1E-01
Ex. Medium Total											4.9E-06					4.1E-01
Risk From Reference											9.1E-10					6.0E-02
Risk from Site											4.9E-06					3.5E-01

TABLE 3-34B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	1.3E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	3.1E-07	3.6E-05	mg/kg-day	9.0E-02	mg/kg/day	4.0E-04
				2,4-Dimethylphenol	2E-01	mg/L	7.2E-04	mg/kg-day	--		--	2.0E-03	mg/kg-day	2.0E-02	mg/kg/day	1.0E-01
				2-Methylphenol	1E+00	mg/L	4.0E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	5.0E-02	mg/kg/day	2.3E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	8.4E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	5.0E-02	mg/kg/day	4.7E-01
				4-Methylphenol	3E-01	mg/L	1.1E-03	mg/kg-day	--		--	3.0E-03	mg/kg-day	5.0E-02	mg/kg/day	6.1E-02
				Aroclor 1254	1E-03	mg/L	4.8E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.9E-06	1.4E-05	mg/kg-day	2.0E-05	mg/kg/day	6.8E-01
				Alpha-BHC	5E-05	mg/L	1.9E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.2E-06	5.3E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	2.5E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	3.4E-05	6.9E-03	mg/kg-day	2.0E-02	mg/kg/day	3.4E-01
				Naphthalene	1E-02	mg/L	4.4E-05	mg/kg-day	--		--	1.2E-04	mg/kg-day	2.0E-02	mg/kg/day	6.2E-03
				Phenol	9E+00	mg/L	3.8E-02	mg/kg-day	--		--	1.1E-01	mg/kg-day	3.0E-01	mg/kg/day	3.5E-01
				1,1,1-Trichloroethane	5E-01	mg/L	2.0E-03	mg/kg-day	--		--	5.5E-03	mg/kg-day	7.0E-01	mg/kg/day	7.9E-03
				1,1,2-Trichloroethane	7E-03	mg/L	2.8E-05	mg/kg-day	5.7E-02	(mg/kg-day)-1	1.6E-06	7.8E-05	mg/kg-day	4.0E-03	mg/kg/day	1.9E-02
				1,1-Dichloroethane	4E+00	mg/L	1.4E-02	mg/kg-day	--		--	4.1E-02	mg/kg-day	2.0E-01	mg/kg/day	2.0E-01
				1,1-Dichloroethene	1E-01	mg/L	5.2E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	5.0E-02	mg/kg/day	2.9E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	5.6E-03	mg/kg-day	--		--	1.6E-02	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	1.8E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	1.6E-05	5.0E-04	mg/kg-day	2.0E-01	mg/kg/day	2.5E-03
				1,2-Dichloroethene	1E-01	mg/L	5.2E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	9.0E-03	mg/kg/day	1.6E-01
				1,2-Dichloropropane	4E-03	mg/L	1.4E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	9.8E-07	4.1E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	4.8E-03	mg/kg-day	--		--	1.4E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.2E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.3E-04	3.4E-02	mg/kg-day	1.0E-01	mg/kg/day	3.4E-01
				2-Butanone	8E+01	mg/L	3.1E-01	mg/kg-day	--		--	8.7E-01	mg/kg-day	6.0E-01	mg/kg/day	1.4E+00
				4-Methyl-2-pentanone	2E+02	mg/L	7.6E-01	mg/kg-day	--		--	2.1E+00	mg/kg-day	8.0E-02	mg/kg/day	2.7E+01
				Acetone	7E+01	mg/L	2.9E-01	mg/kg-day	--		--	8.2E-01	mg/kg-day	9.0E-01	mg/kg/day	9.1E-01
				Acrylonitrile	1E+00	mg/L	5.2E-03	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.8E-03	1.5E-02	mg/kg-day	1.0E-03	mg/kg/day	1.5E+01
				Benzene	5E-02	mg/L	1.8E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	9.9E-06	5.1E-04	mg/kg-day	4.0E-03	mg/kg/day	1.3E-01
				Carbon tetrachloride	5E-02	mg/L	2.1E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	2.7E-05	5.9E-04	mg/kg-day	7.0E-04	mg/kg/day	8.4E-01
				Chloroethane	3E+00	mg/L	1.0E-02	mg/kg-day	--		--	2.8E-02	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	2.3E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	7.1E-07	6.4E-05	mg/kg-day	1.0E-02	mg/kg/day	6.4E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	8.8E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	1.0E-02	mg/kg/day	2.5E-01
				Ethylbenzene	8E+00	mg/L	3.4E-02	mg/kg-day	--		--	9.5E-02	mg/kg-day	1.0E-01	mg/kg/day	9.5E-01
				Ethyl methacrylate	4E+00	mg/L	1.6E-02	mg/kg-day	--		--	4.5E-02	mg/kg-day	9.0E-02	mg/kg/day	5.0E-01
				Isopropylbenzene	8E-02	mg/L	3.3E-04	mg/kg-day	--		--	9.2E-04	mg/kg-day	1.0E-01	mg/kg/day	9.2E-03
				Methylene Chloride	2E+00	mg/L	8.8E-03	mg/kg-day	7.5E-03	(mg/kg-day)-1	6.6E-05	2.5E-02	mg/kg-day	6.0E-02	mg/kg/day	4.1E-01
				n-Propylbenzene	9E-02	mg/L	3.7E-04	mg/kg-day	--		--	1.0E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	3.6E-04	mg/kg-day	--		--	1.0E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	3.9E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	1.0E-01	mg/kg/day	1.1E-02
				tert-Butylbenzene	7E-02	mg/L	2.7E-04	mg/kg-day	--		--	7.5E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	2.4E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.3E-05	6.8E-05	mg/kg-day	1.0E-02	mg/kg/day	6.8E-03
				Tetrahydrofuran	2E+01	mg/L	8.0E-02	mg/kg-day	--		--	2.3E-01	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.1E-01	mg/kg-day	--		--	8.8E-01	mg/kg-day	8.0E-02	mg/kg/day	1.1E+01
				Trichloroethene	6E-03	mg/L	2.4E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	9.6E-06	6.8E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	2.9E-04	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.1E-04	8.0E-04	mg/kg-day	3.0E-03	mg/kg/day	2.7E-01
				Xylenes (total)	3E+01	mg/L	1.1E-01	mg/kg-day	--		--	3.2E-01	mg/kg-day	2.0E-01	mg/kg/day	1.6E+00
				Antimony	1E-01	mg/L	4.0E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	4.0E-04	mg/kg/day	2.8E+00
				Arsenic	2E+00	mg/L	9.3E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.4E-02	2.6E-02	mg/kg-day	3.0E-04	mg/kg/day	8.7E+01
				Barium	4E-01	mg/L	1.5E-03	mg/kg-day	--		--	4.2E-03	mg/kg-day	2.0E-01	mg/kg/day	2.1E-02
				Beryllium	6E-01	mg/L	2.3E-03	mg/kg-day	--		--	6.3E-03	mg/kg-day	2.0E-03	mg/kg/day	3.2E+00
				Cadmium	6E-02	mg/L	2.4E-04	mg/kg-day	--		--	6.8E-04	mg/kg-day	5.0E-04	mg/kg/day	1.4E+00
				Chromium	3E-02	mg/L	1.2E-04	mg/kg-day	--		--	3.4E-04	mg/kg-day	5.0E-04	mg/kg/day	6.8E-01
				Cobalt	1E-01	mg/L	5.6E-04	mg/kg-day	--		--	1.6E-03	mg/kg-day	--		--
				Lead	6E-02	mg/L	2.4E-04	mg/kg-day	--		--	6.8E-04	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.2E-01	mg/kg-day	--		--	3.3E-01	mg/kg-day	4.7E-02	mg/kg/day	7.0E+00
				Nickel	8E-02	mg/L	3.2E-04	mg/kg-day	--		--	9.0E-04	mg/kg-day	2.0E-02	mg/kg/day	4.5E-02
				Silver	8E-01	mg/L	3.2E-03	mg/kg-day	--		--	9.0E-03	mg/kg-day	5.0E-03	mg/kg/day	1.8E+00
				Thallium	3E-03	mg/L	1.9E-05	mg/kg-day	--		--	5.4E-05	mg/kg-day	8.0E-05	mg/kg/day	6.8E-01
				Vanadium	1E-02	mg/L	4.0E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	9.0E-03	mg/kg/day	1.3E-02
				Zinc	6E+01	mg/L	2.2E-01	mg/kg-day	--		--	6.2E-01	mg/kg-day	3.0E-01	mg/kg/day	2.1E+00
			Exp. Route Total								1.7E-02					1.7E+02

TABLE 3-34B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	2.7E-06	mg/kg-day	2.4E-02	(mg/kg-day)-1	6.5E-08	7.6E-06	mg/kg-day	9.0E-02	mg/kg/day	8.4E-05
				2,4-Dimethylphenol	2E-01	mg/L	3.4E-05	mg/kg-day	--		--	9.6E-05	mg/kg-day	2.0E-02	mg/kg/day	4.8E-03
				2-Methylphenol	1E+00	mg/L	1.6E-04	mg/kg-day	--		--	4.4E-04	mg/kg-day	5.0E-02	mg/kg/day	8.9E-03
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	2.6E-04	mg/kg-day	--		--	7.4E-04	mg/kg-day	5.0E-02	mg/kg/day	1.5E-02
				4-Methylphenol	3E-01	mg/L	3.4E-05	mg/kg-day	--		--	9.5E-05	mg/kg-day	5.0E-02	mg/kg/day	1.9E-03
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Alpha-BHC	5E-05	mg/L	1.8E-08	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.1E-07	5.0E-08	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.1E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.6E-05	3.2E-03	mg/kg-day	2.0E-02	mg/kg/day	1.6E-01
				Naphthalene	1E-02	mg/L	9.3E-06	mg/kg-day	--		--	2.6E-05	mg/kg-day	2.0E-02	mg/kg/day	1.3E-03
				Phenol	9E+00	mg/L	1.1E-03	mg/kg-day	--		--	3.1E-03	mg/kg-day	3.0E-01	mg/kg/day	1.0E-02
				1,1,1-Trichloroethane	5E-01	mg/L	1.2E-04	mg/kg-day	--		--	3.3E-04	mg/kg-day	7.0E-01	mg/kg/day	4.7E-04
				1,1,2-Trichloroethane	7E-03	mg/L	8.2E-07	mg/kg-day	5.7E-02	(mg/kg-day)-1	4.7E-08	2.3E-06	mg/kg-day	4.0E-03	mg/kg/day	5.7E-04
				1,1-Dichloroethane	4E+00	mg/L	3.6E-04	mg/kg-day	--		--	1.0E-03	mg/kg-day	2.0E-01	mg/kg/day	5.0E-03
				1,1-Dichloroethene	1E-01	mg/L	2.3E-05	mg/kg-day	--		--	6.4E-05	mg/kg-day	5.0E-02	mg/kg/day	1.3E-03
				1,2,4-Trimethylbenzene	1E+00	mg/L	3.7E-03	mg/kg-day	--		--	1.0E-02	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.8E-06	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.5E-07	7.7E-06	mg/kg-day	2.0E-01	mg/kg/day	3.9E-05
				1,2-Dichloroethene	1E-01	mg/L	1.5E-05	mg/kg-day	--		--	4.1E-05	mg/kg-day	9.0E-03	mg/kg/day	4.5E-03
				1,2-Dichloropropane	4E-03	mg/L	4.6E-07	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.1E-08	1.3E-06	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	1.8E-03	mg/kg-day	--		--	4.9E-03	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.4E-05	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.5E-07	3.8E-05	mg/kg-day	1.0E-01	mg/kg/day	3.8E-04
				2-Butanone	8E+01	mg/L	1.1E-03	mg/kg-day	--		--	3.0E-03	mg/kg-day	6.0E-01	mg/kg/day	5.0E-03
				4-Methyl-2-pentanone	2E+02	mg/L	1.1E-02	mg/kg-day	--		--	3.2E-02	mg/kg-day	8.0E-02	mg/kg/day	3.9E-01
				Acetone	7E+01	mg/L	9.1E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	9.0E-01	mg/kg/day	2.8E-03
				Acrylonitrile	1E+00	mg/L	1.7E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	9.2E-06	4.8E-05	mg/kg-day	1.0E-03	mg/kg/day	4.8E-02
				Benzene	5E-02	mg/L	8.7E-06	mg/kg-day	5.5E-02	(mg/kg-day)-1	4.8E-07	2.4E-05	mg/kg-day	4.0E-03	mg/kg/day	6.1E-03
				Carbon tetrachloride	5E-02	mg/L	1.8E-05	mg/kg-day	1.3E-01	(mg/kg-day)-1	2.3E-06	4.9E-05	mg/kg-day	7.0E-04	mg/kg/day	7.0E-02
				Chloroethane	3E+00	mg/L	1.8E-04	mg/kg-day	--		--	5.0E-04	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	6.6E-07	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.0E-08	1.8E-06	mg/kg-day	1.0E-02	mg/kg/day	1.8E-04
				cis-1,2-Dichloroethene	2E-01	mg/L	2.5E-05	mg/kg-day	--		--	6.9E-05	mg/kg-day	1.0E-02	mg/kg/day	6.9E-03
				Ethylbenzene	8E+00	mg/L	6.4E-03	mg/kg-day	--		--	1.8E-02	mg/kg-day	1.0E-01	mg/kg/day	1.8E-01
				Ethyl methacrylate	4E+00	mg/L	8.7E-04	mg/kg-day	--		--	2.4E-03	mg/kg-day	9.0E-02	mg/kg/day	2.7E-02
				Isopropylbenzene	8E-02	mg/L	1.4E-04	mg/kg-day	--		--	3.8E-04	mg/kg-day	1.0E-01	mg/kg/day	3.8E-03
				Methylene Chloride	2E+00	mg/L	1.0E-04	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.8E-07	2.9E-04	mg/kg-day	6.0E-02	mg/kg/day	4.9E-03
				n-Propylbenzene	9E-02	mg/L	2.0E-04	mg/kg-day	--		--	5.7E-04	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	3.9E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	3.2E-04	mg/kg-day	--		--	9.0E-04	mg/kg-day	1.0E-01	mg/kg/day	9.0E-03
				tert-Butylbenzene	7E-02	mg/L	2.2E-04	mg/kg-day	--		--	6.3E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	4.5E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.4E-06	1.3E-05	mg/kg-day	1.0E-02	mg/kg/day	1.3E-03
				Tetrahydrofuran	2E+01	mg/L	6.2E-04	mg/kg-day	--		--	1.7E-03	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.4E-02	mg/kg-day	--		--	9.6E-02	mg/kg-day	8.0E-02	mg/kg/day	1.2E+00
				Trichloroethene	6E-03	mg/L	1.3E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	5.2E-07	3.7E-06	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	4.7E-06	mg/kg-day	7.2E-01	(mg/kg-day)-1	3.4E-06	1.3E-05	mg/kg-day	3.0E-03	mg/kg/day	4.4E-03
				Xylenes (total)	3E+01	mg/L	3.1E-02	mg/kg-day	--		--	8.6E-02	mg/kg-day	2.0E-01	mg/kg/day	4.3E-01
				Antimony	1E-01	mg/L	6.5E-08	mg/kg-day	--		--	1.8E-07	mg/kg-day	6.0E-05	mg/kg/day	3.0E-03
				Arsenic	2E+00	mg/L	1.5E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.2E-06	4.2E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Barium	4E-01	mg/L	2.4E-07	mg/kg-day	--		--	6.7E-07	mg/kg-day	1.4E-02	mg/kg/day	4.8E-05
				Beryllium	6E-01	mg/L	3.6E-07	mg/kg-day	--		--	1.0E-06	mg/kg-day	1.4E-03	mg/kg/day	7.2E-02
				Cadmium	6E-02	mg/L	3.9E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	2.5E-05	mg/kg/day	4.3E-03
				Chromium	3E-02	mg/L	3.9E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	2.5E-05	mg/kg/day	4.3E-03
				Cobalt	1E-01	mg/L	3.6E-08	mg/kg-day	--		--	1.0E-07	mg/kg-day	--		--
				Lead	6E-02	mg/L	3.9E-09	mg/kg-day	--		--	1.1E-08	mg/kg-day	NA (1)		--
				Manganese	3E+01	mg/L	1.9E-05	mg/kg-day	--		--	5.2E-05	mg/kg-day	1.9E-03	mg/kg/day	2.8E-02
				Nickel	8E-02	mg/L	1.0E-08	mg/kg-day	--		--	2.9E-08	mg/kg-day	8.0E-04	mg/kg/day	3.6E-05
				Silver	8E-01	mg/L	3.1E-07	mg/kg-day	--		--	8.7E-07	mg/kg-day	2.0E-04	mg/kg/day	4.3E-03
				Thallium	5E-03	mg/L	3.1E-09	mg/kg-day	--		--	8.7E-09	mg/kg-day	8.0E-05	mg/kg/day	1.1E-04
				Vanadium	1E-02	mg/L	6.3E-09	mg/kg-day	--		--	1.8E-08	mg/kg-day	2.5E-04	mg/kg/day	7.7E-05
				Zinc	6E+01	mg/L	2.1E-05	mg/kg-day	--		--	6.0E-05	mg/kg-day	3.0E-01	mg/kg/day	2.0E-04
			Exp. Route Total								3.8E-05					2.7E+00
	Exposure Medium Total										1.7E-02					1.7E+02
Risk From Reference											0.0E+00					9.2E+00
Risk from Site											1.7E-02					1.6E+02

TABLE 3-34B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Air	Indoor Air	Group 3	Inhalation	1,4-Dichlorobenzene	3E-05	mg/m3	2.6E-06	mg/m³	--		--	7.4E-06	mg/m3	8.0E-01	(mg/m³)	9.3E-06
				2,4-Dimethylphenol	1E-05	mg/m3	1.1E-06	mg/m³	--		--	3.0E-06	mg/m3	7.0E-02	(mg/m³)	4.3E-05
				2-Methylphenol	1E-04	mg/m3	8.1E-06	mg/m³	--		--	2.3E-05	mg/m3	1.8E-01	(mg/m³)	1.3E-04
				3-Methylphenol/4-Methylphenol	2E-04	mg/m3	1.3E-05	mg/m³	--		--	3.5E-05	mg/m3	1.8E-02	(mg/m³)	2.0E-03
				Naphthalene	5E-05	mg/m3	4.1E-06	mg/m³	--		--	1.2E-05	mg/m3	3.0E-03	(mg/m³)	3.9E-03
				Phenol	1E-04	mg/m3	1.1E-05	mg/m³	--		--	3.2E-05	mg/m3	2.0E-01	(mg/m³)	1.6E-04
				1,2,4-Trimethylbenzene	8E-02	mg/m3	6.8E-03	mg/m³	--		--	1.9E-02	mg/m3	--	--	--
				1,2-Dichloroethane	7E-06	mg/m3	6.0E-07	mg/m³	2.6E-02	(mg/m³)-¹	1.5E-08	1.7E-06	mg/m3	2.4E+00	(mg/m²)	6.9E-07
				1,2-Dichloropropane	2E-05	mg/m3	1.2E-06	mg/m³	--		--	3.5E-06	mg/m3	4.0E-03	(mg/m³)	8.7E-04
				1,3,5-Trimethylbenzene	2E-02	mg/m3	1.9E-03	mg/m³	--		--	5.4E-03	mg/m3	--	--	--
				2-Butanone	1E-01	mg/m3	8.6E-03	mg/m³	--		--	2.4E-02	mg/m3	5.0E+00	(mg/m³)	4.8E-03
				4-Methyl-2-pentanone	4E-01	mg/m3	3.6E-02	mg/m³	--		--	1.0E-01	mg/m3	3.0E+00	(mg/m³)	3.4E-02
				Acetone	1E-01	mg/m3	7.9E-03	mg/m³	--		--	2.2E-02	mg/m3	3.2E+00	(mg/m³)	7.0E-03
				Acrylonitrile	4E-03	mg/m3	2.9E-04	mg/m³	6.8E-02	(mg/m³)-¹	2.0E-05	8.1E-04	mg/m3	3.5E-03	(mg/m³)	2.3E-01
				Benzene	4E-04	mg/m3	2.9E-05	mg/m³	7.8E-03	(mg/m³)-¹	2.2E-07	8.1E-05	mg/m3	3.0E-02	(mg/m³)	2.7E-03
				Chloroethane	9E-01	mg/m3	7.1E-02	mg/m³	--		--	2.0E-01	mg/m3	1.0E+01	(mg/m³)	2.0E-02
				Ethylbenzene	9E-01	mg/m3	7.0E-02	mg/m³	--		--	2.0E-01	mg/m3	1.0E+00	(mg/m³)	2.0E-01
				Ethyl methacrylate	3E-02	mg/m3	2.7E-03	mg/m³	--		--	7.4E-03	mg/m3	3.2E-01	(mg/m³)	2.4E-02
				Methylene Chloride	1E-01	mg/m3	8.5E-03	mg/m³	4.7E-04	(mg/m³)-¹	4.0E-06	2.4E-02	mg/m3	3.0E+00	(mg/m³)	8.0E-03
				n-Propylbenzene	9E-03	mg/m3	7.0E-04	mg/m³	--		--	2.0E-03	mg/m3	1.4E-01	(mg/m³)	1.4E-02
				p-Isopropyltoluene	1E-02	mg/m3	8.4E-04	mg/m³	--		--	2.3E-03	mg/m3	4.0E-01	(mg/m³)	5.9E-03
				Tetrachloroethene	5E-05	mg/m3	4.4E-06	mg/m³	5.9E-03	(mg/m³)-¹	2.6E-08	1.2E-05	mg/m3	3.5E-02	(mg/m³)	3.5E-04
				Tetrahydrofuran	1E-01	mg/m3	9.5E-03	mg/m³	--		--	2.7E-02	mg/m3	3.0E-01	(mg/m³)	8.8E-02
				Toluene	8E+00	mg/m3	6.7E-01	mg/m³	--		--	1.9E+00	mg/m3	5.0E+00	(mg/m³)	3.8E-01
				Trichloroethene	6E-05	mg/m3	5.1E-06	mg/m³	2.0E-03	(mg/m³)-¹	1.0E-08	1.4E-05	mg/m3	6.0E-01	(mg/m³)	2.4E-05
				Vinyl chloride	3E-04	mg/m3	2.6E-05	mg/m³	4.4E-03	(mg/m³)-¹	1.1E-07	7.2E-05	mg/m3	1.0E-01	(mg/m³)	7.2E-04
				Xylenes (total)	3E+00	mg/m3	2.1E-01	mg/m³	--		--	5.8E-01	mg/m3	1.0E-01	(mg/m³)	5.8E+00
			Exp. Route Total								2.4E-05					6.8E+00
	Exposure Medium Total										2.4E-05					6.8E+00
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											2.4E-05					6.8E+00
Total of Receptor Risks Across All Media											2E-02	Total of Receptor Hazards Across All Media				2.E+02
Risks from Reference											2E-06					9.E+00
Risks from Site											2E-02					2.E+02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	1.1E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	7.7E-07	1.1E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	6.3E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.6E-06	6.7E-06	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	4.7E-07	mg/kg-day	--		--	5.0E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	4.5E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	3.3E-07	4.7E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	5.6E-07	mg/kg-day	7.3E-02	(mg/kg-day)-1	4.1E-08	5.9E-06	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.4E-08	mg/kg-day	--		--	1.4E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	6.1E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.2E-08	6.4E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	1.0E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	7.0E-02	mg/kg/day	1.6E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	1.1E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.8E-07	1.1E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	5.6E-07	mg/kg-day	--		--	5.9E-06	mg/kg-day	2.0E-03	mg/kg/day	3.0E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	2.3E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.7E-07	2.5E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	3.3E-07	mg/kg-day	--		--	3.5E-06	mg/kg-day	4.0E-03	mg/kg/day	8.8E-04
				2-Methylnaphthalene	1.4E+01	(mg/kg)	4.0E-07	mg/kg-day	--		--	4.2E-06	mg/kg-day	4.0E-03	mg/kg/day	1.1E-03
				Naphthalene	1.3E+01	(mg/kg)	3.6E-07	mg/kg-day	--		--	3.9E-06	mg/kg-day	2.0E-02	mg/kg/day	1.9E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	2.0E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	3.0E-02	mg/kg/day	7.0E-04
				Arsenic	7.1E+00	(mg/kg)	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.9E-07	2.1E-06	mg/kg-day	3.0E-04	mg/kg/day	6.9E-03
				Lead	1.3E+02	(mg/kg)	3.7E-06	mg/kg-day	--		--	3.9E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	4.7E-06	mg/kg-day	--		--	5.0E-05	mg/kg-day	1.4E-01	mg/kg/day	3.6E-04
				Vanadium	1.6E+01	(mg/kg)	4.4E-07	mg/kg-day	--		--	4.7E-06	mg/kg-day	9.0E-03	mg/kg/day	5.2E-04
			Exp. Route Total								7.0E-06					1.5E-02
			Dermal Contact	Benzo(a)anthracene	3.8E+01	(mg/kg)	1.8E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.3E-06	1.9E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	1.1E-06	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.9E-06	1.1E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	8.1E-07	mg/kg-day	--		--	8.6E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	7.6E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	5.6E-07	8.1E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	9.6E-07	mg/kg-day	7.3E-02	(mg/kg-day)-1	7.0E-08	1.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.8E-08	mg/kg-day	--		--	1.9E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	8.0E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.6E-08	8.5E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	1.4E-08	mg/kg-day	--		--	1.4E-07	mg/kg-day	7.0E-02	mg/kg/day	2.0E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	1.8E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.3E-06	2.0E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	7.4E-07	mg/kg-day	--		--	7.8E-06	mg/kg-day	2.0E-03	mg/kg/day	3.9E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	4.0E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.9E-07	4.3E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	5.7E-07	mg/kg-day	--		--	6.0E-06	mg/kg-day	4.0E-03	mg/kg/day	1.5E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	6.8E-07	mg/kg-day	--		--	7.2E-06	mg/kg-day	4.0E-03	mg/kg/day	1.8E-03
				Naphthalene	1.3E+01	(mg/kg)	6.3E-07	mg/kg-day	--		--	6.6E-06	mg/kg-day	2.0E-02	mg/kg/day	3.3E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	2.6E-06	mg/kg-day	--		--	2.8E-05	mg/kg-day	3.0E-02	mg/kg/day	9.2E-04
				Arsenic	7.1E+00	(mg/kg)	7.8E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.2E-07	8.3E-07	mg/kg-day	3.0E-04	mg/kg/day	2.8E-03
				Lead	1.3E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.2E-05					1.1E-02
	Exposure Medium Total										1.9E-05					2.6E-02
Risk From Reference											2.5E-06					1.0E-02
Risk from Site											1.6E-05					1.6E-02

TABLE 3-34C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Fugitive Dust	Group 4 Soil	Inhalation	Benzo(a)anthracene	2.6E-09	mg/m³	3.3E-11	mg/m³	1.1E-01	(mg/m³)-¹	3.7E-12	3.5E-10	mg/m³	--		--
				Benzo(a)pyrene	1.7E-08	mg/m³	2.2E-10	mg/m3	1.1E+00	(mg/m³)-¹	2.4E-10	2.3E-09	mg/m3	--		--
				Benzo(e)pyrene	1.3E-08	mg/m³	1.6E-10	mg/m3	--		--	1.7E-09	mg/m3	--		--
				Benzo(b)fluoranthene	1.4E-09	mg/m³	1.8E-11	mg/m3	1.1E-01	(mg/m³)-¹	2.0E-12	1.9E-10	mg/m3	--		--
				Benzo(k)fluoranthene	1.5E-09	mg/m³	1.9E-11	mg/m3	1.1E-01	(mg/m³)-¹	2.1E-12	2.0E-10	mg/m3	--		--
				Bis(2-Chloroethoxy)methane	1.8E-10	mg/m³	2.4E-12	mg/m3	--		--	2.5E-11	mg/m3	--		--
				Carbazole	1.9E-08	mg/m³	2.5E-10	mg/m3	--		--	2.6E-09	mg/m3	--		--
				4-Chloro-3-methylphenol	2.2E-10	mg/m³	2.9E-12	mg/m3	--		--	3.0E-11	mg/m3	--		--
				Dibenzo(a,h)anthracene	6.9E-10	mg/m³	8.9E-12	mg/m3	1.2E+00	(mg/m³)-¹	1.1E-11	9.4E-11	mg/m3	--		--
				Dibenzofuran	1.8E-08	mg/m³	2.3E-10	mg/m3	--		--	2.4E-09	mg/m3	7.0E-03	(mg/m³)	3.5E-07
				Indeno(1,2,3-cd)Pyrene	6.2E-09	mg/m³	8.1E-11	mg/m3	1.1E-01	(mg/m³)-¹	8.9E-12	8.6E-10	mg/m3	--		--
				1-Methylnaphthalene	7.2E-04	mg/m³	9.3E-06	mg/m3	--		--	9.9E-05	mg/m3	2.5E-01	(mg/m³)	4.0E-04
				2-Methylnaphthalene	3.0E-04	mg/m³	3.8E-06	mg/m3	--		--	4.1E-05	mg/m3	1.4E-01	(mg/m³)	2.9E-04
				Naphthalene	3.3E-04	mg/m³	4.2E-06	mg/m3	--		--	4.5E-05	mg/m3	3.0E-03	(mg/m³)	1.5E-02
				C11-C22 Aromatics	1.4E-03	mg/m³	1.8E-05	mg/m3	--		--	1.9E-04	mg/m3	5.0E-02	(mg/m³)	3.9E-03
				Arsenic	5.2E-09	mg/m³	6.7E-11	mg/m3	4.3E+00	(mg/m³)-¹	2.9E-10	7.2E-10	mg/m3	3.0E-05	(mg/m³)	2.4E-05
				Lead	9.8E-08	mg/m³	1.3E-09	mg/m3	--		--	1.3E-08	mg/m3	NA (3)		--
				Manganese	1.2E-07	mg/m³	1.6E-09	mg/m3	--		--	1.7E-08	mg/m3	5.0E-05	(mg/m³)	3.4E-04
				Vanadium	1.2E-08	mg/m³	1.5E-10	mg/m3	--		--	1.6E-09	mg/m3	--		--
			Exp. Route Total								5.6E-10					2.0E-02
Ex. Medium Total											5.6E-10					2.0E-02
Risk From Reference											3.0E-10					1.5E-02
Risk from Site											2.5E-10					4.9E-03

TABLE 3-34C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	1.8E-06	mg/kg-day	2.4E-02	(mg/kg-day)-1	4.3E-08	1.9E-05	mg/kg-day	9.0E-02	mg/kg/day	2.1E-04
				2,4-Dimethylphenol	2E-01	mg/L	1.0E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	2.0E-02	mg/kg/day	5.4E-02
				2-Methylphenol	1E+00	mg/L	5.7E-04	mg/kg-day	--		--	6.0E-03	mg/kg-day	5.0E-02	mg/kg/day	1.2E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	1.2E-03	mg/kg-day	--		--	1.3E-02	mg/kg-day	5.0E-02	mg/kg/day	2.5E-01
				4-Methylphenol	3E-01	mg/L	1.5E-04	mg/kg-day	--		--	1.6E-03	mg/kg-day	5.0E-02	mg/kg/day	3.2E-02
				Aroclor 1254	1E-03	mg/L	6.8E-07	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.7E-07	7.2E-06	mg/kg-day	2.0E-05	mg/kg/day	3.6E-01
				Alpha-BHC	5E-05	mg/L	2.7E-08	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.7E-07	2.8E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	3.5E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	4.8E-06	3.7E-03	mg/kg-day	2.0E-02	mg/kg/day	1.8E-01
				Naphthalene	1E-02	mg/L	6.2E-06	mg/kg-day	--		--	6.6E-05	mg/kg-day	2.0E-02	mg/kg/day	3.3E-03
				Phenol	9E+00	mg/L	5.3E-03	mg/kg-day	--		--	5.6E-02	mg/kg-day	3.0E-01	mg/kg/day	1.9E-01
				1,1,1-Trichloroethane	5E-01	mg/L	2.8E-04	mg/kg-day	--		--	2.9E-03	mg/kg-day	7.0E-01	mg/kg/day	4.2E-03
				1,1,2-Trichloroethane	7E-03	mg/L	3.9E-06	mg/kg-day	5.7E-02	(mg/kg-day)-1	2.2E-07	4.2E-05	mg/kg-day	4.0E-03	mg/kg/day	1.0E-02
				1,1-Dichloroethane	4E+00	mg/L	2.0E-03	mg/kg-day	--		--	2.2E-02	mg/kg-day	2.0E-01	mg/kg/day	1.1E-01
				1,1-Dichloroethene	1E-01	mg/L	7.4E-05	mg/kg-day	--		--	7.8E-04	mg/kg-day	5.0E-02	mg/kg/day	1.6E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	7.9E-04	mg/kg-day	--		--	8.4E-03	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.5E-05	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.3E-06	2.7E-04	mg/kg-day	2.0E-01	mg/kg/day	1.3E-03
				1,2-Dichloroethene	1E-01	mg/L	7.4E-05	mg/kg-day	--		--	7.8E-04	mg/kg-day	9.0E-03	mg/kg/day	8.7E-02
				1,2-Dichloropropane	4E-03	mg/L	2.0E-06	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.4E-07	2.2E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	6.8E-04	mg/kg-day	--		--	7.2E-03	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.7E-03	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.9E-05	1.8E-02	mg/kg-day	1.0E-01	mg/kg/day	1.8E-01
				2-Butanone	8E+01	mg/L	4.4E-02	mg/kg-day	--		--	4.6E-01	mg/kg-day	6.0E-01	mg/kg/day	7.7E-01
				4-Methyl-2-pentanone	2E+02	mg/L	1.1E-01	mg/kg-day	--		--	1.1E+00	mg/kg-day	8.0E-02	mg/kg/day	1.4E+01
				Acetone	7E+01	mg/L	4.1E-02	mg/kg-day	--		--	4.4E-01	mg/kg-day	9.0E-01	mg/kg/day	4.9E-01
				Acrylonitrile	1E+00	mg/L	7.4E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	4.0E-04	7.8E-03	mg/kg-day	1.0E-03	mg/kg/day	7.8E+00
				Benzene	5E-02	mg/L	2.5E-05	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.4E-06	2.7E-04	mg/kg-day	4.0E-03	mg/kg/day	6.8E-02
				Carbon tetrachloride	5E-02	mg/L	2.9E-05	mg/kg-day	1.3E-01	(mg/kg-day)-1	3.8E-06	3.1E-04	mg/kg-day	7.0E-04	mg/kg/day	4.5E-01
				Chloroethane	3E+00	mg/L	1.4E-03	mg/kg-day	--		--	1.5E-02	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	3.2E-06	mg/kg-day	3.1E-02	(mg/kg-day)-1	1.0E-07	3.4E-05	mg/kg-day	1.0E-02	mg/kg/day	3.4E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	1.2E-04	mg/kg-day	--		--	1.3E-03	mg/kg-day	1.0E-02	mg/kg/day	1.3E-01
				Ethylbenzene	8E+00	mg/L	4.8E-03	mg/kg-day	--		--	5.0E-02	mg/kg-day	1.0E-01	mg/kg/day	5.0E-01
				Ethyl methacrylate	4E+00	mg/L	2.3E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	9.0E-02	mg/kg/day	2.7E-01
				Isopropylbenzene	8E-02	mg/L	4.6E-05	mg/kg-day	--		--	4.9E-04	mg/kg-day	1.0E-01	mg/kg/day	4.9E-03
				Methylene Chloride	2E+00	mg/L	1.2E-03	mg/kg-day	7.5E-03	(mg/kg-day)-1	9.3E-06	1.3E-02	mg/kg-day	6.0E-02	mg/kg/day	2.2E-01
				n-Propylbenzene	9E-02	mg/L	5.2E-05	mg/kg-day	--		--	5.5E-04	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	5.1E-05	mg/kg-day	--		--	5.4E-04	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	5.4E-05	mg/kg-day	--		--	5.8E-04	mg/kg-day	1.0E-01	mg/kg/day	5.8E-03
				tert-Butylbenzene	7E-02	mg/L	3.8E-05	mg/kg-day	--		--	4.0E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	3.4E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.8E-06	3.6E-05	mg/kg-day	1.0E-02	mg/kg/day	3.6E-03
				Tetrahydrofuran	2E+01	mg/L	1.1E-02	mg/kg-day	--		--	1.2E-01	mg/kg-day	--		--
				Toluene	8E+01	mg/L	4.4E-02	mg/kg-day	--		--	4.7E-01	mg/kg-day	8.0E-02	mg/kg/day	5.9E+00
				Trichloroethene	6E-03	mg/L	3.4E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.4E-06	3.6E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	4.0E-05	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.9E-05	4.3E-04	mg/kg-day	3.0E-03	mg/kg/day	1.4E-01
				Xylenes (total)	3E+01	mg/L	1.6E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	2.0E-01	mg/kg/day	8.5E-01
				Antimony	1E-01	mg/L	5.7E-05	mg/kg-day	--		--	6.0E-04	mg/kg-day	4.0E-04	mg/kg/day	1.5E+00
				Arsenic	2E+00	mg/L	1.3E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.0E-03	1.4E-02	mg/kg-day	3.0E-04	mg/kg/day	4.6E+01
				Barium	4E-01	mg/L	2.1E-04	mg/kg-day	--		--	2.2E-03	mg/kg-day	2.0E-01	mg/kg/day	1.1E-02
				Beryllium	6E-01	mg/L	3.2E-04	mg/kg-day	--		--	3.4E-03	mg/kg-day	2.0E-03	mg/kg/day	1.7E+00
				Cadmium	6E-02	mg/L	3.4E-05	mg/kg-day	--		--	3.6E-04	mg/kg-day	5.0E-04	mg/kg/day	7.2E-01
				Chromium	3E-02	mg/L	1.7E-05	mg/kg-day	--		--	1.8E-04	mg/kg-day	5.0E-04	mg/kg/day	3.6E-01
				Cobalt	1E-01	mg/L	7.9E-05	mg/kg-day	--		--	8.4E-04	mg/kg-day	--		--
				Lead	6E-02	mg/L	3.4E-05	mg/kg-day	--		--	3.6E-04	mg/kg-day	NA (5)		--
				Manganese	3E+01	mg/L	1.6E-02	mg/kg-day	--		--	1.7E-01	mg/kg-day	4.7E-02	mg/kg/day	3.7E+00
				Nickel	8E-02	mg/L	4.5E-05	mg/kg-day	--		--	4.8E-04	mg/kg-day	2.0E-02	mg/kg/day	2.4E-02
				Silver	8E-01	mg/L	4.5E-04	mg/kg-day	--		--	4.8E-03	mg/kg-day	5.0E-03	mg/kg/day	9.6E-01
				Thallium	5E-03	mg/L	2.7E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	8.0E-05	mg/kg/day	3.6E-01
				Vanadium	1E-02	mg/L	5.7E-06	mg/kg-day	--		--	6.0E-05	mg/kg-day	9.0E-03	mg/kg/day	6.7E-03
				Zinc	6E+01	mg/L	3.1E-02	mg/kg-day	--		--	3.3E-01	mg/kg-day	3.0E-01	mg/kg/day	1.1E+00
			Exp. Route Total								2.4E-03					9.0E+01

TABLE 3-34C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	2.2E-07	mg/kg-day	2.4E-02	(mg/kg-day)-1	5.3E-09	2.4E-06	mg/kg-day	9.0E-02	mg/kg/day	2.6E-05
				2,4-Dimethylphenol	2E-01	mg/L	2.8E-06	mg/kg-day	--		--	3.0E-05	mg/kg-day	2.0E-02	mg/kg/day	1.5E-03
				2-Methylphenol	1E+00	mg/L	1.3E-05	mg/kg-day	--		--	1.4E-04	mg/kg-day	5.0E-02	mg/kg/day	2.7E-03
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	2.2E-05	mg/kg-day	--		--	2.3E-04	mg/kg-day	5.0E-02	mg/kg/day	4.6E-03
				4-Methylphenol	3E-01	mg/L	2.8E-06	mg/kg-day	--		--	2.9E-05	mg/kg-day	5.0E-02	mg/kg/day	5.9E-04
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Alpha-BHC	5E-05	mg/L	1.5E-09	mg/kg-day	6.3E+00	(mg/kg-day)-1	9.3E-09	1.6E-08	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	9.3E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.3E-06	9.9E-04	mg/kg-day	2.0E-02	mg/kg/day	5.0E-02
				Naphthalene	1E-02	mg/L	7.6E-07	mg/kg-day	--		--	8.0E-06	mg/kg-day	2.0E-02	mg/kg/day	4.0E-04
				Phenol	9E+00	mg/L	8.9E-05	mg/kg-day	--		--	9.5E-04	mg/kg-day	3.0E-01	mg/kg/day	3.2E-03
				1,1,1-Trichloroethane	5E-01	mg/L	9.7E-06	mg/kg-day	--		--	1.0E-04	mg/kg-day	7.0E-01	mg/kg/day	1.5E-04
				1,1,2-Trichloroethane	7E-03	mg/L	6.7E-08	mg/kg-day	5.7E-02	(mg/kg-day)-1	3.8E-09	7.1E-07	mg/kg-day	4.0E-03	mg/kg/day	1.8E-04
				1,1-Dichloroethane	4E+00	mg/L	2.9E-05	mg/kg-day	--		--	3.1E-04	mg/kg-day	2.0E-01	mg/kg/day	1.5E-03
				1,1-Dichloroethene	1E-01	mg/L	1.9E-06	mg/kg-day	--		--	2.0E-05	mg/kg-day	5.0E-02	mg/kg/day	3.9E-04
				1,2,4-Trimethylbenzene	1E+00	mg/L	3.0E-04	mg/kg-day	--		--	3.2E-03	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.2E-07	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.0E-08	2.4E-06	mg/kg-day	2.0E-01	mg/kg/day	1.2E-05
				1,2-Dichloroethene	1E-01	mg/L	1.2E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	9.0E-03	mg/kg/day	1.4E-03
				1,2-Dichloropropane	4E-03	mg/L	3.7E-08	mg/kg-day	6.8E-02	(mg/kg-day)-1	2.5E-09	4.0E-07	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	1.4E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.1E-06	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.2E-08	1.2E-05	mg/kg-day	1.0E-01	mg/kg/day	1.2E-04
				2-Butanone	8E+01	mg/L	8.7E-05	mg/kg-day	--		--	9.2E-04	mg/kg-day	6.0E-01	mg/kg/day	1.5E-03
				4-Methyl-2-pentanone	2E+02	mg/L	9.2E-04	mg/kg-day	--		--	9.8E-03	mg/kg-day	8.0E-02	mg/kg/day	1.2E-01
				Acetone	7E+01	mg/L	7.4E-05	mg/kg-day	--		--	7.9E-04	mg/kg-day	9.0E-01	mg/kg/day	8.8E-04
				Acrylonitrile	1E+00	mg/L	1.4E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	7.6E-07	1.5E-05	mg/kg-day	1.0E-03	mg/kg/day	1.5E-02
				Benzene	5E-02	mg/L	7.1E-07	mg/kg-day	5.5E-02	(mg/kg-day)-1	3.9E-08	7.5E-06	mg/kg-day	4.0E-03	mg/kg/day	1.9E-03
				Carbon tetrachloride	5E-02	mg/L	1.4E-06	mg/kg-day	1.3E-01	(mg/kg-day)-1	1.9E-07	1.5E-05	mg/kg-day	7.0E-04	mg/kg/day	2.2E-02
				Chloroethane	3E+00	mg/L	1.5E-05	mg/kg-day	--		--	1.6E-04	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	5.4E-08	mg/kg-day	3.1E-02	(mg/kg-day)-1	1.7E-09	5.7E-07	mg/kg-day	1.0E-02	mg/kg/day	5.7E-05
				cis-1,2-Dichloroethene	2E-01	mg/L	2.0E-06	mg/kg-day	--		--	2.1E-05	mg/kg-day	1.0E-02	mg/kg/day	2.1E-03
				Ethylbenzene	8E+00	mg/L	5.2E-04	mg/kg-day	--		--	5.5E-03	mg/kg-day	1.0E-01	mg/kg/day	5.5E-02
				Ethyl methacrylate	4E+00	mg/L	7.2E-05	mg/kg-day	--		--	7.6E-04	mg/kg-day	9.0E-02	mg/kg/day	8.4E-03
				Isopropylbenzene	8E-02	mg/L	1.1E-05	mg/kg-day	--		--	1.2E-04	mg/kg-day	1.0E-01	mg/kg/day	1.2E-03
				Methylene Chloride	2E+00	mg/L	8.5E-06	mg/kg-day	7.5E-03	(mg/kg-day)-1	6.4E-08	9.0E-05	mg/kg-day	6.0E-02	mg/kg/day	1.5E-03
				n-Propylbenzene	9E-02	mg/L	1.7E-05	mg/kg-day	--		--	1.8E-04	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	3.2E-05	mg/kg-day	--		--	3.4E-04	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	2.6E-05	mg/kg-day	--		--	2.8E-04	mg/kg-day	1.0E-01	mg/kg/day	2.8E-03
				tert-Butylbenzene	7E-02	mg/L	1.8E-05	mg/kg-day	--		--	1.9E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	3.7E-07	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.0E-07	3.9E-06	mg/kg-day	1.0E-02	mg/kg/day	3.9E-04
				Tetrahydrofuran	2E+01	mg/L	5.1E-05	mg/kg-day	--		--	5.4E-04	mg/kg-day	--		--
				Toluene	8E+01	mg/L	2.8E-03	mg/kg-day	--		--	3.0E-02	mg/kg-day	8.0E-02	mg/kg/day	3.7E-01
				Trichloroethene	6E-03	mg/L	1.1E-07	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.3E-08	1.1E-06	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	3.8E-07	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.7E-07	4.0E-06	mg/kg-day	3.0E-03	mg/kg/day	1.3E-03
				Xylenes (total)	3E+01	mg/L	2.5E-03	mg/kg-day	--		--	2.7E-02	mg/kg-day	2.0E-01	mg/kg/day	1.3E-01
				Antimony	1E-01	mg/L	3.7E-09	mg/kg-day	--		--	4.0E-08	mg/kg-day	6.0E-05	mg/kg/day	6.6E-04
				Arsenic	2E+00	mg/L	8.7E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.3E-07	9.2E-07	mg/kg-day	3.0E-04	mg/kg/day	3.1E-03
				Barium	4E-01	mg/L	1.4E-08	mg/kg-day	--		--	1.5E-07	mg/kg-day	1.4E-02	mg/kg/day	1.0E-05
				Beryllium	6E-01	mg/L	2.1E-08	mg/kg-day	--		--	2.2E-07	mg/kg-day	1.4E-05	mg/kg/day	1.6E-02
				Cadmium	6E-02	mg/L	2.2E-09	mg/kg-day	--		--	2.4E-08	mg/kg-day	2.5E-05	mg/kg/day	9.5E-04
				Chromium	3E-02	mg/L	2.2E-09	mg/kg-day	--		--	2.4E-08	mg/kg-day	2.5E-05	mg/kg/day	9.5E-04
				Cobalt	1E-01	mg/L	2.1E-09	mg/kg-day	--		--	2.2E-08	mg/kg-day	--		--
				Lead	6E-02	mg/L	2.2E-10	mg/kg-day	--		--	2.4E-09	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.1E-06	mg/kg-day	--		--	1.1E-05	mg/kg-day	1.9E-03	mg/kg/day	6.1E-03
				Nickel	8E-02	mg/L	6.0E-10	mg/kg-day	--		--	6.3E-09	mg/kg-day	8.0E-04	mg/kg/day	7.9E-06
				Silver	8E-01	mg/L	1.8E-08	mg/kg-day	--		--	1.9E-07	mg/kg-day	2.0E-04	mg/kg/day	9.5E-04
				Thallium	5E-03	mg/L	1.8E-10	mg/kg-day	--		--	1.9E-09	mg/kg-day	8.0E-05	mg/kg/day	2.4E-05
				Vanadium	1E-02	mg/L	3.7E-10	mg/kg-day	--		--	4.0E-09	mg/kg-day	2.3E-04	mg/kg/day	1.7E-05
				Zinc	6E+01	mg/L	1.2E-06	mg/kg-day	--		--	1.3E-05	mg/kg-day	3.0E-01	mg/kg/day	4.4E-05
			Exp. Route Total								3.1E-06					8.4E-01
	Exposure Medium Total										2.4E-03					9.1E+01
Risk From Reference											0.0E+00					4.9E+00
Risk from Site											2.4E-03					8.6E+01

TABLE 3-34C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Air	Indoor Air	Group 4	Inhalation	Tetrachloroethene	4E-06	mg/m^3	7.7E-08	mg/m3	5.9E-03	$(mg/m^3)^{-1}$	4.5E-10	8.2E-07	mg/m3	3.5E-02	(mg/m^3)	2.3E-05
				Trichloroethene	3E-06	mg/m^3	5.4E-08	mg/m3	2.0E-03	$(mg/m^3)^{-1}$	1.1E-10	6.5E-07	mg/m3	6.0E-01	(mg/m^3)	1.1E-06
			Exp. Route Total								5.6E-10					2.4E-05
	Exposure Medium Total										5.6E-10					2.4E-05
Risk From Reference																
Risk from Site											5.6E-10					2.4E-05
Total of Receptor Risks Across All Media											2E-03	Total of Receptor Hazards Across All Media				9E+01
Risks from Reference											3E-06					5E+00
Risks from Site											2E-03					9E+01

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	8.0E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	5.8E-06	2.2E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	4.8E-06	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.5E-05	1.3E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	3.6E-06	mg/kg-day	--		--	1.0E-05	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	3.4E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.5E-06	9.5E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	4.2E-06	mg/kg-day	7.3E-02	(mg/kg-day)-1	3.1E-07	1.2E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.0E-07	mg/kg-day	--		--	2.9E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	4.6E-06	mg/kg-day	2.0E-02	(mg/kg-day)-1	9.2E-08	1.3E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	7.8E-08	mg/kg-day	--		--	2.2E-07	mg/kg-day	7.0E-02	mg/kg/day	3.1E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	8.1E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.9E-06	2.3E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	4.2E-06	mg/kg-day	--		--	1.2E-05	mg/kg-day	2.0E-03	mg/kg/day	5.9E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	1.8E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.3E-06	5.0E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	2.5E-06	mg/kg-day	--		--	7.0E-06	mg/kg-day	4.0E-03	mg/kg/day	1.8E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	3.0E-06	mg/kg-day	--		--	8.4E-06	mg/kg-day	4.0E-03	mg/kg/day	2.1E-03
				Naphthalene	1.3E+01	(mg/kg)	2.8E-06	mg/kg-day	--		--	7.7E-06	mg/kg-day	2.0E-02	mg/kg/day	3.9E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	1.5E-05	mg/kg-day	--		--	4.2E-05	mg/kg-day	3.0E-02	mg/kg/day	1.4E-03
				Arsenic	7.1E+00	(mg/kg)	1.5E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.2E-06	4.2E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Lead	1.3E+02	(mg/kg)	2.8E-05	mg/kg-day	--		--	7.8E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	3.6E-05	mg/kg-day	--		--	1.0E-04	mg/kg-day	1.4E-01	mg/kg/day	7.1E-04
				Vanadium	1.6E+01	(mg/kg)	3.3E-06	mg/kg-day	--		--	9.3E-06	mg/kg-day	9.0E-03	mg/kg/day	1.0E-03
			Exp. Route Total								5.3E-05					2.9E-02
			Dermal Contact	Benzo(a)anthracene	3.8E+01	(mg/kg)	6.8E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	5.0E-06	1.9E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	4.1E-06	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.0E-05	1.1E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	3.1E-06	mg/kg-day	--		--	8.6E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	2.9E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.1E-06	8.1E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	3.6E-06	mg/kg-day	7.3E-02	(mg/kg-day)-1	2.7E-07	1.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	6.8E-08	mg/kg-day	--		--	1.9E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	3.0E-06	mg/kg-day	2.0E-02	(mg/kg-day)-1	6.1E-08	8.5E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	5.1E-08	mg/kg-day	--		--	1.4E-07	mg/kg-day	7.0E-02	mg/kg/day	2.0E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	7.0E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.1E-06	2.0E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	2.8E-06	mg/kg-day	--		--	7.8E-06	mg/kg-day	2.0E-03	mg/kg/day	3.9E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	1.5E-06	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.1E-06	4.3E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	2.2E-06	mg/kg-day	--		--	6.0E-06	mg/kg-day	4.0E-03	mg/kg/day	1.5E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	2.6E-06	mg/kg-day	--		--	7.2E-06	mg/kg-day	4.0E-03	mg/kg/day	1.8E-03
				Naphthalene	1.3E+01	(mg/kg)	2.4E-06	mg/kg-day	--		--	6.6E-06	mg/kg-day	2.0E-02	mg/kg/day	3.3E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	9.9E-06	mg/kg-day	--		--	2.8E-05	mg/kg-day	3.0E-02	mg/kg/day	9.2E-04
				Arsenic	7.1E+00	(mg/kg)	2.9E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.4E-07	8.3E-07	mg/kg-day	3.0E-04	mg/kg/day	2.8E-03
				Lead	1.3E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								4.4E-05					1.1E-02
	Exposure Medium Total										9.7E-05					4.1E-02
Risk From Reference											1.4E-05					1.7E-02
Risk from Site											8.3E-05					2.3E-02

TABLE 3-34D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Fugitive Dust	Group 4 Soil	Inhalation	Benzo(a)anthracene	2.6E-09	mg/m³	1.3E-10	mg/m³	1.1E-01	(mg/m³)-¹	1.4E-11	3.5E-10	mg/m³	--		--
				Benzo(a)pyrene	1.7E-08	mg/m³	8.2E-10	mg/m3	1.1E+00	(mg/m³)-¹	9.0E-10	2.3E-09	mg/m3	--		--
				Benzo(e)pyrene	1.3E-08	mg/m³	6.1E-10	mg/m3	--		--	1.7E-09	mg/m3	--		--
				Benzo(b)fluoranthene	1.4E-09	mg/m³	6.8E-11	mg/m3	1.1E-01	(mg/m³)-¹	7.5E-12	1.9E-10	mg/m3	--		--
				Benzo(k)fluoranthene	1.5E-09	mg/m³	7.3E-11	mg/m3	1.1E-01	(mg/m³)-¹	8.1E-12	2.0E-10	mg/m3	--		--
				Bis(2-Chloroethoxy)methane	1.8E-10	mg/m³	8.9E-12	mg/m3	--		--	2.5E-11	mg/m3	--		--
				Carbazole	1.9E-08	mg/m³	9.4E-10	mg/m3	--		--	2.6E-09	mg/m3	--		--
				4-Chloro-3-methylphenol	2.2E-10	mg/m³	1.1E-11	mg/m3	--		--	3.0E-11	mg/m3	--		--
				Dibenzo(a,h)anthracene	6.9E-10	mg/m³	3.4E-11	mg/m3	1.2E+00	(mg/m³)-¹	4.0E-11	9.4E-11	mg/m3	--		--
				Dibenzofuran	1.8E-08	mg/m³	8.6E-10	mg/m3	--		--	2.4E-09	mg/m3	7.0E-03	(mg/m³)	3.5E-07
				Indeno(1,2,3-cd)Pyrene	6.2E-09	mg/m³	3.1E-10	mg/m3	1.1E-01	(mg/m³)-¹	3.4E-11	8.6E-10	mg/m3	--		--
				1-Methylnaphthalene	7.2E-04	mg/m³	3.5E-05	mg/m3	--		--	9.9E-05	mg/m3	2.5E-01	(mg/m³)	4.0E-04
				2-Methylnaphthalene	3.0E-04	mg/m³	1.5E-05	mg/m3	--		--	4.1E-05	mg/m3	1.4E-01	(mg/m³)	2.9E-04
				Naphthalene	3.3E-04	mg/m³	1.6E-05	mg/m3	--		--	4.5E-05	mg/m3	3.0E-03	(mg/m³)	1.5E-02
				C11-C22 Aromatics	1.4E-03	mg/m³	7.0E-05	mg/m3	--		--	1.9E-04	mg/m3	5.0E-02	(mg/m³)	3.9E-03
				Arsenic	5.2E-09	mg/m³	2.6E-10	mg/m3	4.3E+00	(mg/m³)-¹	1.1E-09	7.2E-10	mg/m3	3.0E-05	(mg/m³)	2.4E-05
				Lead	9.8E-08	mg/m³	4.8E-09	mg/m3	--		--	1.3E-08	mg/m3	NA (3)		--
				Manganese	1.2E-07	mg/m³	6.1E-09	mg/m3	--		--	1.7E-08	mg/m3	5.0E-05	(mg/m³)	3.4E-04
				Vanadium	1.2E-08	mg/m³	5.7E-10	mg/m3	--		--	1.6E-09	mg/m3	--		--
			Exp. Route Total								2.1E-09					2.0E-02
Ex. Medium Total											2.1E-09					2.0E-02
Risk From Reference											1.1E-09					1.5E-02
Risk from Site											9.7E-10					4.9E-03

TABLE 3-34D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Groundwater	Potable Groundwater	Groups 3-6	Ingestion	1,4-Dichlorobenzene	3E-03	mg/L	1.3E-05	mg/kg-day	2.4E-02	(mg/kg-day)-1	3.1E-07	3.6E-05	mg/kg-day	9.0E-02	mg/kg/day	4.0E-04
				2,4-Dimethylphenol	2E-01	mg/L	7.2E-04	mg/kg-day	--		--	2.0E-03	mg/kg-day	2.0E-02	mg/kg/day	1.0E-01
				2-Methylphenol	1E+00	mg/L	4.0E-03	mg/kg-day	--		--	1.1E-02	mg/kg-day	5.0E-02	mg/kg/day	2.3E-01
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	8.4E-03	mg/kg-day	--		--	2.4E-02	mg/kg-day	5.0E-02	mg/kg/day	4.7E-01
				4-Methylphenol	3E-01	mg/L	1.1E-03	mg/kg-day	--		--	3.0E-03	mg/kg-day	5.0E-02	mg/kg/day	6.1E-02
				Aroclor 1254	1E-03	mg/L	4.8E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.9E-06	1.4E-05	mg/kg-day	2.0E-05	mg/kg/day	6.8E-01
				Alpha-BHC	5E-05	mg/L	1.9E-07	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.2E-06	5.3E-07	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	2.5E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	3.4E-05	6.9E-03	mg/kg-day	2.0E-02	mg/kg/day	3.4E-01
				Naphthalene	1E-02	mg/L	4.4E-05	mg/kg-day	--		--	1.2E-04	mg/kg-day	2.0E-02	mg/kg/day	6.2E-03
				Phenol	9E+00	mg/L	3.8E-02	mg/kg-day	--		--	1.1E-01	mg/kg-day	3.0E-01	mg/kg/day	3.5E-01
				1,1,1-Trichloroethane	5E-01	mg/L	2.0E-03	mg/kg-day	--		--	5.5E-03	mg/kg-day	7.0E-01	mg/kg/day	7.9E-03
				1,1,2-Trichloroethane	7E-03	mg/L	2.8E-05	mg/kg-day	5.7E-02	(mg/kg-day)-1	1.6E-06	7.8E-05	mg/kg-day	4.0E-03	mg/kg/day	1.9E-02
				1,1-Dichloroethane	4E+00	mg/L	1.4E-02	mg/kg-day	--		--	4.1E-02	mg/kg-day	2.0E-01	mg/kg/day	2.0E-01
				1,1-Dichloroethene	1E-01	mg/L	5.2E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	5.0E-02	mg/kg/day	2.9E-02
				1,2,4-Trimethylbenzene	1E+00	mg/L	5.6E-03	mg/kg-day	--		--	1.6E-02	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	1.8E-04	mg/kg-day	9.1E-02	(mg/kg-day)-1	1.6E-05	5.0E-04	mg/kg-day	2.0E-01	mg/kg/day	2.5E-03
				1,2-Dichloroethene	1E-01	mg/L	5.2E-04	mg/kg-day	--		--	1.5E-03	mg/kg-day	9.0E-03	mg/kg/day	1.6E-01
				1,2-Dichloropropane	4E-03	mg/L	1.4E-05	mg/kg-day	6.8E-02	(mg/kg-day)-1	9.8E-07	4.1E-05	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	4.8E-03	mg/kg-day	--		--	1.4E-02	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.2E-02	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.3E-04	3.4E-02	mg/kg-day	1.0E-01	mg/kg/day	3.4E-01
				2-Butanone	8E+01	mg/L	3.1E-01	mg/kg-day	--		--	8.7E-01	mg/kg-day	6.0E-01	mg/kg/day	1.4E+00
				4-Methyl-2-pentanone	2E+02	mg/L	7.6E-01	mg/kg-day	--		--	2.1E+00	mg/kg-day	8.0E-02	mg/kg/day	2.7E+01
				Acetone	7E+01	mg/L	2.9E-01	mg/kg-day	--		--	8.2E-01	mg/kg-day	9.0E-01	mg/kg/day	9.1E-01
				Acrylonitrile	1E+00	mg/L	5.2E-03	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.8E-03	1.5E-02	mg/kg-day	1.0E-03	mg/kg/day	1.5E+01
				Benzene	5E-02	mg/L	1.8E-04	mg/kg-day	5.5E-02	(mg/kg-day)-1	9.9E-06	5.1E-04	mg/kg-day	4.0E-03	mg/kg/day	1.3E-01
				Carbon tetrachloride	5E-02	mg/L	2.1E-04	mg/kg-day	1.3E-01	(mg/kg-day)-1	2.7E-05	5.9E-04	mg/kg-day	7.0E-04	mg/kg/day	8.4E-01
				Chloroethane	3E+00	mg/L	1.0E-02	mg/kg-day	--		--	2.8E-02	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	2.3E-05	mg/kg-day	3.1E-02	(mg/kg-day)-1	7.1E-07	6.4E-05	mg/kg-day	1.0E-02	mg/kg/day	6.4E-03
				cis-1,2-Dichloroethene	2E-01	mg/L	8.8E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	1.0E-02	mg/kg/day	2.5E-01
				Ethylbenzene	8E+00	mg/L	3.4E-02	mg/kg-day	--		--	9.3E-02	mg/kg-day	1.0E-01	mg/kg/day	9.5E-01
				Ethyl methacrylate	4E+00	mg/L	1.6E-02	mg/kg-day	--		--	4.5E-02	mg/kg-day	9.0E-02	mg/kg/day	5.0E-01
				Isopropylbenzene	8E-02	mg/L	3.3E-04	mg/kg-day	--		--	9.2E-04	mg/kg-day	1.0E-01	mg/kg/day	9.2E-03
				Methylene Chloride	2E+00	mg/L	8.8E-03	mg/kg-day	7.5E-03	(mg/kg-day)-1	6.6E-05	2.5E-02	mg/kg-day	6.0E-02	mg/kg/day	4.1E-01
				n-Propylbenzene	9E-02	mg/L	3.7E-04	mg/kg-day	--		--	1.0E-03	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	3.6E-04	mg/kg-day	--		--	1.0E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	3.9E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	1.0E-01	mg/kg/day	1.1E-02
				tert-Butylbenzene	7E-02	mg/L	2.7E-04	mg/kg-day	--		--	7.5E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	2.4E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.3E-05	6.8E-05	mg/kg-day	1.0E-02	mg/kg/day	6.8E-03
				Tetrahydrofuran	2E+01	mg/L	8.0E-02	mg/kg-day	--		--	2.3E-01	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.1E-01	mg/kg-day	--		--	8.8E-01	mg/kg-day	8.0E-02	mg/kg/day	1.1E+01
				Trichloroethene	6E-03	mg/L	2.4E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	9.6E-06	6.8E-05	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	2.9E-04	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.1E-04	8.0E-04	mg/kg-day	3.0E-03	mg/kg/day	2.7E-01
				Xylenes (total)	3E+01	mg/L	1.1E-01	mg/kg-day	--		--	3.2E-01	mg/kg-day	2.0E-01	mg/kg/day	1.6E+00
				Antimony	1E-01	mg/L	4.0E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	4.0E-04	mg/kg/day	2.8E+00
				Arsenic	2E+00	mg/L	9.3E-03	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.4E-02	2.6E-02	mg/kg-day	3.0E-04	mg/kg/day	8.7E+01
				Barium	4E-01	mg/L	1.5E-03	mg/kg-day	--		--	4.2E-03	mg/kg-day	2.0E-01	mg/kg/day	2.1E-02
				Beryllium	6E-01	mg/L	2.3E-03	mg/kg-day	--		--	6.3E-03	mg/kg-day	2.0E-03	mg/kg/day	3.2E+00
				Cadmium	6E-02	mg/L	2.4E-04	mg/kg-day	--		--	6.8E-04	mg/kg-day	5.0E-04	mg/kg/day	1.4E+00
				Chromium	3E-02	mg/L	1.2E-04	mg/kg-day	--		--	3.4E-04	mg/kg-day	5.0E-04	mg/kg/day	6.8E-01
				Cobalt	1E-01	mg/L	5.6E-04	mg/kg-day	--		--	1.6E-03	mg/kg-day	--		--
				Lead	6E-02	mg/L	2.4E-04	mg/kg-day	--		--	6.8E-04	mg/kg-day	NA (2)		--
				Manganese	3E+01	mg/L	1.2E-01	mg/kg-day	--		--	3.3E-01	mg/kg-day	4.7E-02	mg/kg/day	7.0E+00
				Nickel	8E-02	mg/L	3.2E-04	mg/kg-day	--		--	9.0E-04	mg/kg-day	2.0E-02	mg/kg/day	4.5E-02
				Silver	8E-01	mg/L	3.2E-03	mg/kg-day	--		--	9.0E-03	mg/kg-day	5.0E-03	mg/kg/day	1.8E+00
				Thallium	5E-03	mg/L	1.9E-05	mg/kg-day	--		--	5.4E-05	mg/kg-day	8.0E-05	mg/kg/day	6.8E-01
				Vanadium	1E-02	mg/L	4.0E-05	mg/kg-day	--		--	1.1E-04	mg/kg-day	9.0E-03	mg/kg/day	1.3E-02
				Zinc	6E+01	mg/L	2.2E-01	mg/kg-day	--		--	6.2E-01	mg/kg-day	3.0E-01	mg/kg/day	2.1E+00
			Exp. Route Total								1.7E-02					1.7E+02

TABLE 3-34D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Potable Groundwater	Groups 3-6	Dermal Contact	1,4-Dichlorobenzene	3E-03	mg/L	2.7E-06	mg/kg-day	2.4E-02	(mg/kg-day)-1	6.5E-08	7.6E-06	mg/kg-day	9.0E-02	mg/kg/day	8.4E-05
				2,4-Dimethylphenol	2E-01	mg/L	3.4E-05	mg/kg-day	--		--	9.6E-05	mg/kg-day	2.0E-02	mg/kg/day	4.8E-03
				2-Methylphenol	1E+00	mg/L	1.6E-04	mg/kg-day	--		--	4.4E-04	mg/kg-day	5.0E-02	mg/kg/day	8.9E-03
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	2.6E-04	mg/kg-day	--		--	7.4E-04	mg/kg-day	5.0E-02	mg/kg/day	1.5E-02
				4-Methylphenol	3E-01	mg/L	3.4E-05	mg/kg-day	--		--	9.5E-05	mg/kg-day	5.0E-02	mg/kg/day	1.9E-03
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Alpha-BHC	5E-05	mg/L	1.8E-08	mg/kg-day	6.3E+00	(mg/kg-day)-1	1.1E-07	5.0E-08	mg/kg-day	--		--
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.1E-03	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.6E-05	3.2E-03	mg/kg-day	2.0E-02	mg/kg/day	1.6E-01
				Naphthalene	1E-02	mg/L	9.3E-06	mg/kg-day	--		--	2.6E-05	mg/kg-day	2.0E-02	mg/kg/day	1.3E-03
				Phenol	9E+00	mg/L	1.1E-03	mg/kg-day	--		--	3.1E-03	mg/kg-day	3.0E-01	mg/kg/day	1.0E-02
				1,1,1-Trichloroethane	5E-01	mg/L	1.2E-04	mg/kg-day	--		--	3.3E-04	mg/kg-day	7.0E-01	mg/kg/day	4.7E-04
				1,1,2-Trichloroethane	7E-03	mg/L	8.2E-07	mg/kg-day	5.7E-02	(mg/kg-day)-1	4.7E-08	2.3E-06	mg/kg-day	4.0E-03	mg/kg/day	5.7E-04
				1,1-Dichloroethane	4E+00	mg/L	3.6E-04	mg/kg-day	--		--	1.0E-03	mg/kg-day	2.0E-01	mg/kg/day	5.0E-03
				1,1-Dichloroethene	1E-01	mg/L	2.3E-05	mg/kg-day	--		--	6.4E-05	mg/kg-day	5.0E-02	mg/kg/day	1.3E-03
				1,2,4-Trimethylbenzene	1E+00	mg/L	3.7E-03	mg/kg-day	--		--	1.0E-02	mg/kg-day	--		--
				1,2-Dichloroethane	4E-02	mg/L	2.8E-06	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.5E-07	7.7E-06	mg/kg-day	2.0E-01	mg/kg/day	3.9E-05
				1,2-Dichloroethene	1E-01	mg/L	1.5E-05	mg/kg-day	--		--	4.1E-05	mg/kg-day	9.0E-03	mg/kg/day	4.5E-03
				1,2-Dichloropropane	4E-03	mg/L	4.6E-07	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.1E-08	1.3E-06	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	1E+00	mg/L	1.8E-03	mg/kg-day	--		--	4.9E-03	mg/kg-day	--		--
				1,4-Dioxane	3E+00	mg/L	1.4E-05	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.5E-07	3.8E-05	mg/kg-day	1.0E-01	mg/kg/day	3.8E-04
				2-Butanone	8E+01	mg/L	1.1E-03	mg/kg-day	--		--	3.0E-03	mg/kg-day	6.0E-01	mg/kg/day	5.0E-03
				4-Methyl-2-pentanone	2E+02	mg/L	1.1E-02	mg/kg-day	--		--	3.2E-02	mg/kg-day	8.0E-02	mg/kg/day	3.9E-01
				Acetone	7E+01	mg/L	9.1E-04	mg/kg-day	--		--	2.5E-03	mg/kg-day	9.0E-01	mg/kg/day	2.8E-03
				Acrylonitrile	1E+00	mg/L	1.7E-05	mg/kg-day	5.4E-01	(mg/kg-day)-1	9.2E-06	4.8E-05	mg/kg-day	1.0E-03	mg/kg/day	4.8E-02
				Benzene	5E-02	mg/L	8.7E-06	mg/kg-day	5.5E-02	(mg/kg-day)-1	4.8E-07	2.4E-05	mg/kg-day	4.0E-03	mg/kg/day	6.1E-03
				Carbon tetrachloride	5E-02	mg/L	1.8E-05	mg/kg-day	1.3E-01	(mg/kg-day)-1	2.3E-06	4.9E-05	mg/kg-day	7.0E-04	mg/kg/day	7.0E-02
				Chloroethane	3E+00	mg/L	1.8E-04	mg/kg-day	--		--	5.0E-04	mg/kg-day	--		--
				Chloroform	6E-03	mg/L	6.6E-07	mg/kg-day	3.1E-02	(mg/kg-day)-1	2.0E-08	1.8E-06	mg/kg-day	1.0E-02	mg/kg/day	1.8E-04
				cis-1,2-Dichloroethene	2E-01	mg/L	2.5E-05	mg/kg-day	--		--	6.9E-05	mg/kg-day	1.0E-02	mg/kg/day	6.9E-03
				Ethylbenzene	8E+00	mg/L	6.4E-03	mg/kg-day	--		--	1.8E-02	mg/kg-day	1.0E-01	mg/kg/day	1.8E-01
				Ethyl methacrylate	4E+00	mg/L	8.7E-04	mg/kg-day	--		--	2.4E-03	mg/kg-day	9.0E-02	mg/kg/day	2.7E-02
				Isopropylbenzene	8E-02	mg/L	1.4E-04	mg/kg-day	--		--	3.8E-04	mg/kg-day	1.0E-01	mg/kg/day	3.8E-03
				Methylene Chloride	2E+00	mg/L	1.0E-04	mg/kg-day	7.5E-03	(mg/kg-day)-1	7.8E-07	2.9E-04	mg/kg-day	6.0E-02	mg/kg/day	4.9E-03
				n-Propylbenzene	9E-02	mg/L	2.0E-04	mg/kg-day	--		--	5.7E-04	mg/kg-day	--		--
				n-Butylbenzene	9E-02	mg/L	3.9E-04	mg/kg-day	--		--	1.1E-03	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	3.2E-04	mg/kg-day	--		--	9.0E-04	mg/kg-day	1.0E-01	mg/kg/day	9.0E-03
				tert-Butylbenzene	7E-02	mg/L	2.2E-04	mg/kg-day	--		--	6.3E-04	mg/kg-day	--		--
				Tetrachloroethene	6E-03	mg/L	4.5E-06	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.4E-06	1.3E-05	mg/kg-day	1.0E-02	mg/kg/day	1.3E-03
				Tetrahydrofuran	2E+01	mg/L	6.2E-04	mg/kg-day	--		--	1.7E-03	mg/kg-day	--		--
				Toluene	8E+01	mg/L	3.4E-02	mg/kg-day	--		--	9.6E-02	mg/kg-day	8.0E-02	mg/kg/day	1.2E+00
				Trichloroethene	6E-03	mg/L	1.3E-06	mg/kg-day	4.0E-01	(mg/kg-day)-1	5.2E-07	3.7E-06	mg/kg-day	--		--
				Vinyl chloride	7E-02	mg/L	4.7E-06	mg/kg-day	7.2E-01	(mg/kg-day)-1	3.4E-06	1.3E-05	mg/kg-day	3.0E-03	mg/kg/day	4.4E-03
				Xylenes (total)	3E+01	mg/L	3.1E-02	mg/kg-day	--		--	8.6E-02	mg/kg-day	2.0E-01	mg/kg/day	4.3E-01
				Antimony	1E-01	mg/L	6.5E-08	mg/kg-day	--		--	1.8E-07	mg/kg-day	6.0E-05	mg/kg/day	3.0E-03
				Arsenic	2E+00	mg/L	1.5E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.2E-06	4.2E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Barium	4E-01	mg/L	2.4E-07	mg/kg-day	--		--	6.7E-07	mg/kg-day	1.4E-02	mg/kg/day	4.8E-05
				Beryllium	6E-01	mg/L	3.6E-07	mg/kg-day	--		--	1.0E-06	mg/kg-day	1.4E-05	mg/kg/day	7.2E-02
				Cadmium	6E-02	mg/L	3.9E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	2.5E-05	mg/kg/day	4.3E-03
				Chromium	3E-02	mg/L	3.9E-08	mg/kg-day	--		--	1.1E-07	mg/kg-day	2.5E-05	mg/kg/day	4.3E-03
				Cobalt	1E-01	mg/L	3.6E-08	mg/kg-day	--		--	1.0E-07	mg/kg-day	--		--
				Lead	6E-02	mg/L	3.9E-09	mg/kg-day	--		--	1.1E-08	mg/kg-day	NA (3)		--
				Manganese	3E+01	mg/L	1.9E-05	mg/kg-day	--		--	5.2E-05	mg/kg-day	1.9E-03	mg/kg/day	2.8E-02
				Nickel	8E-02	mg/L	1.0E-08	mg/kg-day	--		--	2.9E-08	mg/kg-day	8.0E-04	mg/kg/day	3.6E-05
				Silver	8E-01	mg/L	3.1E-07	mg/kg-day	--		--	8.7E-07	mg/kg-day	2.0E-04	mg/kg/day	4.3E-03
				Thallium	5E-03	mg/L	3.1E-09	mg/kg-day	--		--	8.7E-09	mg/kg-day	8.0E-05	mg/kg/day	1.1E-04
				Vanadium	1E-02	mg/L	6.5E-09	mg/kg-day	--		--	1.8E-08	mg/kg-day	2.3E-04	mg/kg/day	7.7E-05
				Zinc	6E+01	mg/L	2.1E-05	mg/kg-day	--		--	6.0E-05	mg/kg-day	3.0E-01	mg/kg/day	2.0E-04
			Exp. Route Total								3.8E-05					2.7E+00
	Exposure Medium Total										1.7E-02					1.7E+02
Risk From Reference											0.0E+00					9.2E+00
Risk from Site											1.7E-02					1.6E+02

TABLE 3-34D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Facility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Air	Indoor Air	Group 4	Inhalation	Tetrachloroethene	4E-06	mg/m3	3.3E-07	mg/m^2	5.9E-03	(mg/m^3)-^{1}	2.0E-09	9.3E-07	mg/m3	3.5E-02	(mg/m^3)	2.7E-05
				Trichloroethene	3E-06	mg/m3	2.3E-07	mg/m2	2.0E-03	(mg/m^3)-^{1}	4.6E-10	6.5E-07	mg/m3	6.0E-01	(mg/m^3)	1.1E-06
			Exp. Route Total								2.4E-09					2.8E-05
	Exposure Medium Total										2.4E-09					2.8E-05
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											2.4E-09					2.8E-05
Total of Receptor Risks Across All Media											2E-02	Total of Receptor Hazards Across All Media				2.E+02
Risks from Reference											1E-05					9.E+00
Risks from Site											2E-02					2.E+02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34E

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3, Upland	Benzo(a)anthracene	2.2E-08	1.1E-12	3.8E-08	6E-08	--	--	--	--	--
			Benzo(a)pyrene	2.2E-07	1.1E-11	3.8E-07	6E-07	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.7E-08	8.8E-13	2.9E-08	5E-08	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	5.8E-07	3.4E-11	7.7E-07	1E-06	Liver	2.2E-02	2.2E-06	2.9E-02	5E-02
			Di-n-octylphthalate	--	--	--	--	Not available	1.2E-02	1.2E-06	1.5E-02	3E-02
			Indeno(1,2,3-cd)Pyrene	1.5E-08	7.5E-13	2.5E-08	4E-08	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	1.5E-02	6.0E-02	2.5E-03	6E-02
			Toluene	--	--	--	--	Kidney	2.6E-03	6.9E-03	0.0E+00	9E-03
			Tetrachloroethene	4.0E-07	1.3E-06	0.0E+00	2E-06	Liver	7.9E-04	6.6E-02	0.0E+00	7E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	1.3E-03	2.8E-01	0.0E+00	3E-01
			Arsenic	2.4E-07	2.4E-10	9.7E-08	3E-07	Skin; cardiovascular system	5.8E-03	2.0E-05	2.3E-03	8E-03
			Cadmium	--	6.5E-11	--	6E-11	--	1.1E-03	--	5.9E-04	2E-03
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	4.4E-04	--	0.0E+00	4E-04
			Chemical Total	1.5E-06	1.3E-06	1.3E-06	4E-06		4.7E-02	4.1E-01	5.0E-02	5E-01
		Exposure Point Total		1.5E-06	1.3E-06	1.3E-06	4E-06		4.7E-02	4.1E-01	5.0E-02	5E-01
	Exposure Medium Total			1.5E-06	1.3E-06	1.3E-06	4E-06		4.7E-02	4.1E-01	5.0E-02	5E-01
Medium Total				1.5E-06	1.3E-06	1.3E-06	4E-06		4.7E-02	4.1E-01	5.0E-02	5E-01
Air	Indoor Air	Group 3	1,4-Dichlorobenzene	--	--	--	--	Liver	--	8.1E-06	--	8E-06
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	--	3.8E-05	--	4E-05
			2-Methylphenol	--	--	--	--	Whole body; nervous system	--	1.1E-04	--	1E-04
			3-Methylphenol 4-Methylphenol	--	--	--	--	Whole body; nervous system	--	1.8E-03	--	2E-03
			4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	--	--
			Naphthalene	--	--	--	--	Respiratory system	--	3.4E-03	--	3E-03
			Phenol	--	--	--	--	Alimentary, cardiovascular, nervous systems; kidney	--	1.4E-04	--	1E-04
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	0.0E+00	--	--
			1,1,2-Trichloroethane	--	--	--	--	Blood	--	--	--	--
			1,1-Dichloroethane	--	--	--	--	None observed	--	0.0E+00	--	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	0.0E+00	--	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	3.6E-09	--	4E-09	Liver	--	6.0E-07	--	6E-07

TABLE 3-34E

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Indoor Air	Group 3	1,2-Dichloroethane	--	--	--	--	Respiratory system; liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	0.0E+00	--	--
			1,2-Dichloropropane	--	--	--	--	Nasal mucosa	--	7.6E-04	--	8E-04
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	--	0.0E+00	--	--	Not available	--	0.0E+00	--	--
			2-Butanone	--	--	--	--	Development fetus	--	4.2E-03	--	4E-03
			4-Methyl-2-pentanone	--	--	--	--	Development fetus	--	2.9E-02	--	3E-02
			Acetone	--	--	--	--	Kidney	--	6.1E-03	--	6E-03
			Acrylonitrile	--	4.5E-06	--	5E-06	Respiratory system	--	2.0E-01	--	2E-01
			Benzene	--	5.2E-08	--	5E-08	Blood; immune system	--	2.4E-03	--	2E-03
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloroform	--	--	--	--	Kidney; development fetus; alimentary system	--	--	--	--
			Chloromethane	--	--	--	--	Development fetus	--	1.7E-02	--	2E-02
			Ethylbenzene	--	--	--	--	Development fetus	--	1.7E-01	--	2E-01
			Ethyl methacrylate	--	--	--	--	Kidney	--	2.1E-02	--	2E-02
			Isopropylbenzene	--	--	--	--	Kidney adrenal gland	--	0.0E+00	--	--
			Methylene Chloride	--	9.3E-07	--	9E-07	Liver	--	7.0E-03	--	7E-03
			n-Propylbenzene	--	--	--	--	Not available	--	1.2E-02	--	1E-02
			n-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			tert-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney adrenal gland	--	5.1E-03	--	5E-03
			Tetrachloroethene	--	6.0E-09	--	6E-09	system	--	3.1E-04	--	3E-04
			Tetrahydrofuran	--	--	--	--	--	--	7.7E-02	--	8E-02
			Toluene	--	--	--	--	Nervous system	--	3.3E-01	--	3E-01
			Trichloroethene	--	2.4E-09	--	2E-09	Nervous system; eyes	--	2.1E-05	--	2E-05
			Vinyl chloride	--	2.6E-08	--	3E-08	Liver	--	6.3E-04	--	6E-04
			Xylenes (total)	--	--	--	--	Nervous system	--	5.1E-00	--	5E-00
			Chemical Total	0.0E+00	5.6E-06	0.0E+00	5.6E-06		0E+00	6E+00	0E+00	6E+00
		Exposure Point Total		0.0E+00	5.6E-06	0.0E+00	6E-06		0.0E+00	6.0E+00	0.0E+00	6E+00
	Exposure Medium Total			0.0E+00	5.6E-06	0.0E+00	6E-06		0.0E+00	6.0E+00	0.0E+00	6E+00
Medium Total				0.0E+00	5.6E-06	0.0E+00	6E-06		0.0E+00	6.0E+00	0.0E+00	6E+00

TABLE 3-34E

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	4.3E-08	--	5.3E-09	5E-08	None observed	2.1E-04	--	2.6E-05	2E-04
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	5.4E-02	--	1.5E-03	6E-02
			2-Methylphenol	--	--	--	--	Whole body; nervous system	1.2E-01	--	2.7E-03	1E-01
			3-Methylphenol 4-Methylphenol	--	--	--	--	Whole body; nervous system	2.5E-01	--	4.6E-03	3E-01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	3.2E-02	--	5.9E-04	3E-02
			Aroclor 1254	2.7E-07	--	0.0E+00	3E-07	Eyes; immune system	3.6E-01	--	0.0E+00	4E-01
			Alpha-BHC	1.7E-07	--	9.3E-09	2E-07	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	4.8E-06	--	1.3E-06	6E-06	Liver	1.8E-01	--	5.0E-02	2E-01
			Naphthalene	--	--	--	--	Whole body	3.3E-03	--	4.0E-04	4E-03
			Phenol	--	--	--	--	Development Fetus	1.9E-01	--	3.2E-03	2E-01
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	4.2E-03	--	1.1E-04	4E-03
			1,1,2-Trichloroethane	2.2E-07	--	3.8E-09	2E-07	Blood	1.0E-02	--	1.8E-04	1E-02
			1,1-Dichloroethane	--	--	--	--	None observed	1.1E-01	--	1.5E-03	1E-01
			1,1-Dichloroethene	--	--	--	--	Liver	1.6E-02	--	3.9E-04	2E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	2.3E-06	--	2.0E-08	2E-06	Kidney	1.3E-03	--	1.2E-05	1E-03
			1,2-Dichloroethene	--	--	--	--	Liver	8.7E-02	--	1.4E-03	9E-02
			1,2-Dichloropropane	1.4E-07	--	2.5E-09	1E-07	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.9E-05	--	1.2E-08	2E-05	Liver	1.8E-01	--	1.2E-04	2E-01
			2-Butanone	--	--	--	--	Whole body	7.7E-01	--	1.5E-03	8E-01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.4E-01	--	1.2E-01	1E-01
			Acetone	--	--	--	--	Kidney	4.9E-01	--	8.8E-04	5E-01
			Acrylonitrile	4.0E-04	--	7.6E-07	4E-04	Reproductive	7.8E+00	--	1.5E-02	8E+00
			Benzene	1.4E-06	--	3.9E-08	1E-06	Blood; immune system	6.8E-02	--	1.9E-03	7E-02
			Carbon tetrachloride	3.8E-06	--	1.9E-07	4E-06	Liver	4.5E-01	--	2.2E-02	5E-01
			Chloromethane	--	--	--	--	--	--	--	--	--
			Chloroform	1.0E-07	--	1.7E-09	1E-07	Liver	3.4E-03	--	5.7E-05	3E-03
			cis-1,2-Dichloroethene	--	--	--	--	Blood	1.3E-01	--	2.1E-03	1E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	5.0E-01	--	5.5E-02	6E-01
			Ethyl methacrylate	--	--	--	--	Kidney	2.7E-01	--	8.4E-03	3E-01
			Isopropylbenzene	--	--	--	--	Kidney	4.9E-03	--	1.2E-03	6E-03
			Methylene Chloride	9.3E-06	--	6.4E-08	9E-06	Liver	2.2E-01	--	1.5E-03	2E-01
			n-Propylbenzene	--	--	--	--	--	--	--	--	--
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	5.8E-03	--	2.8E-03	9E-03
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			Tetrachloroethene	1.8E-06	--	2.0E-07	2E-06	Liver	3.6E-03	--	3.9E-04	4E-03
			Tetrahydrofuran	--	--	--	--	--	--	--	--	--
			Toluene	--	--	--	--	Kidney	5.9E-00	--	3.7E-01	6E+00
			Trichloroethene	1.4E-06	--	4.3E-08	1E-06	--	--	--	--	--
			Vinyl chloride	2.9E-05	--	2.7E-07	3E-05	Liver	1.4E-01	--	1.3E-03	1E-01
			Xylenes (total)	--	--	--	--	Whole body	8.5E-01	--	1.3E-01	1E+00
			Antimony	--	--	--	--	Blood; whole body	1.5E+00	--	6.6E-04	2E+00
			Arsenic	2.0E-03	--	1.3E-07	2E-03	Skin; cardiovascular system	4.6E-01	--	3.1E-03	5E+01
			Barium	--	--	--	--	Kidney	1.1E-02	--	1.0E-05	1E-02
			Beryllium	--	--	--	--	Intestines	1.2E+00	--	1.6E-02	2E+00
			Cadmium	--	--	--	--	--	7.2E-01	--	9.5E-04	7E-01
			Chromium	--	--	--	--	None observed	3.6E-01	--	9.5E-04	4E-01
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.7E+00	--	6.1E-03	4E+00
			Nickel	--	--	--	--	Whole body	2.3E-02	--	7.9E-06	2E-02
			Silver	--	--	--	--	Skin	9.6E-01	--	9.5E-04	1E+00
			Thallium	--	--	--	--	Blood	3.6E-01	--	2.4E-05	3E-01
			Vanadium	--	--	--	--	Hair cysteine	6.7E-05	--	1.7E-05	7E-05
			Zinc	--	--	--	--	Blood	1.1E+00	--	4.4E-03	1E+00
			Chemical Total	2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
		Exposure Point Total		2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
	Exposure Medium Total			2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
Medium Total				2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
Receptor Total							2E-03					Receptor HI Total 1E+02
Site Related Receptor Risk Total							2E-03					9E+01
Reference Related Receptor Risk Total							3E-07					7E+00

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3. Upland	Benzo(a)anthracene	1.7E-07	4.4E-12	1.4E-07	3E-07	--	--	--	--	--
			Benzo(a)pyrene	1.7E-06	4.4E-11	1.4E-06	3E-06	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.3E-07	3.3E-12	1.1E-07	2E-07	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	4.4E-06	1.3E-10	2.9E-06	7E-06	Liver	4.4E-02	2.2E-06	2.9E-02	7E-02
			Di-n-octylphthalate	--	--	--	--	Not available	2.3E-02	1.2E-06	1.5E-02	4E-02
			Indeno(1,2,3-cd)Pyrene	1.1E-07	2.8E-12	9.5E-08	2E-07	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	2.9E-02	6.0E-02	2.5E-03	7E-02
			Toluene	--	--	--	--	Kidney	5.2E-03	6.9E-03	0.0E+00	1E-02
			Tetrachloroethene	3.1E-06	4.9E-06	0.0E+00	8E-06	Liver	1.6E-03	6.6E-02	0.0E+00	7E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	2.6E-03	2.8E-01	0.0E+00	3E-01
			Arsenic	1.9E-06	9.1E-10	3.7E-07	2E-06	Skin, cardiovascular system	1.2E-02	2.0E-05	2.3E-03	1E-02
			Cadmium	--	2.5E-10	--	2E-10	--	2.2E-03	--	5.9E-04	3E-03
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	8.8E-04	--	0.0E+00	9E-04
			Chemical Total	1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01
		Exposure Point Total		1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01
	Exposure Medium Total			1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01
Medium Total				1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01

TABLE 3-34F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Indoor Air	Group 3	1,4-Dichlorobenzene	--	--	--	--	Liver	--	9.3E-06	--	9E-06
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	--	4.3E-05	--	4E-05
			2-Methylphenol	--	--	--	--	Whole body; nervous system	--	1.3E-04	--	1E-04
			3-Methylphenol 4-Methylphenol	--	--	--	--	Whole body; nervous system	--	2.0E-03	--	2E-03
			4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	--	--
			Naphthalene	--	--	--	--	Respiratory system	--	3.9E-03	--	4E-03
			Phenol	--	--	--	--	Alimentary, cardiovascular, nervous systems; kidney	--	1.6E-04	--	2E-04
			1,1,1-Trichloromethane	--	--	--	--	Nervous system	--	0.0E+00	--	--
			1,1,2-Trichloroethane	--	--	--	--	Blood	--	--	--	--
			1,1-Dichloroethane	--	--	--	--	None observed	--	0.0E+00	--	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	0.0E+00	--	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	1.6E-08	--	2E-08	Liver	--	6.9E-07	--	7E-07
			1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Respiratory system; liver	--	0.0E+00	--	--
			1,2-Dichloropropane	--	--	--	--	Nasal mucosa	--	8.7E-04	--	9E-04
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	--	0.0E+00	--	--	Not available	--	0.0E+00	--	--
			2-Butanone	--	--	--	--	Development fetus	--	4.8E-03	--	5E-03
			4-Methyl-2-pentanone	--	--	--	--	Development fetus	--	3.4E-02	--	3E-02
			Acetone	--	--	--	--	Kidney	--	7.0E-03	--	7E-03
			Acrylonitrile	--	2.0E-05	--	2E-05	Respiratory system	--	2.3E-01	--	2E-01
			Benzene	--	2.2E-07	--	2E-07	Blood; immune system	--	2.7E-03	--	3E-03
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloroform	--	--	--	--	Kidney; development fetus; alimentary system	--	--	--	--
			Chloromethane	--	--	--	--	Development fetus	--	2.0E-02	--	2E-02
			Ethylbenzene	--	--	--	--	Development fetus	--	2.0E-01	--	2E-01

TABLE 3-34F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Indoor Air	Group 3	Ethyl methacrylate	--	--	--	--	Kidney	--	2.4E-02	--	2E-02
			Isopropylbenzene	--	--	--	--	Kidney adrenal gland	--	0.0E+00	--	--
			Methylene Chloride	--	4.0E-06	--	4E-06	Liver	--	8.0E-03	--	8E-03
			n-Propylbenzene	--	--	--	--	Not available	--	1.4E-02	--	1E-02
			n-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			tert-Butylbenzene	--	--	--	--	Not available	--	0.0E+00	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney adrenal gland	--	5.9E-03	--	6E-03
			Tetrachloroethene	--	2.6E-08	--	3E-08	Nervous system; eyes; respiratory system	--	3.5E-04	--	4E-04
			Tetrahydrofuran	--	--	--	--	--	--	8.8E-02	--	9E-02
			Toluene	--	--	--	--	Nervous system	--	3.8E-01	--	4E-01
			Trichloroethene	--	1.0E-08	--	1E-08	Nervous system; eyes	--	2.4E-05	--	2E-05
			Vinyl chloride	--	1.1E-07	--	1E-07	Liver	--	7.2E-04	--	7E-04
			Xylenes (total)	--	--	--	--	Nervous system	--	5.8E-00	--	6E-00
			Chemical Total	0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00
		Exposure Point Total		0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00
	Exposure Medium Total			0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00
Medium Total				0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00

TABLE 3-34F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	3.1E-07	--	6.5E-08	4E-07	None observed	4.0E-04	--	8.4E-05	5E-04
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	1.0E-01	--	4.8E-03	1E-01
			2-Methylphenol	--	--	--	--	Whole body; nervous system	2.3E-01	--	8.9E-03	2E-01
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	4.7E-01	--	1.5E-02	5E-01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	6.1E-02	--	1.9E-03	6E-02
			Aroclor 1254	1.9E-06	--	0.0E+00	2E-06	Eyes; immune system	6.8E-01	--	0.0E+00	7E-01
			Alpha-BHC	1.2E-06	--	1.1E-07	1E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	3.4E-05	--	1.6E-05	5E-05	Liver	3.4E-01	--	1.6E-01	5E-01
			Naphthalene	--	--	--	--	Whole body	6.2E-03	--	1.3E-03	7E-03
			Phenol	--	--	--	--	Development; Fetus	3.5E-01	--	1.0E-02	4E-01
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	7.9E-03	--	4.7E-04	8E-03
			1,1,2-Trichloroethane	1.6E-06	--	4.7E-08	2E-06	Blood	1.9E-02	--	5.7E-04	2E-02
			1,1-Dichloroethane	--	--	--	--	None observed	2.0E-01	--	5.0E-03	2E-01
			1,1-Dichloroethene	--	--	--	--	Liver	2.9E-02	--	1.3E-03	3E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	1.6E-05	--	2.5E-07	2E-05	Kidney	2.5E-03	--	3.9E-05	3E-03
			1,2-Dichloroethene	--	--	--	--	Liver	1.6E-01	--	4.5E-03	2E-01
			1,2-Dichloropropane	9.8E-07	--	3.1E-08	1E-06	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.3E-04	--	1.5E-07	1E-04	Liver	3.4E-01	--	3.8E-04	3E-01
			2-Butanone	--	--	--	--	Whole body	1.4E+00	--	5.0E-03	1E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.7E+01	--	3.9E-01	3E+01
			Acetone	--	--	--	--	Kidney	9.1E-01	--	2.8E-03	9E-01
			Acrylonitrile	2.8E-03	--	9.2E-06	3E-03	Reproductive	1.5E-01	--	4.8E-02	1E-01
			Benzene	9.9E-06	--	4.8E-07	1E-05	Blood; immune system	1.3E-01	--	6.1E-03	1E-01
			Carbon tetrachloride	2.7E-05	--	2.3E-06	3E-05	Liver	8.4E-01	--	7.0E-02	9E-01
			Chloroethane	--	--	--	--	--	--	--	--	--
			Chloroform	7.1E-07	--	2.0E-08	7E-07	Liver	6.4E-03	--	1.8E-04	7E-03
			cis-1,2-Dichloroethene	--	--	--	--	Blood	2.5E-01	--	6.9E-03	3E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	9.5E-01	--	1.8E-01	1E+00
			Ethyl methacrylate	--	--	--	--	Kidney	5.0E-01	--	2.7E-02	5E-01
			Isopropylbenzene	--	--	--	--	Kidney	9.2E-03	--	3.8E-03	1E-02
			Methylene Chloride	6.6E-05	--	7.8E-07	7E-05	Liver	4.1E-01	--	4.9E-03	4E-01
			n-Propylbenzene	--	--	--	--	--	--	--	--	--
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	1.1E-02	--	9.0E-03	2E-02
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			Tetrachloroethene	1.3E-05	--	2.4E-06	2E-05	Liver	6.8E-03	--	1.3E-03	8E-03
			Tetrahydrofuran	--	--	--	--	--	--	--	--	--
			Toluene	--	--	--	--	Kidney	1.1E-01	--	1.2E+00	1E+01
			Trichloroethene	9.6E-06	--	5.2E-07	1E-05	--	--	--	--	--
			Vinyl chloride	2.1E-04	--	3.4E-06	2E-04	Liver	2.7E-01	--	4.4E-03	3E-01
			Xylenes (total)	--	--	--	--	Whole body	1.6E+00	--	4.3E-01	2E+00
			Antimony	--	--	--	--	Blood; whole body	2.8E+00	--	5.0E-03	3E+00
			Arsenic	1.4E-02	--	2.2E-06	1E-02	Skin; cardiovascular system	8.7E+01	--	1.4E-02	9E+01
			Barium	--	--	--	--	Kidney	2.1E-02	--	4.8E-05	2E-02
			Beryllium	--	--	--	--	Intestines	2.2E+00	--	7.2E-02	3E+00
			Cadmium	--	--	--	--	--	1.4E+00	--	4.3E-02	1E+00
			Chromium	--	--	--	--	None observed	6.8E-01	--	1.5E-03	7E-01
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	7.0E+00	--	2.8E-02	7E+00
			Nickel	--	--	--	--	Whole body	4.5E-02	--	3.6E-05	5E-02
			Silver	--	--	--	--	Skin	1.8E+00	--	4.3E-03	2E+00
			Thallium	--	--	--	--	Blood	6.8E-01	--	1.1E-04	7E-01
			Vanadium	--	--	--	--	Hair cysteine	1.3E-02	--	7.7E-03	1E-02
			Zinc	--	--	--	--	Blood	2.1E+00	--	2.0E-04	2E+00
			Chemical Total	1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
		Exposure Point Total		1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
	Exposure Medium Total			1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
Medium Total				1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
Receptor Total							2E-02				Receptor HI Total	2E+02
Site Related Receptor Risk Total							2E-02					2E+02
Reference Related Receptor Risk Total							2E-06					1E+01

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)anthracene	7.7E-07	3.7E-12	1.3E-06	2E-06	--	--	--	--	--
			Benzo(a)pyrene	4.6E-06	2.4E-10	7.9E-06	1E-05	--	--	--	--	--
			Benzo(c)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	3.3E-07	2.0E-12	5.6E-07	9E-07	--	--	--	--	--
			Benzo(k)fluoranthene	4.1E-08	2.1E-12	7.0E-08	1E-07	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	1.2E-08	--	1.6E-08	3E-08	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	1.6E-06	--	2.0E-06	4E-06
			Dibenzo(a,h)anthracene	7.8E-07	3.3E-11	1.3E-06	2E-06	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	3.0E-03	3.5E-07	3.9E-03	7E-03
			Indeno(1,2,3-cd)Pyrene	1.7E-07	8.9E-12	2.9E-07	5E-07	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	8.8E-04	4.0E-04	1.5E-03	3E-03
			2-Methylnaphthalene	--	--	--	--	Lungs	1.1E-03	2.9E-04	1.8E-03	3E-03
			Naphthalene	--	--	--	--	Whole body	1.9E-04	1.5E-02	3.3E-04	2E-02
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	7.0E-04	3.9E-03	9.2E-04	6E-03
			Arsenic	2.9E-07	2.9E-10	1.2E-07	4E-07	Skin; cardiovascular system	6.9E-03	2.4E-05	2.3E-02	3E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.6E-04	3.4E-04	0.0E+00	7E-04
			Vanadium	--	--	--	--	Hair cysteine	5.2E-04	--	0.0E+00	5E-04
			Chemical Total	**7.0E-06**	**5.6E-10**	**1.2E-05**	**2E-05**		**1.5E-02**	**2.0E-02**	**1.1E-02**	**5E-02**
		Exposure Point Total		7.0E-06	5.6E-10	1.2E-05	2E-05		1.5E-02	2.0E-02	1.1E-02	5E-02
	Exposure Medium Total			7.0E-06	5.6E-10	1.2E-05	2E-05		1.5E-02	2.0E-02	1.1E-02	5E-02
Medium Total				7.0E-06	5.6E-10	1.2E-05	2E-05		1.5E-02	2.0E-02	1.1E-02	5E-02
Air	Indoor Air	Group 4	Tetrachloroethene	--	4.3E-10	--	5E-10	system	--	2.3E-05	--	2E-05
			Trichloroethene	--	1.1E-10	--	1E-10	Nervous system; eyes	--	1.1E-06	--	1E-06
			Chemical Total	**0.0E+00**	**5.6E-10**	**0.0E+00**	**6E-10**		**0.0E+00**	**2.4E-05**	**0.0E+00**	**2E-05**
		Exposure Point Total		0.0E+00	5.6E-10	0.0E+00	6E-10		0.0E+00	2.4E-05	0.0E+00	2E-05
	Exposure Medium Total			0.0E+00	5.6E-10	0.0E+00	6E-10		0.0E+00	2.4E-05	0.0E+00	2E-05
Medium Total				0.0E+00	5.6E-10	0.0E+00	6E-10		0.0E+00	2.4E-05	0.0E+00	2E-05

TABLE 3-34G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	4.3E-08	--	5.3E-09	5E-08	None observed	2.1E-04	--	2.6E-05	2E-04
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	5.4E-02	--	1.5E-03	6E-02
			2-Methylphenol	--	--	--	--	Whole body; nervous system	1.2E-01	--	2.7E-03	1E-01
			3-Methylphenol 4-Methylphenol	--	--	--	--	Whole body; nervous system	2.5E-01	--	4.6E-03	3E-01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	3.2E-02	--	5.9E-04	3E-02
			Aroclor 1254	2.7E-07	--	0.0E+00	3E-07	Eyes; immune system	3.6E-01	--	0.0E+00	4E-01
			Alpha-BHC	1.7E-07	--	9.3E-09	2E-07	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	4.8E-06	--	1.3E-06	6E-06	Liver	1.8E-01	--	5.0E-02	2E-01
			Naphthalene	--	--	--	--	Whole body	3.3E-03	--	4.0E-04	4E-03
			Phenol	--	--	--	--	Development Fetus	1.9E-01	--	3.2E-03	2E-01
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	4.2E-03	--	1.5E-04	4E-03
			1,1,2-Trichloroethane	2.2E-07	--	3.8E-09	2E-07	Blood	1.0E-02	--	1.8E-04	1E-02
			1,1-Dichloroethane	--	--	--	--	Nervous system	1.1E-01	--	1.5E-03	1E-01
			1,1-Dichloroethene	--	--	--	--	Liver	1.6E-02	--	3.9E-04	2E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	2.3E-06	--	2.0E-08	2E-06	Kidney	1.3E-03	--	1.2E-05	1E-03
			1,2-Dichloroethene	--	--	--	--	Liver	8.7E-02	--	1.4E-03	9E-02
			1,2-Dichloropropane	1.4E-07	--	2.5E-09	1E-07	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.9E-05	--	1.2E-08	2E-05	Liver	1.8E-01	--	1.2E-04	2E-01
			2-Butanone	--	--	--	--	Whole body	7.7E-01	--	1.5E-03	8E-01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.4E-01	--	1.2E-01	1E-01
			Acetone	--	--	--	--	Kidney	4.9E-01	--	8.8E-04	5E-01
			Acrylonitrile	4.0E-04	--	7.6E-07	4E-04	Reproductive	7.8E-00	--	1.5E-02	8E-00
			Benzene	1.4E-06	--	3.9E-08	1E-06	Blood; immune system	6.8E-02	--	1.9E-03	7E-02
			Carbon tetrachloride	3.8E-06	--	1.9E-07	4E-06	Liver	4.5E-01	--	2.2E-02	5E-01
			Chloroethane	--	--	--	--	--	--	--	--	--
			Chloroform	1.0E-07	--	1.7E-09	1E-07	Liver	3.4E-03	--	5.7E-05	3E-03
			cis-1,2-Dichloroethene	--	--	--	--	Blood	1.3E-01	--	2.1E-03	1E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	5.0E-01	--	5.5E-02	6E-01
			Ethyl methacrylate	--	--	--	--	Kidney	2.7E-01	--	8.4E-03	3E-01
			Isopropylbenzene	--	--	--	--	Kidney	4.9E-03	--	1.2E-03	6E-03
			Methylene Chloride	9.3E-06	--	6.4E-08	9E-06	Liver	2.2E-01	--	1.5E-03	2E-01
			n-Propylbenzene	--	--	--	--	--	--	--	--	--
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	5.8E-03	--	2.8E-03	9E-03
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			Tetrachloroethene	1.8E-06	--	2.0E-07	2E-06	Liver	3.6E-03	--	3.9E-04	4E-03
			Tetrahydrofuran	--	--	--	--	--	--	--	--	--
			Toluene	--	--	--	--	Kidney	5.9E-00	--	3.7E-01	6E-00
			Trichloroethene	1.4E-06	--	4.3E-08	1E-06	--	--	--	--	--
			Vinyl chloride	2.9E-05	--	2.7E-07	3E-05	Liver	1.4E-01	--	1.3E-03	1E-01
			Xylenes (total)	--	--	--	--	Whole body	8.5E-01	--	1.3E-01	1E-00
			Antimony	--	--	--	--	Blood; whole body	1.5E+00	--	6.6E-04	2E+00
			Arsenic	2.0E-03	--	1.3E-07	2E-03	Skin; cardiovascular system	4.6E+01	--	3.1E-03	5E+01
			Barium	--	--	--	--	Kidney	1.1E-02	--	1.0E-05	1E-02
			Beryllium	--	--	--	--	Intestines	1.7E+00	--	1.6E-02	2E+00
			Cadmium	--	--	--	--	--	7.2E-01	--	9.5E-04	7E-01
			Chromium	--	--	--	--	None observed	3.6E-01	--	9.5E-04	4E-01
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	3.7E-00	--	6.1E-03	4E+00
			Nickel	--	--	--	--	Whole body	2.4E-02	--	7.9E-06	2E-02
			Silver	--	--	--	--	Skin	9.6E-01	--	9.5E-04	1E+00
			Thallium	--	--	--	--	Blood	3.6E-01	--	2.4E-05	4E-01
			Vanadium	--	--	--	--	Hair cysteine	6.7E-03	--	1.7E-05	7E-03
			Zinc	--	--	--	--	Blood	1.1E-00	--	4.4E-05	1E+00
			Chemical Total	**2.4E-03**	**0.0E+00**	**3.1E-06**	**2E-03**		**9.0E+01**	**0.0E+00**	**8.4E-01**	**9E+01**
		Exposure Point Total		2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
	Exposure Medium Total			2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
Medium Total				2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
Receptor Total							2E-03					Receptor HI Total 9E+01
Site Related Receptor Risk Total							2E-03					8E+01
Reference Related Receptor Risk Total							3E-06					7E+00

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-34H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4. Upland	Benzo(a)anthracene	5.8E-06	1.4E-11	5.0E-06	1E-05	--	--	--	--	--
			Benzo(a)pyrene	3.5E-05	9.0E-10	3.0E-05	6E-05	--	--	--	--	--
			Benzo(c)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	2.5E-06	7.5E-12	2.1E-06	5E-06	--	--	--	--	--
			Benzo(k)fluoranthene	3.1E-07	8.1E-12	2.7E-07	6E-07	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	9.2E-08	--	6.1E-08	2E-07	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	3.1E-06	--	2.0E-06	5E-06
			Dibenz(a,h)anthracene	2.9E-06	4.0E-11	5.1E-06	1E-05	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	5.9E-03	3.5E-07	3.9E-03	1E-02
			Indeno(1,2,3-cd)Pyrene	1.3E-06	3.4E-11	1.1E-06	2E-06	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	1.8E-03	4.0E-04	1.5E-03	4E-03
			2-Methylnaphthalene	--	--	--	--	Lungs	2.1E-03	2.9E-04	1.8E-03	4E-03
			Naphthalene	--	--	--	--	Whole body	5.9E-03	1.5E-02	3.3E-04	2E-02
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	1.4E-03	3.9E-03	9.2E-04	6E-03
			Arsenic	2.2E-06	1.1E-09	4.4E-07	3E-06	Skin cardiovascular system	1.4E-02	2.4E-05	2.8E-02	2E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	7.1E-04	3.4E-04	0.0E+00	1E-03
			Vanadium	--	--	--	--	Hair cysteine	1.0E-03	--	0.0E+00	1E-03
			Chemical Total	5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
		Exposure Point Total		5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
	Exposure Medium Total			5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
Medium Total				5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
Air	Indoor Air	Group 4. Upland	Tetrachloroethene	--	2.0E-09	--	2E-09	Nervous system; eyes; respiratory system	--	2.7E-05	--	3E-05
			Trichloroethene	--	4.6E-10	--	5E-10	Nervous system; eyes	--	1.1E-06	--	1E-06
			Chemical Total	0.0E+00	2.4E-09	0.0E+00	2E-09		0.0E+00	2.8E-05	0.0E+00	3E-05
		Exposure Point Total		0.0E+00	2.4E-09	0.0E+00	2E-09		0.0E+00	2.8E-05	0.0E+00	3E-05
	Exposure Medium Total			0.0E+00	2.4E-09	0.0E+00	2E-09		0.0E+00	2.8E-05	0.0E+00	3E-05
Medium Total				0.0E+00	2.4E-09	0.0E+00	2E-09		0.0E+00	2.8E-05	0.0E+00	3E-05

TABLE 3-34H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	3.1E-07	--	6.5E-08	4E-07	None observed	4.0E-04	--	8.4E-05	5E-04
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	1.0E-01	--	4.8E-03	1E-01
			2-Methylphenol	--	--	--	--	Whole body; nervous system	2.3E-01	--	8.9E-03	2E-01
			3-Methylphenol 4-Methylphenol	--	--	--	--	Whole body; nervous system	4.7E-01	--	1.5E-02	5E-01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	6.1E-02	--	1.0E-03	6E-02
			Aroclor 1254	1.9E-06	--	0.0E+00	2E-06	Eyes; immune system	6.8E-01	--	0.0E+00	7E-01
			Alpha-BHC	1.2E-06	--	1.1E-07	1E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	3.4E-05	--	1.6E-05	5E-05	Liver	3.4E-01	--	1.6E-01	5E-01
			Naphthalene	--	--	--	--	Whole body	6.2E-03	--	1.3E-03	7E-03
			Phenol	--	--	--	--	Development Fetus	3.5E-01	--	1.0E-02	4E-01
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	7.9E-03	--	4.7E-04	8E-03
			1,1,2-Trichloroethane	1.6E-06	--	4.7E-08	2E-06	Blood	1.9E-02	--	5.7E-04	2E-02
			1,1-Dichloroethane	--	--	--	--	Nervous system	2.0E-01	--	5.0E-03	2E-01
			1,1-Dichloroethene	--	--	--	--	Liver	2.9E-02	--	1.3E-03	3E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	1.6E-05	--	2.5E-07	2E-05	Kidney	2.5E-03	--	3.9E-05	3E-03
			1,2-Dichloroethene	--	--	--	--	Liver	1.6E-01	--	4.5E-03	2E-01
			1,2-Dichloropropane	9.8E-07	--	3.1E-08	1E-06	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dioxane	1.3E-04	--	1.5E-07	1E-04	Liver	3.4E-01	--	3.8E-04	3E-01
			2-Butanone	--	--	--	--	Whole body	1.4E+00	--	5.0E-03	1E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.7E-01	--	3.9E-03	3E-01
			Acetone	--	--	--	--	Kidney	9.1E-01	--	2.8E-03	9E-01
			Acrylonitrile	2.8E-03	--	9.2E-06	3E-03	Reproductive	1.5E-01	--	4.8E-02	1E-01
			Benzene	9.9E-06	--	4.8E-07	1E-05	Blood; immune system	1.3E-01	--	6.1E-03	1E-01
			Carbon tetrachloride	2.7E-05	--	2.3E-06	3E-05	Liver	8.4E-01	--	7.0E-02	9E-01
			Chloroethane	--	--	--	--	--	--	--	--	--
			Chloroform	7.1E-07	--	2.0E-08	7E-07	Liver	6.4E-03	--	1.8E-04	7E-03
			cis-1,2-Dichloroethene	--	--	--	--	Blood	2.5E-01	--	6.9E-03	3E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	9.5E-01	--	1.8E-01	1E+00
			Ethyl methacrylate	--	--	--	--	Kidney	5.0E-01	--	2.7E-02	5E-01
			Isopropylbenzene	--	--	--	--	Kidney	9.2E-03	--	3.8E-03	1E-02
			Methylene Chloride	6.6E-05	--	7.8E-07	7E-05	Liver	4.1E-01	--	4.0E-03	4E-01
			n-Propylbenzene	--	--	--	--	--	--	--	--	--
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	1.1E-02	--	9.0E-03	2E-02
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			Tetrachloroethene	1.3E-05	--	2.4E-06	2E-05	Liver	6.8E-03	--	1.3E-03	8E-03
			Tetrahydrofuran	--	--	--	--	--	--	--	--	--
			Toluene	--	--	--	--	Kidney	1.1E+01	--	1.2E+00	1E+01
			Trichloroethene	9.6E-06	--	5.2E-07	1E-05	--	--	--	--	--
			Vinyl chloride	2.1E-04	--	3.4E-06	2E-04	Liver	2.7E-01	--	4.4E-03	3E-01
			Xylenes (total)	--	--	--	--	Whole body	1.6E+00	--	4.3E-01	2E+00
			Antimony	--	--	--	--	Blood; whole body	2.8E+00	--	3.0E-03	3E+00
			Arsenic	1.4E-02	--	2.2E-06	1E-02	Skin; cardiovascular system	8.7E+01	--	1.4E-02	9E+01
			Barium	--	--	--	--	Kidney	2.1E-02	--	4.8E-05	2E-02
			Beryllium	--	--	--	--	Intestines	5.2E+00	--	7.2E-02	5E+00
			Cadmium	--	--	--	--	--	1.4E+00	--	4.3E-03	1E+00
			Chromium	--	--	--	--	None observed	6.8E-01	--	4.5E-05	7E-01
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	7.0E+00	--	2.8E-02	7E+00
			Nickel	--	--	--	--	Whole body	4.5E-02	--	5.6E-05	5E-02
			Silver	--	--	--	--	Skin	1.8E+00	--	4.5E-03	2E+00
			Thallium	--	--	--	--	Blood	6.8E-01	--	1.1E-04	7E-01
			Vanadium	--	--	--	--	Hair; cystaine	1.5E-02	--	7.7E-05	1E-02
			Zinc	--	--	--	--	Blood	2.1E+00	--	2.0E-04	2E+00
			Chemical Total	**1.7E-02**	**0.0E+00**	**3.8E-05**	**2E-02**		**1.7E+02**	**0.0E+00**	**2.7E+00**	**2E+02**
		Exposure Point Total		**1.7E-02**	**0.0E+00**	**3.8E-05**	**2E-02**		**1.7E+02**	**0.0E+00**	**2.7E+00**	**2E+02**
	Exposure Medium Total			**1.7E-02**	**0.0E+00**	**3.8E-05**	**2E-02**		**1.7E+02**	**0.0E+00**	**2.7E+00**	**2E+02**
Medium Total				**1.7E-02**	**0.0E+00**	**3.8E-05**	**2E-02**		**1.7E+02**	**0.0E+00**	**2.7E+00**	**2E+02**
Receptor Total							**2E-02**				**Receptor HI Total**	**2E+02**
Site Related Receptor Risk Total							**2E-02**					**2E+02**
Reference Related Receptor Risk Total							**1E-05**					**1E+01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Upland Soil	Group 3		Benzo(a)anthracene	1.1E+00	(mg/kg)	8.0E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	5.8E-09	5.6E-07	mg/kg-day	--		--
	(0-10' bgs)	Upland Area		Benzo(a)pyrene	1.1E+00	(mg/kg)	8.0E-09	mg/kg-day	7.2E+00	(mg/kg-day)-1	5.8E-08	5.6E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	5.5E-09	mg/kg-day	--		--	3.9E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	6.1E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	4.5E-09	4.3E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	1.1E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.5E-07	7.6E-04	mg/kg-day	2.0E-02	mg/kg/day	3.8E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	1.2E-05	mg/kg-day	--		--	8.1E-04	mg/kg-day	4.0E-02	mg/kg/day	2.0E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	5.2E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	3.8E-09	3.7E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	7.3E-07	mg/kg-day	--		--	5.1E-05	mg/kg-day	2.0E-02	mg/kg/day	2.5E-03
			Incidental Ingestion	Toluene	7.1E+02	(mg/kg)	5.2E-06	mg/kg-day	--		--	3.6E-04	mg/kg-day	8.0E-02	mg/kg/day	4.5E-03
				Tetrachloroethene	2.7E+01	(mg/kg)	2.0E-07	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.1E-07	1.4E-05	mg/kg-day	1.0E-02	mg/kg/day	1.4E-03
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	4.3E-06	mg/kg-day	--		--	3.0E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	1.5E-06	mg/kg-day	--		--	1.0E-04	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	6.5E-06	mg/kg-day	--		--	4.6E-04	mg/kg-day	2.0E-01	mg/kg/day	2.3E-03
				Arsenic	5.9E+00	(mg/kg)	4.3E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.4E-08	3.0E-06	mg/kg-day	3.0E-04	mg/kg/day	1.0E-02
				Cadmium	3.8E+00	(mg/kg)	2.8E-08	mg/kg-day	--		--	1.9E-06	mg/kg-day	1.0E-03	mg/kg/day	1.9E-03
				Lead	7.3E+01	(mg/kg)	5.3E-07	mg/kg-day	--		--	3.7E-05	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	9.8E-08	mg/kg-day	--		--	6.8E-06	mg/kg-day	9.0E-03	mg/kg/day	7.6E-04
			Exp. Route Total								4.0E-07					8.2E-02
				Benzo(a)anthracene	1.1E+00	(mg/kg)	7.7E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	5.6E-09	5.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	7.7E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.6E-08	5.4E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	5.3E-09	mg/kg-day	--		--	3.7E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	5.9E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	4.3E-09	4.1E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	8.1E-06	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.1E-07	5.7E-04	mg/kg-day	2.0E-02	mg/kg/day	2.8E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	8.6E-06	mg/kg-day	--		--	6.1E-04	mg/kg-day	4.0E-02	mg/kg/day	1.5E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	5.1E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	3.7E-09	3.5E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	7.0E-07	mg/kg-day	--		--	4.9E-05	mg/kg-day	2.0E-02	mg/kg/day	2.5E-03
			Dermal Contact	Toluene	7.1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	2.7E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	5.9E+00	(mg/kg)	9.5E-09	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.4E-08	6.7E-07	mg/kg-day	3.0E-04	mg/kg/day	2.2E-03
				Cadmium	3.8E+00	(mg/kg)	2.1E-10	mg/kg-day	--		--	1.4E-08	mg/kg-day	2.5E-05	mg/kg/day	5.8E-04
				Lead	7.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.0E-07					4.9E-02
	Exposure Medium Total										5.9E-07					1.3E-01
Risk From Reference											7.9E-08					1.7E-02
Risk from Site											5.1E-07					1.1E-01
Soil	Fugitive Dust	Group 3 Soil	Inhalation	Benzo(a)anthracene	8.1E-10	mg/m³	1.4E-12	mg/m³	1.1E-01	(mg/m³)-1	1.5E-13	9.6E-11	mg/m³	--	--	--
				Benzo(a)pyrene	8.1E-10	mg/m³	1.4E-12	mg/m3	1.1E+00	(mg/m³)-1	1.5E-12	9.6E-11	mg/m3	--	--	--
				Benzo(e)pyrene	5.6E-10	mg/m³	9.5E-13	mg/m3	--		--	6.6E-11	mg/m3	--	--	--
				Benzo(b)fluoranthene	6.2E-10	mg/m³	1.0E-12	mg/m3	1.1E-01	(mg/m³)-1	1.2E-13	7.3E-11	mg/m3	--	--	--
				Bis(2-ethylhexyl)phthalate	1.1E-06	mg/m³	1.9E-09	mg/m3	2.4E-03	(mg/m³)-1	4.5E-12	1.3E-07	mg/m3	7.0E-02	(mg/m³)	1.9E-06
				Di-n-octylphthalate	1.2E-06	mg/m³	2.0E-09	mg/m3	--		--	1.4E-07	mg/m3	1.4E-01	(mg/m³)	1.0E-06
				Indeno(1,2,3-cd)Pyrene	5.3E-10	mg/m³	9.0E-13	mg/m3	1.1E-01	(mg/m³)-1	9.9E-14	6.3E-11	mg/m3	--	--	--
				Naphthalene	1.3E-03	mg/m³	2.2E-06	mg/m3	--		--	1.6E-04	mg/m3	3.0E-03	(mg/m³)	5.2E-02
				Toluene	2.5E-01	mg/m³	4.3E-04	mg/m3	--		--	3.0E-02	mg/m3	5.0E+00	(mg/m³)	6.0E-03
				Tetrachloroethene	1.7E-02	mg/m³	2.9E-05	mg/m3	5.9E-03	(mg/m³)-1	1.7E-07	2.0E-03	mg/m3	3.5E-02	(mg/m³)	5.7E-02
				1,2,4-Trimethylbenzene	6.5E-02	mg/m³	1.1E-04	mg/m3	--		--	7.7E-03	mg/m3	--	--	--
				1,3,5-Trimethylbenzene	2.1E-02	mg/m³	3.6E-05	mg/m3	--		--	2.6E-03	mg/m3	--	--	--
				Xylenes (total)	2.1E-01	mg/m³	3.5E-04	mg/m3	--		--	2.4E-02	mg/m3	1.0E-01	(mg/m³)	2.4E-01
				Arsenic	4.3E-09	mg/m³	7.3E-12	mg/m3	4.3E+00	(mg/m³)-1	3.2E-11	5.1E-10	mg/m3	3.0E-05	(mg/m³)	1.7E-05
				Cadmium	2.8E-09	mg/m³	4.7E-12	mg/m3	1.8E+00	(mg/m³)-1	8.5E-12	3.3E-10	mg/m3	--	--	--
				Lead	5.4E-08	mg/m³	9.1E-11	mg/m3	--		--	6.4E-09	mg/m3	NA (3)	--	--
				Vanadium	9.9E-09	mg/m³	1.7E-11	mg/m3	--		--	1.2E-09	mg/m3	--	--	--
			Exp. Route Total								1.7E-07					3.6E-01
Ex. Medium Total											1.7E-07					3.6E-01
Risk From Reference											3.2E-11					3.2E-02
Risk from Site											1.7E-07					3.1E-01

TABLE 3-35A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Group 3	Dermal Contact	1,2,4-Trimethylbenzene	1.4E+00	mg/L	1.8E-05	mg/kg-day	--		--	1.3E-03	mg/kg-day	--		--
				1,2-Dichloroethane	3.8E-04	mg/L	1.2E-10	mg/kg-day	9.1E-02	(mg/kg-day)-1	1.1E-11	8.1E-09	mg/kg-day	2.0E-01	mg/kg/day	4.1E-08
				1,2-Dichloropropane	3.5E-04	mg/L	2.2E-10	mg/kg-day	6.8E-02	(mg/kg-day)-1	1.5E-11	1.5E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	4.2E-01	mg/L	3.0E-06	mg/kg-day	--		--	2.1E-04	mg/kg-day	--		--
				1,4-Dichlorobenzene	1.2E-03	mg/L	5.0E-09	mg/kg-day	2.4E-02	(mg/kg-day)-1	1.2E-10	3.5E-07	mg/kg-day	9.0E-02	mg/kg/day	3.9E-06
				1,4-Dioxane	3.0E+00	mg/L	6.7E-08	mg/kg-day	1.1E-02	(mg/kg-day)-1	7.4E-10	4.7E-06	mg/kg-day	1.0E-01	mg/kg/day	4.7E-05
				2,4-Dimethylphenol	1.8E-01	mg/L	1.7E-07	mg/kg-day	--		--	1.2E-05	mg/kg-day	2.0E-02	mg/kg/day	5.9E-04
				2-Butanone	7.7E+01	mg/L	5.2E-06	mg/kg-day	--		--	3.7E-04	mg/kg-day	6.0E-01	mg/kg/day	6.1E-04
				2-Methylphenol	1.0E+00	mg/L	7.8E-07	mg/kg-day	--		--	5.5E-05	mg/kg-day	5.0E-02	mg/kg/day	1.1E-03
				3-Methylphenol/4-Methylphenol	2.1E+00	mg/L	1.3E-06	mg/kg-day	--		--	9.1E-05	mg/kg-day	5.0E-02	mg/kg/day	1.8E-03
				4-Methyl-2-pentanone	1.9E+02	mg/L	5.6E-05	mg/kg-day	--		--	3.9E-03	mg/kg-day	8.0E-02	mg/kg/day	4.9E-02
				Acetone	7.3E+01	mg/L	4.5E-06	mg/kg-day	--		--	3.1E-04	mg/kg-day	9.0E-01	mg/kg/day	3.5E-04
				Acrylonitrile	1.3E+00	mg/L	8.4E-08	mg/kg-day	5.4E-01	(mg/kg-day)-1	4.6E-08	5.9E-06	mg/kg-day	1.0E-03	mg/kg/day	5.9E-03
				Aroclor 1254	1.2E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Benzene	3.6E-03	mg/L	3.4E-09	mg/kg-day	5.5E-02	(mg/kg-day)-1	1.9E-10	2.4E-07	mg/kg-day	4.0E-03	mg/kg/day	6.0E-05
				Bis(2-Ethylhexyl)phthalate	6.1E-01	mg/L	5.6E-06	mg/kg-day	1.4E-02	(mg/kg-day)-1	7.9E-08	3.9E-04	mg/kg-day	2.0E-02	mg/kg/day	2.0E-02
				Chloroethane	2.3E+00	mg/L	8.1E-07	mg/kg-day	--		--	5.7E-05	mg/kg-day	--		--
				Ethylbenzene	8.4E+00	mg/L	3.1E-05	mg/kg-day	--		--	2.2E-03	mg/kg-day	1.0E-01	mg/kg/day	2.2E-02
				Ethyl methacrylate	4.0E+00	mg/L	4.3E-06	mg/kg-day	--		--	3.0E-04	mg/kg-day	9.0E-02	mg/kg/day	3.4E-03
				Methylene Chloride	2.2E+00	mg/L	5.1E-07	mg/kg-day	7.5E-03	(mg/kg-day)-1	3.9E-09	3.6E-05	mg/kg-day	6.0E-02	mg/kg/day	6.0E-04
				Naphthalene	1.1E-02	mg/L	4.6E-08	mg/kg-day	--		--	3.2E-06	mg/kg-day	2.0E-02	mg/kg/day	1.6E-04
				n-Propylbenzene	8.2E-02	mg/L	8.9E-07	mg/kg-day	--		--	6.2E-05	mg/kg-day	--		--
				p-Isopropyltoluene	9.6E-02	mg/L	1.6E-06	mg/kg-day	--		--	1.1E-04	mg/kg-day	1.0E-01	mg/kg/day	1.1E-03
				Phenol	9.4E+00	mg/L	5.4E-06	mg/kg-day	--		--	3.8E-04	mg/kg-day	3.0E-01	mg/kg/day	1.3E-03
				Tetrachloroethene	2.2E-04	mg/L	8.2E-10	mg/kg-day	5.4E-01	(mg/kg-day)-1	4.4E-10	5.7E-08	mg/kg-day	1.0E-02	mg/kg/day	5.7E-06
				Tetrahydrofuran	2.0E+01	mg/L	3.1E-06	mg/kg-day	--		--	2.1E-04	mg/kg-day	--		--
				Toluene	7.8E+01	mg/L	1.7E-04	mg/kg-day	--		--	1.2E-02	mg/kg-day	8.0E-02	mg/kg/day	1.5E-01
				Trichloroethane	3.9E-04	mg/L	4.2E-10	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.7E-10	2.9E-08	mg/kg-day	--		--
				Vinyl chloride	4.4E-04	mg/L	1.4E-10	mg/kg-day	7.2E-01	(mg/kg-day)-1	1.0E-10	1.0E-08	mg/kg-day	3.0E-03	mg/kg/day	3.3E-06
				Xylenes (total)	2.8E+01	mg/L	1.5E-04	mg/kg-day	--		--	1.1E-02	mg/kg-day	2.0E-01	mg/kg/day	5.3E-02
				Antimony	3.8E-03	mg/L	1.1E-10	mg/kg-day	--		--	8.0E-09	mg/kg-day	6.0E-05	mg/kg/day	1.3E-04
				Arsenic	5.8E-01	mg/L	1.8E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.6E-08	1.2E-06	mg/kg-day	3.0E-04	mg/kg/day	4.1E-03
				Barium	3.0E-01	mg/L	9.1E-09	mg/kg-day	--		--	6.3E-07	mg/kg-day	1.4E-02	mg/kg/day	4.5E-05
				Cadmium	2.0E-03	mg/L	6.0E-11	mg/kg-day	--		--	4.2E-09	mg/kg-day	2.5E-05	mg/kg/day	1.7E-04
				Cobalt	1.4E-01	mg/L	1.7E-09	mg/kg-day	--		--	1.2E-07	mg/kg-day	--		--
				Lead	5.8E-03	mg/L	1.8E-11	mg/kg-day	--		--	1.2E-09	mg/kg-day	NA (3)		--
				Manganese	2.9E+01	mg/L	8.8E-07	mg/kg-day	--		--	6.1E-05	mg/kg-day	1.9E-03	mg/kg/day	3.3E-02
				Nickel	5.8E-02	mg/L	3.5E-10	mg/kg-day	--		--	2.5E-08	mg/kg-day	8.0E-04	mg/kg/day	3.1E-05
				Thallium	5.0E-05	mg/L	1.5E-12	mg/kg-day	--		--	1.1E-10	mg/kg-day	8.0E-05	mg/kg/day	1.3E-06
				Vanadium	1.0E-02	mg/L	3.0E-10	mg/kg-day	--		--	2.1E-08	mg/kg-day	2.3E-04	mg/kg/day	9.0E-05
			Exp. Route Total								1.6E-07					3.5E-01
	Exposure Medium Total										1.6E-07					3.5E-01
Risk From Reference											0.0E+00					2.9E-04
Risk from Site											1.6E-07					3.5E-01

TABLE 3-35A

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Air	Ambient Air (Trench)	Group 3	Inhalation	1,4-Dichlorobenzene	2E-07	mg/m3	3.1E-10	mg/m3	--		--	2.1E-08	mg/m3	8.0E-01	(mg/m³)	2.7E-08
				Naphthalene	1E-06	mg/m3	2.2E-09	mg/m3	--		--	1.5E-07	mg/m3	3.0E-02	(mg/m³)	5.1E-05
				1,1,1-Trichloroethane	1E-07	mg/m3	1.7E-10	mg/m3	--		--	1.2E-08	mg/m3	3.8E+00	(mg/m³)	3.1E-09
				1,1-Dichloroethane	5E-07	mg/m3	9.2E-10	mg/m3	--		--	6.5E-08	mg/m3	5.0E-01	(mg/m³)	1.3E-07
				1,1-Dichloroethene	3E-07	mg/m3	5.2E-10	mg/m3	--		--	3.6E-08	mg/m3	2.0E-01	(mg/m³)	1.8E-07
				1,2,4-Trimethylbenzene	2E-04	mg/m3	4.2E-07	mg/m3	--		--	2.9E-05	mg/m3	--	--	--
				1,2-Dichloroethane	6E-08	mg/m3	1.0E-10	mg/m3	2.6E-02	(mg/m³)-¹	2.7E-12	7.3E-09	mg/m3	2.4E+00	(mg/m³)	3.0E-09
				cis-1,2-Dichloroethene	3E-07	mg/m3	4.6E-10	mg/m3	--		--	3.2E-08	mg/m3	6.0E-02	(mg/m³)	5.3E-07
				1,2-Dichloropropane	6E-08	mg/m3	1.0E-10	mg/m3	--		--	7.2E-09	mg/m3	4.0E-03	(mg/m³)	1.8E-06
				1,3,5-Trimethylbenzene	7E-05	mg/m3	1.3E-07	mg/m3	--		--	8.9E-06	mg/m3	--	--	--
				2-Butanone	2E-03	mg/m3	3.0E-06	mg/m3	--		--	2.1E-04	mg/m3	5.0E+00	(mg/m³)	4.2E-05
				4-Methyl-2-pentanone	1E-02	mg/m3	2.3E-05	mg/m3	--		--	1.6E-03	mg/m3	3.0E+00	(mg/m³)	5.3E-04
				Acetone	3E-03	mg/m3	4.3E-06	mg/m3	--		--	3.0E-04	mg/m3	3.2E+00	(mg/m³)	9.6E-05
				Acrylonitrile	9E-05	mg/m3	1.6E-07	mg/m3	6.8E-02	(mg/m³)-¹	1.1E-08	1.1E-05	mg/m3	3.5E-03	(mg/m³)	3.2E-03
				Benzene	8E-07	mg/m3	1.3E-09	mg/m3	7.8E-03	(mg/m³)-¹	1.0E-11	9.3E-08	mg/m3	3.0E-02	(mg/m³)	3.1E-06
				Chloroethane	6E-04	mg/m3	9.6E-07	mg/m3	--		--	6.7E-05	mg/m3	1.0E+01	(mg/m³)	6.7E-06
				Ethylbenzene	2E-03	mg/m3	2.7E-06	mg/m3	--		--	1.9E-04	mg/m3	1.0E+00	(mg/m³)	1.9E-04
				Ethyl methacrylate	8E-04	mg/m3	1.3E-06	mg/m3	--		--	9.0E-05	mg/m3	3.2E-01	(mg/m³)	2.8E-04
				Methylene Chloride	4E-04	mg/m3	7.3E-07	mg/m3	4.7E-04	(mg/m³)-¹	3.4E-10	5.1E-05	mg/m3	3.0E+00	(mg/m³)	1.7E-05
				Isopropylbenzene	1E-05	mg/m3	1.8E-08	mg/m3	--		--	1.2E-06	mg/m3	4.0E-01	(mg/m³)	3.1E-06
				n-Propylbenzene	1E-05	mg/m3	2.0E-08	mg/m3	--		--	1.4E-06	mg/m3	1.4E-01	(mg/m³)	9.8E-06
				p-Isopropyltoluene	2E-05	mg/m3	2.8E-08	mg/m3	--		--	1.9E-06	mg/m3	4.0E-01	(mg/m³)	4.9E-06
				Tetrachloroethene	3E-08	mg/m3	5.8E-11	mg/m3	5.9E-03	(mg/m³)-¹	3.4E-13	4.0E-09	mg/m3	3.5E-02	(mg/m³)	1.2E-07
				Tetrahydrofuran	1E-03	mg/m3	1.7E-06	mg/m3	--		--	1.2E-04	mg/m3	3.0E-01	(mg/m³)	4.1E-04
				Toluene	2E-02	mg/m3	2.7E-05	mg/m3	--		--	1.9E-03	mg/m3	5.0E+00	(mg/m³)	3.8E-04
				Trichloroethene	7E-08	mg/m3	1.1E-10	mg/m3	2.0E-03	(mg/m³)-¹	2.3E-13	8.0E-09	mg/m3	6.0E-01	(mg/m³)	1.3E-08
				Vinyl chloride	1E-07	mg/m3	1.9E-10	mg/m3	4.4E-03	(mg/m³)-¹	8.3E-13	1.3E-08	mg/m3	1.0E-01	(mg/m³)	1.3E-07
				Xylenes (total)	5E-03	mg/m3	9.1E-06	mg/m3	--		--	6.3E-04	mg/m3	1.0E-01	(mg/m³)	6.3E-03
			Exp. Route Total								1.1E-08					1.2E-02
	Exposure Medium Total										1.1E-08					1.2E-02
Risk From Reference																
Risk from Site											1.1E-08					1.2E-02
Total of Receptor Risks Across All Media											9E-07	Total of Receptor Hazards Across All Media				8E-01
Risks from Reference											8E-08					7E-02
Risks from Site											9E-07					8E-01

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10' bgs)	Group 3 Upland Area	Incidental Ingestion	Benzo(a)anthracene	1.1E+00	(mg/kg)	2.6E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.9E-08	1.8E-06	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	2.6E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.9E-07	1.8E-06	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	1.8E-08	mg/kg-day	--		--	1.3E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	2.0E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.5E-08	1.4E-06	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	3.6E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	5.0E-07	2.5E-03	mg/kg-day	2.0E-02	mg/kg/day	1.3E-01
				Di-n-octylphthalate	1.6E+03	(mg/kg)	3.8E-05	mg/kg-day	--		--	2.7E-03	mg/kg-day	4.0E-02	mg/kg/day	6.7E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	1.7E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.3E-08	1.2E-06	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	2.4E-06	mg/kg-day	--		--	1.7E-04	mg/kg-day	2.0E-02	mg/kg/day	8.4E-03
				Toluene	7.1E+02	(mg/kg)	1.7E-05	mg/kg-day	--		--	1.2E-03	mg/kg-day	8.0E-02	mg/kg/day	1.5E-02
				Tetrachloroethene	2.7E+01	(mg/kg)	6.5E-07	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.5E-07	4.5E-05	mg/kg-day	1.0E-02	mg/kg/day	4.5E-03
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	1.4E-05	mg/kg-day	--		--	9.9E-04	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	4.8E-06	mg/kg-day	--		--	3.4E-04	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	2.2E-05	mg/kg-day	--		--	1.5E-03	mg/kg-day	2.0E-01	mg/kg/day	7.5E-03
				Arsenic	5.9E+00	(mg/kg)	1.4E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.1E-07	9.9E-06	mg/kg-day	3.0E-04	mg/kg/day	3.3E-02
				Cadmium	3.8E+00	(mg/kg)	9.1E-08	mg/kg-day	--		--	6.4E-06	mg/kg-day	1.0E-03	mg/kg/day	6.4E-03
				Lead	7.3E+01	(mg/kg)	1.8E-06	mg/kg-day	--		--	1.2E-04	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	3.2E-07	mg/kg-day	--		--	2.3E-05	mg/kg-day	9.0E-03	mg/kg/day	2.5E-03
			Exp. Route Total								1.3E-06					2.7E-01
			Dermal Contact	Benzo(a)anthracene	1.1E+00	(mg/kg)	7.7E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	5.6E-09	5.4E-07	mg/kg-day	--		--
				Benzo(a)pyrene	1.1E+00	(mg/kg)	7.7E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.6E-08	5.4E-07	mg/kg-day	--		--
				Benzo(e)pyrene	7.6E-01	(mg/kg)	5.3E-09	mg/kg-day	--		--	3.7E-07	mg/kg-day	--		--
				Benzo(b)fluoranthene	8.4E-01	(mg/kg)	5.9E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	4.3E-09	4.1E-07	mg/kg-day	--		--
				Bis(2-ethylhexyl)phthalate	1.5E+03	(mg/kg)	8.1E-06	mg/kg-day	1.4E-02	(mg/kg-day)-1	1.1E-07	5.7E-04	mg/kg-day	2.0E-02	mg/kg/day	2.8E-02
				Di-n-octylphthalate	1.6E+03	(mg/kg)	8.6E-06	mg/kg-day	--		--	6.1E-04	mg/kg-day	4.0E-02	mg/kg/day	1.5E-02
				Indeno(1,2,3-cd)Pyrene	7.2E-01	(mg/kg)	5.1E-09	mg/kg-day	7.3E-01	(mg/kg-day)-1	3.7E-09	3.5E-07	mg/kg-day	--		--
				Naphthalene	1.0E+02	(mg/kg)	7.0E-07	mg/kg-day	--		--	4.9E-05	mg/kg-day	2.0E-02	mg/kg/day	2.5E-03
				Toluene	7.1E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	8.0E-02	mg/kg/day	0.0E+00
				Tetrachloroethene	2.7E+01	(mg/kg)	0.0E+00	mg/kg-day	5.4E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	1.0E-02	mg/kg/day	0.0E+00
				1,2,4-Trimethylbenzene	5.9E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	2.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	--		--
				Xylenes (total)	9.0E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.0E-01	mg/kg/day	0.0E+00
				Arsenic	5.9E+00	(mg/kg)	9.3E-09	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.4E-08	6.7E-07	mg/kg-day	3.0E-04	mg/kg/day	2.2E-03
				Cadmium	3.8E+00	(mg/kg)	2.1E-10	mg/kg-day	--		--	1.4E-08	mg/kg-day	2.5E-05	mg/kg/day	5.8E-04
				Lead	7.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Vanadium	1.3E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								2.0E-07					4.9E-02
	Exposure Medium Total										1.5E-06					3.2E-01
Risk From Reference											2.3E-07					4.6E-02
Risk from Site											1.3E-06					2.7E-01
Soil	Fugitive Dust	Group 3 Soil	Inhalation	Benzo(a)anthracene	8.1E-10	mg/m³	1.4E-12	mg/m³	1.1E-01	(mg/m³)-¹	1.5E-13	9.6E-11	mg/m³	--		--
				Benzo(a)pyrene	8.1E-10	mg/m³	1.4E-12	mg/m3	1.1E+00	(mg/m³)-¹	1.5E-12	9.6E-11	mg/m3	--		--
				Benzo(e)pyrene	5.6E-10	mg/m³	9.5E-13	mg/m3	--		--	6.6E-11	mg/m3	--		--
				Benzo(b)fluoranthene	6.2E-10	mg/m³	1.0E-12	mg/m3	1.1E-01	(mg/m³)-¹	1.2E-13	7.2E-11	mg/m3	--		--
				Bis(2-ethylhexyl)phthalate	1.1E-06	mg/m³	1.9E-09	mg/m3	2.4E-03	(mg/m³)-¹	4.5E-12	1.3E-07	mg/m3	7.0E-02	(mg/m³)	1.9E-06
				Di-n-octylphthalate	1.2E-06	mg/m³	2.0E-09	mg/m3	--		--	1.4E-07	mg/m3	1.4E-01	(mg/m³)	1.0E-06
				Indeno(1,2,3-cd)Pyrene	5.3E-10	mg/m³	9.0E-13	mg/m3	1.1E-01	(mg/m³)-¹	9.9E-14	6.3E-11	mg/m3	--		--
				Naphthalene	1.3E-03	mg/m³	2.2E-06	mg/m3	--		--	1.6E-04	mg/m3	3.0E-03	(mg/m³)	5.2E-02
				Toluene	2.5E-01	mg/m³	4.3E-04	mg/m3	--		--	3.0E-02	mg/m3	5.0E+00	(mg/m³)	6.0E-03
				Tetrachloroethene	1.7E-02	mg/m³	2.9E-05	mg/m3	5.9E-03	(mg/m³)-¹	1.7E-07	2.0E-03	mg/m3	3.5E-02	(mg/m³)	5.7E-02
				1,2,4-Trimethylbenzene	6.5E-02	mg/m³	1.1E-04	mg/m3	--		--	7.7E-03	mg/m3	--		--
				1,3,5-Trimethylbenzene	2.1E-02	mg/m³	3.6E-05	mg/m3	--		--	2.6E-03	mg/m3	--		--
				Xylenes (total)	2.1E-01	mg/m³	3.5E-04	mg/m3	--		--	2.4E-02	mg/m3	1.0E-01	(mg/m³)	2.4E-01
				Arsenic	4.3E-09	mg/m³	7.3E-12	mg/m3	4.3E+00	(mg/m³)-¹	3.2E-11	5.1E-10	mg/m3	3.0E-05	(mg/m³)	1.7E-05
				Cadmium	2.8E-09	mg/m³	4.7E-12	mg/m3	1.8E+00	(mg/m³)-¹	8.5E-12	3.3E-10	mg/m3	--		--
				Lead	5.4E-08	mg/m³	9.1E-11	mg/m3	--		--	6.4E-09	mg/m3	NA (3)		--
				Vanadium	9.9E-09	mg/m³	1.7E-11	mg/m3	--		--	1.2E-09	mg/m3	--		--
			Exp. Route Total								1.7E-07					3.6E-01
Ex. Medium Total											1.7E-07					3.6E-01
Risk From Reference											3.2E-11					5.2E-02
Risk from Site											1.7E-07					3.1E-01

TABLE 3-35B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Group 3	Dermal Contact	1,2,4-Trimethylbenzene	1E+00	mg/L	4.5E-05	mg/kg-day	--		--	3.2E-03	mg/kg-day	--		--
				1,2-Dichloroethane	4E-04	mg/L	2.9E-10	mg/kg-day	9.1E-02	(mg/kg-day)-1	2.6E-11	2.0E-08	mg/kg-day	2.0E-01	mg/kg-day	1.0E-07
				1,2-Dichloropropane	4E-04	mg/L	5.5E-10	mg/kg-day	6.8E-02	(mg/kg-day)-1	3.7E-11	3.8E-08	mg/kg-day	--		--
				1,3,5-Trimethylbenzene	4E-01	mg/L	7.6E-06	mg/kg-day	--		--	5.3E-04	mg/kg-day	--		--
				1,4-Dichlorobenzene	1E-03	mg/L	1.3E-08	mg/kg-day	2.4E-02	(mg/kg-day)-1	3.0E-10	8.8E-07	mg/kg-day	9.0E-02	mg/kg/day	9.7E-06
				1,4-Dioxane	3E+00	mg/L	1.7E-07	mg/kg-day	1.1E-02	(mg/kg-day)-1	1.8E-09	1.2E-05	mg/kg-day	1.0E-01	mg/kg/day	1.2E-04
				2,4-Dimethylphenol	2E-01	mg/L	4.2E-07	mg/kg-day	--		--	2.9E-05	mg/kg-day	2.0E-02	mg/kg/day	1.5E-03
				2-Butanone	8E+01	mg/L	1.3E-05	mg/kg-day	--		--	9.2E-04	mg/kg-day	6.0E-01	mg/kg/day	1.5E-03
				2-Methylphenol	1E+00	mg/L	2.0E-06	mg/kg-day	--		--	1.4E-04	mg/kg-day	5.0E-02	mg/kg/day	2.7E-03
				3-Methylphenol/4-Methylphenol	2E+00	mg/L	3.3E-06	mg/kg-day	--		--	2.3E-04	mg/kg-day	5.0E-02	mg/kg/day	4.6E-03
				4-Methyl-2-pentanone	2E+02	mg/L	1.4E-04	mg/kg-day	--		--	9.7E-03	mg/kg-day	8.0E-02	mg/kg/day	1.2E-01
				Acetone	7E+01	mg/L	1.1E-05	mg/kg-day	--		--	7.8E-04	mg/kg-day	9.0E-01	mg/kg/day	8.7E-04
				Acrylonitrile	1E+00	mg/L	2.1E-07	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.1E-07	1.5E-05	mg/kg-day	1.0E-03	mg/kg/day	1.5E-02
				Aroclor 1254	1E-03	mg/L	0.0E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	0.0E+00	0.0E+00	mg/kg-day	2.0E-05	mg/kg/day	0.0E+00
				Benzene	4E-03	mg/L	8.6E-09	mg/kg-day	5.5E-02	(mg/kg-day)-1	4.7E-10	6.0E-07	mg/kg-day	4.0E-03	mg/kg/day	1.5E-04
				Bis(2-Ethylhexyl)phthalate	6E-01	mg/L	1.4E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	2.0E-07	9.9E-04	mg/kg-day	2.0E-02	mg/kg/day	4.9E-02
				Chloroethane	2E+00	mg/L	2.0E-06	mg/kg-day	--		--	1.4E-04	mg/kg-day	--		--
				Ethylbenzene	8E+00	mg/L	7.9E-05	mg/kg-day	--		--	5.5E-03	mg/kg-day	1.0E-01	mg/kg/day	5.5E-02
				Ethyl methacrylate	4E+00	mg/L	1.1E-05	mg/kg-day	--		--	7.6E-04	mg/kg-day	9.0E-02	mg/kg/day	8.4E-03
				Methylene Chloride	2E+00	mg/L	1.3E-06	mg/kg-day	7.5E-03	(mg/kg-day)-1	9.6E-09	9.0E-05	mg/kg-day	6.0E-02	mg/kg/day	1.5E-03
				Naphthalene	1E-02	mg/L	1.1E-07	mg/kg-day	--		--	8.0E-06	mg/kg-day	2.0E-02	mg/kg/day	4.0E-04
				n-Propylbenzene	8E-02	mg/L	2.2E-06	mg/kg-day	--		--	1.6E-04	mg/kg-day	--		--
				p-Isopropyltoluene	1E-01	mg/L	4.0E-06	mg/kg-day	--		--	2.8E-04	mg/kg-day	1.0E-01	mg/kg/day	2.8E-03
				Phenol	9E+00	mg/L	1.3E-05	mg/kg-day	--		--	9.4E-04	mg/kg-day	3.0E-01	mg/kg/day	3.1E-03
				Tetrachloroethene	2E-04	mg/L	2.0E-09	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.1E-09	1.4E-07	mg/kg-day	1.0E-02	mg/kg/day	1.4E-05
				Tetrahydrofuran	2E+01	mg/L	7.7E-06	mg/kg-day	--		--	5.4E-04	mg/kg-day	--		--
				Toluene	8E+01	mg/L	4.2E-04	mg/kg-day	--		--	3.0E-02	mg/kg-day	8.0E-02	mg/kg/day	3.7E-01
				Trichloroethene	4E-04	mg/L	1.1E-09	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.2E-10	7.4E-08	mg/kg-day	--		--
				Vinyl chloride	4E-04	mg/L	3.6E-10	mg/kg-day	7.2E-01	(mg/kg-day)-1	2.6E-10	2.5E-08	mg/kg-day	3.0E-03	mg/kg/day	8.3E-06
				Xylenes (total)	3E+01	mg/L	3.8E-04	mg/kg-day	--		--	2.7E-02	mg/kg-day	2.0E-01	mg/kg/day	1.3E-01
				Antimony	4E-03	mg/L	2.9E-10	mg/kg-day	--		--	2.0E-08	mg/kg-day	6.0E-05	mg/kg/day	3.3E-04
				Arsenic	6E-01	mg/L	4.4E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.6E-08	3.1E-06	mg/kg-day	3.0E-04	mg/kg/day	1.0E-02
				Barium	3E-01	mg/L	2.3E-08	mg/kg-day	--		--	1.6E-06	mg/kg-day	1.4E-02	mg/kg/day	1.1E-04
				Cadmium	2.0E-03	mg/L	1.5E-10	mg/kg-day	--		--	1.1E-08	mg/kg-day	2.5E-05	mg/kg/day	4.2E-04
				Cobalt	1.4E-01	mg/L	4.2E-09	mg/kg-day	--		--	3.0E-07	mg/kg-day	--		--
				Lead	5.8E-03	mg/L	4.4E-11	mg/kg-day	--		--	3.1E-09	mg/kg-day	NA (3)		--
				Manganese	2.9E+01	mg/L	2.2E-06	mg/kg-day	--		--	1.5E-04	mg/kg-day	1.9E-03	mg/kg/day	8.2E-02
				Nickel	5.8E-02	mg/L	8.8E-10	mg/kg-day	--		--	6.1E-08	mg/kg-day	8.0E-04	mg/kg/day	7.7E-05
				Thallium	5.0E-05	mg/L	3.8E-12	mg/kg-day	--		--	2.6E-10	mg/kg-day	8.0E-05	mg/kg/day	3.3E-06
				Vanadium	1.0E-02	mg/L	7.5E-10	mg/kg-day	--		--	5.3E-08	mg/kg-day	2.3E-04	mg/kg/day	2.3E-04
			Exp. Route Total								3.9E-07					8.6E-01
	Exposure Medium Total										3.9E-07					8.6E-01
Risk From Reference											0.0E+00					7.3E-04
Risk from Site											3.9E-07					8.6E-01

TABLE 3-35B

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Air	Ambient Air (Trench)	Group 3	Inhalation	1,4-Dichlorobenzene	2E-07	mg/m3	3.1E-10	mg/m3	--		--	2.1E-08	mg/m3	8.0E-01	(mg/m³)	2.7E-08
				Naphthalene	1E-06	mg/m3	2.2E-09	mg/m3	--		--	1.5E-07	mg/m3	3.0E-03	(mg/m³)	5.1E-05
				1,2,4-Trimethylbenzene	2E-04	mg/m3	4.2E-07	mg/m3	--		--	2.9E-05	mg/m3	--		--
				1,2-Dichloroethane	6E-08	mg/m3	1.0E-10	mg/m3	2.6E-02	(mg/m³)-¹	2.7E-12	7.2E-09	mg/m3	2.4E+00	(mg/m³)	3.0E-09
				1,2-Dichloropropane	6E-08	mg/m3	1.0E-10	mg/m3	--		--	7.2E-09	mg/m3	4.0E-03	(mg/m³)	1.8E-06
				1,3,5-Trimethylbenzene	7E-05	mg/m3	1.3E-07	mg/m3	--		--	8.9E-06	mg/m3	--		--
				2-Butanone	2E-03	mg/m3	3.0E-06	mg/m3	--		--	2.1E-04	mg/m3	5.0E+00	(mg/m³)	4.2E-05
				4-Methyl-2-pentanone	1E-02	mg/m3	2.3E-05	mg/m3	--		--	1.6E-03	mg/m3	3.0E+00	(mg/m³)	5.3E-04
				Acetone	3E-02	mg/m3	4.3E-06	mg/m3	--		--	3.0E-04	mg/m3	3.2E+00	(mg/m³)	9.6E-05
				Acrylonitrile	9E-05	mg/m3	1.6E-07	mg/m3	6.8E-02	(mg/m³)-¹	1.1E-08	1.1E-05	mg/m3	3.5E-03	(mg/m³)	3.2E-03
				Benzene	8E-07	mg/m3	1.3E-09	mg/m3	7.8E-03	(mg/m³)-¹	1.0E-11	9.3E-08	mg/m3	3.0E-02	(mg/m³)	3.1E-06
				Chloroethane	6E-04	mg/m3	9.6E-07	mg/m3	--		--	6.7E-05	mg/m3	1.0E+01	(mg/m³)	6.7E-06
				Ethylbenzene	2E-03	mg/m3	2.7E-06	mg/m3	--		--	1.9E-04	mg/m3	1.0E+00	(mg/m³)	1.9E-04
				Ethyl methacrylate	8E-04	mg/m3	1.3E-06	mg/m3	--		--	9.0E-05	mg/m3	3.2E-01	(mg/m³)	2.8E-04
				Methylene Chloride	4E-04	mg/m3	7.3E-07	mg/m3	4.7E-04	(mg/m³)-¹	3.4E-10	5.1E-05	mg/m3	3.0E+00	(mg/m³)	1.7E-05
				n-Propylbenzene	1E-05	mg/m3	2.0E-08	mg/m3	--		--	1.4E-06	mg/m3	1.4E-01	(mg/m³)	9.8E-06
				p-Isopropyltoluene	2E-05	mg/m3	2.8E-08	mg/m3	--		--	1.9E-06	mg/m3	4.0E-01	(mg/m³)	4.9E-06
				Tetrachloroethene	3E-08	mg/m3	5.8E-11	mg/m3	5.9E-03	(mg/m³)-¹	3.4E-13	4.0E-09	mg/m3	3.5E-02	(mg/m³)	1.2E-07
				Tetrahydrofuran	1E-03	mg/m3	1.7E-06	mg/m3	--		--	1.2E-04	mg/m3	3.0E-01	(mg/m³)	4.1E-04
				Toluene	2E-02	mg/m3	2.7E-05	mg/m3	--		--	1.9E-03	mg/m3	5.0E+00	(mg/m³)	3.8E-04
				Trichloroethene	7E-08	mg/m3	1.1E-10	mg/m3	2.0E-03	(mg/m³)-¹	2.3E-13	8.0E-09	mg/m3	6.0E-01	(mg/m³)	1.3E-08
				Vinyl chloride	1E-07	mg/m3	1.9E-10	mg/m3	4.4E-03	(mg/m³)-¹	8.3E-13	1.3E-08	mg/m3	1.0E-01	(mg/m³)	1.3E-07
				Xylenes (total)	5E-03	mg/m3	9.1E-06	mg/m3	--		--	6.3E-04	mg/m3	1.0E-01	(mg/m³)	6.3E-03
			Exp. Route Total								1.1E-08					1.2E-02
	Exposure Medium Total										1.1E-08					1.2E-02
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											1.1E-08					1.2E-02
Total of Receptor Risks Across All Media											2E-06	Total of Receptor Hazards Across All Media				2E+00
Risks from Reference											2E-07					1E-01
Risks from Site											2E-06					1E+00

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Upland Soil (0-10' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	2.8E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.0E-07	1.9E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	1.7E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-06	1.2E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	1.2E-07	mg/kg-day	--		--	8.6E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	1.2E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	8.5E-08	8.2E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	1.5E-07	mg/kg-day	7.3E-02	(mg/kg-day)-1	1.1E-08	1.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	3.6E-09	mg/kg-day	--		--	2.5E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	1.6E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	3.2E-09	1.1E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	2.7E-09	mg/kg-day	--		--	1.9E-07	mg/kg-day	7.0E-02	mg/kg/day	2.7E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	2.8E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.1E-07	2.0E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	1.5E-07	mg/kg-day	--		--	1.0E-05	mg/kg-day	2.0E-03	mg/kg/day	5.1E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	6.2E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	4.5E-08	4.3E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	8.7E-08	mg/kg-day	--		--	6.1E-06	mg/kg-day	4.0E-03	mg/kg/day	1.5E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	1.0E-07	mg/kg-day	--		--	7.3E-06	mg/kg-day	4.0E-03	mg/kg/day	1.8E-03
				Naphthalene	1.3E+01	(mg/kg)	9.6E-08	mg/kg-day	--		--	6.7E-06	mg/kg-day	2.0E-02	mg/kg/day	3.3E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	5.2E-07	mg/kg-day	--		--	3.6E-05	mg/kg-day	3.0E-02	mg/kg/day	1.2E-03
				Arsenic	7.1E+00	(mg/kg)	5.2E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.7E-08	3.6E-06	mg/kg-day	3.0E-04	mg/kg/day	1.2E-02
				Lead	1.3E+02	(mg/kg)	9.7E-07	mg/kg-day	--		--	6.8E-05	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	1.2E-06	mg/kg-day	--		--	8.6E-05	mg/kg-day	1.4E-01	mg/kg/day	6.2E-04
				Vanadium	1.6E+01	(mg/kg)	1.2E-07	mg/kg-day	--		--	8.1E-06	mg/kg-day	9.0E-03	mg/kg/day	9.0E-04
			Exp. Route Total								1.8E-06					2.5E-02
			Dermal Contact	Benzo(a)anthracene	3.8E+01	(mg/kg)	2.7E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.9E-07	1.9E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	1.6E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-06	1.1E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	1.2E-07	mg/kg-day	--		--	8.4E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	1.1E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	8.3E-08	7.9E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	1.4E-07	mg/kg-day	7.3E-02	(mg/kg-day)-1	1.0E-08	1.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	2.6E-09	mg/kg-day	--		--	1.9E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	1.2E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	2.4E-09	8.3E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	2.0E-09	mg/kg-day	--		--	1.4E-07	mg/kg-day	7.0E-02	mg/kg/day	2.0E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	2.7E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.0E-07	1.9E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	1.1E-07	mg/kg-day	--		--	7.7E-06	mg/kg-day	2.0E-03	mg/kg/day	3.8E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	6.0E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	4.4E-08	4.2E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	8.4E-08	mg/kg-day	--		--	5.9E-06	mg/kg-day	4.0E-03	mg/kg/day	1.5E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	1.0E-07	mg/kg-day	--		--	7.1E-06	mg/kg-day	4.0E-03	mg/kg/day	1.8E-03
				Naphthalene	1.3E+01	(mg/kg)	9.2E-08	mg/kg-day	--		--	6.5E-06	mg/kg-day	2.0E-02	mg/kg/day	3.2E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	3.9E-07	mg/kg-day	--		--	2.7E-05	mg/kg-day	3.0E-02	mg/kg/day	9.0E-04
				Arsenic	7.1E+00	(mg/kg)	1.2E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.7E-08	8.1E-07	mg/kg-day	3.0E-04	mg/kg/day	2.7E-03
				Lead	1.3E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	5.6E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.7E-06					1.1E-02
	Exposure Medium Total										3.6E-06					3.6E-02
Risk From Reference											5.0E-07					1.5E-02
Risk from Site											3.1E-06					2.1E-02

TABLE 3-35C

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Fugitive Dust	Group 4 Soil	Inhalation	Benzo(a)anthracene	2.8E-08	mg/m³	4.7E-11	mg/m³	1.1E-01	(mg/m³)-¹	5.2E-12	3.3E-09	mg/m³	--		--
				Benzo(a)pyrene	1.7E-08	mg/m³	2.8E-11	mg/m3	1.1E+00	(mg/m³)-¹	3.1E-11	2.0E-09	mg/m3	--		--
				Benzo(e)pyrene	1.3E-08	mg/m³	2.1E-11	mg/m3	--		--	1.5E-09	mg/m3	--		--
				Benzo(b)fluoranthene	1.2E-08	mg/m³	2.0E-11	mg/m3	1.1E-01	(mg/m³)-¹	2.2E-12	1.4E-09	mg/m3	--		--
				Benzo(k)fluoranthene	1.5E-08	mg/m³	2.5E-11	mg/m3	1.1E-01	(mg/m³)-¹	2.8E-12	1.8E-09	mg/m3	--		--
				Bis(2-Chloroethoxy)methane	3.6E-10	mg/m³	6.1E-13	mg/m3	--		--	4.3E-11	mg/m3	--		--
				Carbazole	1.6E-08	mg/m³	2.7E-11	mg/m3	--		--	1.9E-09	mg/m3	--		--
				4-Chloro-3-methylphenol	2.7E-10	mg/m³	4.6E-13	mg/m3	--		--	3.2E-11	mg/m3	--		--
				Dibenzo(a,h)anthracene	2.9E-09	mg/m³	4.8E-12	mg/m3	1.2E+00	(mg/m³)-¹	5.8E-12	3.4E-10	mg/m3	--		--
				Dibenzofuran	1.5E-08	mg/m³	2.5E-11	mg/m3	--		--	1.8E-09	mg/m3	7.0E-03	(mg/m³)	2.5E-07
				Indeno(1,2,3-cd)Pyrene	6.2E-09	mg/m³	1.1E-11	mg/m3	1.1E-01	(mg/m³)-¹	1.2E-12	7.4E-10	mg/m3	--		--
				1-Methylnaphthalene	7.2E-04	mg/m³	1.2E-06	mg/m3	--		--	8.6E-05	mg/m3	2.5E-01	(mg/m³)	3.5E-04
				2-Methylnaphthalene	3.0E-04	mg/m³	5.0E-07	mg/m3	--		--	3.5E-05	mg/m3	1.4E-01	(mg/m³)	2.5E-04
				Naphthalene	3.3E-04	mg/m³	5.6E-07	mg/m3	--		--	3.9E-05	mg/m3	3.0E-03	(mg/m³)	1.3E-02
				C11-C22 Aromatics	1.4E-03	mg/m³	2.4E-06	mg/m3	--		--	1.7E-04	mg/m3	5.0E-02	(mg/m³)	3.4E-03
				Arsenic	5.2E-09	mg/m³	8.9E-12	mg/m3	4.3E+00	(mg/m³)-¹	3.8E-11	6.2E-10	mg/m3	3.0E-05	(mg/m³)	2.1E-05
				Lead	9.8E-08	mg/m³	1.7E-10	mg/m3	--		--	1.2E-08	mg/m3	NA (2)		--
				Manganese	1.2E-07	mg/m³	2.1E-10	mg/m3	--		--	1.5E-08	mg/m3	5.0E-05	(mg/m³)	3.0E-04
				Vanadium	1.2E-08	mg/m³	2.0E-11	mg/m3	--		--	1.4E-09	mg/m3	--		--
			Exp. Route Total								8.7E-11					1.7E-02
Ex. Medium Total											8.7E-11					1.7E-02
Risk From Reference											4.4E-11					1.3E-02
Risk from Site											4.3E-11					4.3E-03
Groundwater	Groundwater	Group 4	Dermal Contact	1,1-Dichloroethane	3E-04	mg/L	1.5E-10	mg/kg-day	--		--	1.0E-08	mg/kg-day	2.0E-01	mg/kg/day	5.1E-08
				Bis(2-Ethylhexyl)phthalate	3E-03	mg/L	2.7E-08	mg/kg-day	1.4E-02	(mg/kg-day)-1	3.8E-10	1.9E-06	mg/kg-day	2.0E-02	mg/kg/day	9.4E-05
				Ethylbenzene	6E-04	mg/L	2.2E-09	mg/kg-day	--		--	1.5E-07	mg/kg-day	1.0E-01	mg/kg/day	1.5E-06
				Tetrachloroethene	3E-04	mg/L	1.1E-09	mg/kg-day	5.4E-01	(mg/kg-day)-1	5.9E-10	7.7E-08	mg/kg-day	1.0E-02	mg/kg/day	7.7E-06
				Trichloroethene	3E-04	mg/L	3.2E-10	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.3E-10	2.2E-08	mg/kg-day	--		--
				Xylenes (total)	6E-03	mg/L	3.4E-08	mg/kg-day	--		--	2.4E-06	mg/kg-day	2.0E-01	mg/kg/day	1.2E-05
				Arsenic	1E-01	mg/L	3.1E-09	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.6E-09	2.2E-07	mg/kg-day	3.0E-04	mg/kg/day	7.2E-04
				Barium	9E-03	mg/L	2.9E-10	mg/kg-day	--		--	2.0E-08	mg/kg-day	2.0E-01	mg/kg/day	1.0E-07
				Beryllium	1.1E-01	mg/L	3.4E-09	mg/kg-day	--		--	2.4E-07	mg/kg-day	2.0E-03	mg/kg/day	1.2E-04
				Cadmium	5.8E-03	mg/L	1.7E-10	mg/kg-day	--		--	1.2E-08	mg/kg-day	2.5E-05	mg/kg/day	4.9E-04
				Cobalt	1.5E-03	mg/L	1.8E-11	mg/kg-day	--		--	1.3E-09	mg/kg-day	--		--
				Lead	1.5E-02	mg/L	4.6E-11	mg/kg-day	--		--	3.2E-09	mg/kg-day	NA (3)		--
				Manganese	3.7E-01	mg/L	1.1E-08	mg/kg-day	--		--	7.7E-07	mg/kg-day	1.9E-03	mg/kg/day	4.1E-04
				Nickel	2.5E-02	mg/L	1.5E-10	mg/kg-day	--		--	1.1E-08	mg/kg-day	2.0E-02	mg/kg/day	5.3E-07
				Silver	2.0E-01	mg/L	3.6E-09	mg/kg-day	--		--	2.5E-07	mg/kg-day	5.0E-03	mg/kg/day	5.1E-05
				Vanadium	2.8E-03	mg/L	8.5E-11	mg/kg-day	--		--	6.0E-09	mg/kg-day	9.0E-03	mg/kg/day	6.6E-07
				Zinc	5.8E-02	mg/L	1.0E-09	mg/kg-day	--		--	7.3E-08	mg/kg-day	3.0E-01	mg/kg/day	2.4E-07
			Exp. Route Total								5.7E-09					1.9E-03
	Exposure Medium Total										5.7E-09					1.9E-03
Risk From Reference											0.0E+00					6.6E-04
Risk from Site											5.7E-09					1.2E-03
Air	Ambient Air	Group 4	Inhalation	Tetrachloroethene	5E-08	mg/m3	8.9E-11	mg/m3	5.9E-03	(mg/m³)-¹	5.3E-13	6.2E-09	mg/m3	3.5E-02	(mg/m³)	1.8E-07
				Trichloroethene	6E-08	mg/m3	9.9E-11	mg/m3	2.0E-03	(mg/m³)-¹	2.0E-13	7.0E-09	mg/m3	6.0E-01	(mg/m³)	1.2E-08
			Exp. Route Total								7.3E-13					1.9E-07
	Exposure Medium Total										7.3E-13					1.9E-07
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											7.3E-13					1.9E-07
Total of Receptor Risks Across All Media											4E-06	Total of Receptor Hazards Across All Media				6E-02
Risks from Reference											5E-07					3E-02
Risks from Site											3E-06					3E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Upland Soil (0-10' bgs)	Group 4 Upland Area	Incidental Ingestion	Benzo(a)anthracene	3.8E+01	(mg/kg)	9.1E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	6.6E-07	6.4E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	5.5E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.0E-06	3.8E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	4.1E-07	mg/kg-day	--		--	2.9E-05	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	3.9E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	2.8E-07	2.7E-05	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	4.9E-07	mg/kg-day	7.3E-02	(mg/kg-day)-1	3.5E-08	3.4E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	1.2E-08	mg/kg-day	--		--	8.2E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	5.3E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	1.1E-08	3.7E-05	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	8.9E-09	mg/kg-day	--		--	6.2E-07	mg/kg-day	7.0E-02	mg/kg/day	8.9E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	9.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.8E-07	6.5E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	4.9E-07	mg/kg-day	--		--	3.4E-05	mg/kg-day	2.0E-03	mg/kg/day	1.7E-02
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	2.0E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.5E-07	1.4E-05	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	2.9E-07	mg/kg-day	--		--	2.0E-05	mg/kg-day	4.0E-03	mg/kg/day	5.0E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	3.4E-07	mg/kg-day	--		--	2.4E-05	mg/kg-day	4.0E-03	mg/kg/day	6.0E-03
				Naphthalene	1.3E+01	(mg/kg)	3.2E-07	mg/kg-day	--		--	2.2E-05	mg/kg-day	2.0E-02	mg/kg/day	1.1E-03
				C11-C22 Aromatics	7.2E+01	(mg/kg)	1.7E-06	mg/kg-day	--		--	1.2E-04	mg/kg-day	3.0E-02	mg/kg/day	4.0E-03
				Arsenic	7.1E+00	(mg/kg)	1.7E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.6E-07	1.2E-05	mg/kg-day	3.0E-04	mg/kg/day	4.0E-02
				Lead	1.3E+02	(mg/kg)	3.2E-06	mg/kg-day	--		--	2.2E-04	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	4.1E-06	mg/kg-day	--		--	2.9E-04	mg/kg-day	4.7E-02	mg/kg/day	6.1E-03
				Vanadium	1.6E+01	(mg/kg)	3.8E-07	mg/kg-day	--		--	2.7E-05	mg/kg-day	9.0E-03	mg/kg/day	3.0E-03
			Exp. Route Total								6.1E-06					8.8E-02
			Dermal Contact	Benzo(a)anthracene	3.8E+01	(mg/kg)	2.7E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	1.9E-07	1.9E-05	mg/kg-day	--		--
				Benzo(a)pyrene	2.3E+01	(mg/kg)	1.6E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-06	1.1E-05	mg/kg-day	--		--
				Benzo(e)pyrene	1.7E+01	(mg/kg)	1.2E-07	mg/kg-day	--		--	8.4E-06	mg/kg-day	--		--
				Benzo(b)fluoranthene	1.6E+01	(mg/kg)	1.1E-07	mg/kg-day	7.3E-01	(mg/kg-day)-1	8.3E-08	7.9E-06	mg/kg-day	--		--
				Benzo(k)fluoranthene	2.0E+01	(mg/kg)	1.4E-07	mg/kg-day	7.3E-02	(mg/kg-day)-1	1.0E-08	1.0E-05	mg/kg-day	--		--
				Bis(2-Chloroethoxy)methane	4.9E-01	(mg/kg)	2.6E-09	mg/kg-day	--		--	1.9E-07	mg/kg-day	--		--
				Carbazole	2.2E+01	(mg/kg)	1.2E-07	mg/kg-day	2.0E-02	(mg/kg-day)-1	2.4E-09	8.3E-06	mg/kg-day	--		--
				4-Chloro-3-methylphenol	3.7E-01	(mg/kg)	2.0E-09	mg/kg-day	--		--	1.4E-07	mg/kg-day	7.0E-02	mg/kg/day	2.0E-06
				Dibenzo(a,h)anthracene	3.9E+00	(mg/kg)	2.7E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.0E-07	1.9E-06	mg/kg-day	--		--
				Dibenzofuran	2.0E+01	(mg/kg)	1.1E-07	mg/kg-day	--		--	7.7E-06	mg/kg-day	2.0E-03	mg/kg/day	3.8E-03
				Indeno(1,2,3-cd)Pyrene	8.5E+00	(mg/kg)	6.0E-08	mg/kg-day	7.3E-01	(mg/kg-day)-1	4.4E-08	4.2E-06	mg/kg-day	--		--
				1-Methylnaphthalene	1.2E+01	(mg/kg)	8.4E-08	mg/kg-day	--		--	5.9E-06	mg/kg-day	4.0E-03	mg/kg/day	1.5E-03
				2-Methylnaphthalene	1.4E+01	(mg/kg)	1.0E-07	mg/kg-day	--		--	7.1E-06	mg/kg-day	4.0E-03	mg/kg/day	1.8E-03
				Naphthalene	1.3E+01	(mg/kg)	9.2E-08	mg/kg-day	--		--	6.5E-06	mg/kg-day	2.0E-02	mg/kg/day	3.2E-04
				C11-C22 Aromatics	7.2E+01	(mg/kg)	3.9E-07	mg/kg-day	--		--	2.7E-05	mg/kg-day	3.0E-02	mg/kg/day	9.0E-04
				Arsenic	7.1E+00	(mg/kg)	1.2E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.7E-08	8.1E-07	mg/kg-day	3.0E-04	mg/kg/day	2.7E-03
				Lead	1.3E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	NA (3)		--
				Manganese	1.7E+02	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	1.9E-03	mg/kg/day	0.0E+00
				Vanadium	1.6E+01	(mg/kg)	0.0E+00	mg/kg-day	--		--	0.0E+00	mg/kg-day	2.3E-04	mg/kg/day	0.0E+00
			Exp. Route Total								1.7E-06					1.1E-02
	Exposure Medium Total										7.8E-06					9.9E-02
Risk From Reference											1.2E-06					4.4E-02
Risk from Site											6.6E-06					5.5E-02

TABLE 3-35D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk			Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Soil	Fugitive Dust	Group 4 Soil	Inhalation	Benzo(a)anthracene	2.8E-08	mg/m³	4.7E-11	mg/m³	1.1E-01	(mg/m³)⁻¹	5.2E-12	3.3E-09	mg/m³	--		--
				Benzo(a)pyrene	1.7E-08	mg/m³	2.8E-11	mg/m3	1.1E+00	(mg/m³)⁻¹	3.1E-11	2.0E-09	mg/m3	--		--
				Benzo(e)pyrene	1.3E-08	mg/m³	2.1E-11	mg/m3	--		--	1.5E-09	mg/m3	--		--
				Benzo(b)fluoranthene	1.2E-08	mg/m³	2.0E-11	mg/m3	1.1E-01	(mg/m³)⁻¹	2.2E-12	1.4E-09	mg/m3	--		--
				Benzo(k)fluoranthene	1.5E-08	mg/m³	2.5E-11	mg/m3	1.1E-01	(mg/m³)⁻¹	2.8E-12	1.8E-09	mg/m3	--		--
				Bis(2-Chloroethoxy)methane	3.6E-10	mg/m³	6.1E-13	mg/m3	--		--	4.3E-11	mg/m3	--		--
				Carbazole	1.6E-08	mg/m³	2.7E-11	mg/m3	--		--	1.9E-09	mg/m3	--		--
				4-Chloro-3-methylphenol	2.7E-10	mg/m³	4.6E-13	mg/m3	--		--	3.2E-11	mg/m3	--		--
				Dibenzo(a,h)anthracene	2.9E-09	mg/m³	4.8E-12	mg/m3	1.2E+00	(mg/m³)⁻¹	5.8E-12	3.4E-10	mg/m3	--		--
				Dibenzofuran	1.5E-08	mg/m³	2.5E-11	mg/m3	--		--	1.8E-09	mg/m3	7.0E-03	(mg/m³)	2.5E-07
				Indeno(1,2,3-cd)Pyrene	6.2E-09	mg/m³	1.1E-11	mg/m3	1.1E-01	(mg/m³)⁻¹	1.2E-12	7.4E-10	mg/m3	--		--
				1-Methylnaphthalene	7.2E-04	mg/m³	1.2E-06	mg/m3	--		--	8.6E-05	mg/m3	2.5E-01	(mg/m³)	3.5E-04
				2-Methylnaphthalene	3.0E-04	mg/m³	5.0E-07	mg/m3	--		--	3.5E-05	mg/m3	1.4E-01	(mg/m³)	2.5E-04
				Naphthalene	3.3E-04	mg/m³	5.6E-07	mg/m3	--		--	3.9E-05	mg/m3	3.0E-03	(mg/m³)	1.3E-02
				C11-C22 Aromatics	1.4E-03	mg/m³	2.4E-06	mg/m3	--		--	1.7E-04	mg/m3	5.0E-02	(mg/m³)	3.4E-03
				Arsenic	5.2E-09	mg/m³	8.9E-12	mg/m3	4.3E+00	(mg/m³)⁻¹	3.8E-11	6.2E-10	mg/m3	3.0E-05	(mg/m³)	2.1E-05
				Lead	9.8E-08	mg/m³	1.7E-10	mg/m3	--		--	1.2E-08	mg/m3	NA (3)		--
				Manganese	1.2E-07	mg/m³	2.1E-10	mg/m3	--		--	1.5E-08	mg/m3	5.0E-05	(mg/m³)	3.0E-04
				Vanadium	1.2E-08	mg/m³	2.0E-11	mg/m3	--		--	1.4E-09	mg/m3	--		--
			Exp. Route Total								8.7E-11					1.7E-02
Ex. Medium Total											8.7E-11					1.7E-02
Risk From Reference											4.4E-11					1.3E-02
Risk from Site											4.3E-11					4.3E-03

TABLE 3-35D

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Group 4	Dermal Contact	1,1-Dichloroethane	3E-04	mg/L	3.7E-10	mg/kg-day	--		--	2.6E-08	mg/kg-day	2.0E-01	mg/kg/day	1.3E-07
				Bis(2-Ethylhexyl)phthalate	3E-03	mg/L	6.7E-08	mg/kg-day	1.4E-02	(mg/kg-day)-1	9.4E-10	4.7E-06	mg/kg-day	2.0E-02	mg/kg/day	2.4E-04
				Ethylbenzene	6E-04	mg/L	5.5E-09	mg/kg-day	--		--	3.8E-07	mg/kg-day	1.0E-01	mg/kg/day	3.8E-06
				Tetrachloroethene	3E-04	mg/L	2.7E-09	mg/kg-day	5.4E-01	(mg/kg-day)-1	1.5E-09	1.9E-07	mg/kg-day	1.0E-02	mg/kg/day	1.9E-05
				Trichloroethene	3E-04	mg/L	8.0E-10	mg/kg-day	4.0E-01	(mg/kg-day)-1	3.2E-10	5.6E-08	mg/kg-day	--		--
				Xylenes (total)	6E-03	mg/L	8.6E-08	mg/kg-day	--		--	6.0E-06	mg/kg-day	2.0E-01	mg/kg/day	3.0E-05
				Arsenic	1E-01	mg/L	7.7E-09	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.2E-08	5.4E-07	mg/kg-day	3.0E-04	mg/kg/day	1.8E-03
				Barium	9E-03	mg/L	7.1E-10	mg/kg-day	--		--	5.0E-08	mg/kg-day	2.0E-01	mg/kg/day	2.5E-07
				Beryllium	1.1E-03	mg/L	8.5E-09	mg/kg-day	--		--	6.0E-07	mg/kg-day	2.0E-03	mg/kg/day	3.0E-04
				Cadmium	5.8E-03	mg/L	4.3E-10	mg/kg-day	--		--	3.0E-08	mg/kg-day	2.5E-05	mg/kg/day	1.2E-03
				Cobalt	1.5E-03	mg/L	4.6E-11	mg/kg-day	--		--	3.2E-09	mg/kg-day	--		--
				Lead	1.5E-02	mg/L	1.2E-10	mg/kg-day	--		--	8.1E-09	mg/kg-day	NA (3)		--
				Manganese	3.7E-01	mg/L	2.8E-08	mg/kg-day	--		--	1.9E-06	mg/kg-day	1.9E-03	mg/kg/day	1.0E-03
				Nickel	2.5E-02	mg/L	3.8E-10	mg/kg-day	--		--	2.7E-08	mg/kg-day	2.0E-02	mg/kg/day	1.3E-06
				Silver	2.0E-01	mg/L	9.1E-09	mg/kg-day	--		--	6.4E-07	mg/kg-day	5.0E-03	mg/kg/day	1.3E-04
				Vanadium	2.8E-03	mg/L	2.1E-10	mg/kg-day	--		--	1.5E-08	mg/kg-day	9.0E-03	mg/kg/day	1.7E-06
				Zinc	5.8E-02	mg/L	2.6E-09	mg/kg-day	--		--	1.8E-07	mg/kg-day	3.0E-01	mg/kg/day	6.1E-07
			Exp. Route Total								1.4E-08					4.8E-03
	Exposure Medium Total										1.4E-08					4.8E-03
Risk From Reference											0.0E+00					1.6E-03
Risk from Site											1.4E-08					3.1E-03
Air	Ambient Air	Group 4	Inhalation	Tetrachloroethene	5E-08	mg/m3	8.9E-11	mg/m3	5.9E-03	$(mg/m^3)^{-1}$	5.3E-13	6.2E-09	mg/m3	3.5E-02	(mg/m^3)	1.8E-07
				Trichloroethene	6E-08	mg/m3	9.9E-11	mg/m3	2.0E-03	$(mg/m^3)^{-1}$	2.0E-13	7.0E-09	mg/m3	6.0E-01	(mg/m^3)	1.2E-08
			Exp. Route Total								7.3E-13					1.9E-07
	Exposure Medium Total										7.3E-13					1.9E-07
Risk From Reference											0.0E+00					0.0E+00
Risk from Site											7.3E-13					1.9E-07
Total of Receptor Risks Across All Media											8E-06	Total of Receptor Hazards Across All Media				1.E-01
Risks from Reference											1E-06					6.E-02
Risks from Site											7E-06					6.E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

(3) Lead risks were evaluated separately. See text for explanation.

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35E

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3, Upland	Benzo(a)anthracene	5.8E-09	1.5E-13	5.6E-09	1E-08	--	--	--	--	--
			Benzo(a)pyrene	5.8E-08	1.5E-12	5.6E-08	1E-07	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	4.5E-09	1.2E-13	4.3E-09	9E-09	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	1.5E-07	4.5E-12	1.1E-07	3E-07	Liver	3.8E-02	1.9E-06	2.8E-02	7E-02
			Di-n-octylphthalate	--	--	--	--	Not available	2.0E-02	1.0E-06	1.5E-02	4E-02
			Indeno(1,2,3-cd)Pyrene	3.8E-09	9.9E-14	3.7E-09	8E-09	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	2.5E-03	5.2E-02	2.5E-03	6E-02
			Toluene	--	--	--	--	Kidney	4.5E-03	6.0E-03	0.0E+00	1E-02
			Tetrachloroethene	1.1E-07	1.7E-07	0.0E+00	3E-07	Liver	1.4E-03	5.7E-02	0.0E+00	6E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	2.3E-03	2.4E-01	0.0E+00	2E-01
			Arsenic	6.4E-08	3.2E-11	1.4E-08	8E-08	Skin; cardiovascular system	1.0E-02	1.7E-05	2.2E-03	1E-02
			Cadmium	--	8.5E-12	--	9E-12	--	1.9E-03	--	5.8E-04	3E-03
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	7.6E-04	--	0.0E+00	8E-04
			Chemical Total	**4.0E-07**	**1.7E-07**	**2.0E-07**	**8E-07**		**8.2E-02**	**3.6E-01**	**4.9E-02**	**5E-01**
		Exposure Point Total		4.0E-07	1.7E-07	2.0E-07	8E-07		8.2E-02	3.6E-01	4.9E-02	5E-01
	Exposure Medium Total			4.0E-07	1.7E-07	2.0E-07	8E-07		8.2E-02	3.6E-01	4.9E-02	5E-01
Medium Total				4.0E-07	1.7E-07	2.0E-07	8E-07		8.2E-02	3.6E-01	4.9E-02	5E-01
Groundwater	Groundwater	Group 3	1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	--	0.0E+00	--
			1,1,2-Trichloroethane	--	--	0.0E+00	--	Blood	--	--	0.0E+00	--
			1,1-Dichloroethane	--	--	--	--	Nervous system	--	--	0.0E+00	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	--	0.0E+00	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	--	1.1E-11	1E-11	Kidney	--	--	4.1E-08	4E-08
			1,2-Dichloroethene	--	--	--	--	Liver	--	--	--	--
			1,2-Dichloropropane	--	--	1.5E-11	1E-11	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dichlorobenzene	--	--	1.2E-10	1E-10	None observed	--	--	3.9E-06	4E-06
			1,4-Dioxane	--	--	7.4E-10	7E-10	Liver	--	--	4.7E-05	5E-05
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	--	--	5.9E-04	6E-04
			2-Butanone	--	--	--	--	Whole body	--	--	6.1E-04	6E-04
			2-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	1.1E-03	1E-03
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	1.8E-03	2E-03
			4-Methyl-2-pentanone	--	--	--	--	Whole body	--	--	4.9E-02	5E-02
			4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	--	--

TABLE 3-35E

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Group 3	Acetone	--	--	--	--	Kidney	--	--	3.5E-04	3E-04
			Acrylonitrile	--	--	4.6E-08	5E-08	Reproductive	--	--	5.9E-03	6E-03
			Alpha-BHC	--	--	--	--	--	--	--	--	--
			Aroclor 1254	--	--	0.0E+00	--	Eyes; immune system	--	--	0.0E+00	--
			Benzene	--	--	1.9E-10	2E-10	Blood; immune system	--	--	6.0E-05	6E-05
			Bis(2-Ethylhexyl)phthalate	--	--	7.9E-08	8E-08	Liver	--	--	2.0E-02	2E-02
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloroethane	--	--	--	--	--	--	--	--	--
			Chloroform	--	--	--	--	Liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Blood	--	--	0.0E+00	--
			Ethylbenzene	--	--	--	--	Liver; kidney	--	--	2.2E-02	2E-02
			Ethyl methacrylate	--	--	--	--	Kidney	--	--	3.4E-03	3E-03
			Isopropylbenzene	--	--	--	--	Kidney	--	--	0.0E+00	--
			Methylene Chloride	--	--	3.9E-09	4E-09	Liver	--	--	6.0E-04	6E-04
			Naphthalene	--	--	--	--	Whole body	--	--	1.6E-04	2E-04
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			n-Propylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	--	--	1.1E-03	1E-03
			Phenol	--	--	--	--	Development/Fetus	--	--	1.3E-03	1E-03
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			Tetrachloroethene	--	--	4.4E-10	4E-10	Liver	--	--	5.7E-06	6E-06
			Tetrahydrofuran	--	--	--	--	--	--	--	--	--
			Toluene	--	--	--	--	Kidney	--	--	1.5E-01	1E-01
			Trichloroethene	--	--	1.7E-10	2E-10	--	--	--	--	--
			Vinyl chloride	--	--	1.0E-10	1E-10	Liver	--	--	3.3E-06	3E-06
			Xylenes (total)	--	--	--	--	Whole body	--	--	5.3E-02	5E-02
			Antimony	--	--	--	--	Blood; whole body	--	--	1.3E-04	1E-04
			Arsenic	--	--	2.6E-08	3E-08	Skin; cardiovascular system	--	--	4.1E-03	4E-03
			Barium	--	--	--	--	Kidney	--	--	4.5E-05	5E-05
			Beryllium	--	--	--	--	Intestines	--	--	0.0E+00	--
			Cadmium	--	--	--	--	--	--	--	1.7E-04	2E-04
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	3.3E-02	3E-02
			Nickel	--	--	--	--	Whole body	--	--	3.1E-05	3E-05
			Silver	--	--	--	--	Skin	--	--	0.0E+00	--
			Thallium	--	--	--	--	Blood	--	--	1.3E-06	1E-06
			Vanadium	--	--	--	--	Hair cysteine	--	--	9.0E-05	9E-05
			Chemical Total	**0.0E+00**	**0.0E+00**	**1.6E-07**	**2E-07**		**0.0E+00**	**0.0E+00**	**3.5E-01**	**3E-01**
		Exposure Point Total		0.0E+00	0.0E+00	1.6E-07	2E-07		0.0E+00	0.0E+00	3.5E-01	3E-01
	Exposure Medium Total			0.0E+00	0.0E+00	1.6E-07	2E-07		0.0E+00	0.0E+00	3.5E-01	3E-01
Medium Total				0.0E+00	0.0E+00	1.6E-07	2E-07		0.0E+00	0.0E+00	3.5E-01	3E-01

TABLE 3-35E

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Ambient Air (Trench)	Group 3	1,4-Dichlorobenzene	--	--	--	--	None observed	--	2.7E-08	--	3E-08
			Naphthalene	--	--	--	--	Whole body	--	5.1E-05	--	5E-05
			2-Nitrophenol	--	--	--	--	Not available	--	--	--	--
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	3.1E-09	--	3E-09
			1,1,2-Trichloroethane	--	--	--	--	Blood	--	--	--	--
			1,1-Dichloroethane	--	--	--	--	Nervous system	--	1.3E-07	--	1E-07
			1,1-Dichloroethene	--	--	--	--	Liver	--	1.8E-07	--	2E-07
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	2.7E-12	--	3E-12	Kidney	--	3.0E-09	--	3E-09
			1,2-Dichloroethene	--	--	--	--	Liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Blood	--	5.3E-07	--	5E-07
			1,2-Dichloropropane	--	--	--	--	--	--	1.8E-06	--	2E-06
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			2-Butanone	--	--	--	--	Whole body	--	4.2E-05	--	4E-05
			4-Methyl-2-pentanone	--	--	--	--	Whole body	--	5.3E-04	--	5E-04
			Acetone	--	--	--	--	Kidney	--	9.6E-05	--	1E-04
			Acrylonitrile	--	1.1E-08	--	1E-08	Reproductive	--	3.2E-03	--	3E-03
			Benzene	--	1.0E-11	--	1E-11	Blood; immune system	--	3.1E-06	--	3E-06
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloromethane	--	--	--	--	--	--	6.7E-06	--	7E-06
			Chloroform	--	--	--	--	Liver	--	--	--	--
			Ethylbenzene	--	--	--	--	Liver; kidney	--	1.9E-04	--	2E-04
			Ethyl methacrylate	--	--	--	--	Kidney	--	2.8E-04	--	3E-04
			Methylene Chloride	--	3.4E-10	--	3E-10	Liver	--	1.7E-05	--	2E-05
			Isopropylbenzene	--	--	--	--	Kidney	--	3.1E-06	--	3E-06
			n-Propylbenzene	--	--	--	--	--	--	9.8E-06	--	1E-05
			Styrene	--	--	--	--	Blood; liver	--	--	--	--
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	--	4.9E-06	--	5E-06
			Tetrachloroethene	--	3.4E-13	--	3E-13	Liver	--	1.2E-07	--	1E-07
			Tetrahydrofuran	--	--	--	--	--	--	4.1E-04	--	4E-04
			Toluene	--	--	--	--	Kidney	--	3.8E-04	--	4E-04
			Trichloroethene	--	2.3E-13	--	2E-13	--	--	1.3E-08	--	1E-08
			Vinyl chloride	--	8.3E-13	--	8E-13	Liver	--	1.3E-07	--	1E-07
			Xylenes (total)	--	--	--	--	Whole body	--	6.3E-03	--	6E-03
			Chemical Total	**0E+00**	**1E-08**	**0E+00**	**1E-08**		**0E+00**	**1E-02**	**0E+00**	**1E-02**
		Exposure Point Total		0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1E-02
	Exposure Medium Total			0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1E-02
Medium Total				0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1E-02
Receptor Total							**9E-07**				**Receptor III Total**	**8E-01**
Site Related Receptor Risk Total							9E-07					7E-01
Reference Related Receptor Risk Total							**8E-08**					**1E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3, Upland	Benzo(a)anthracene	1.9E-08	1.5E-13	5.6E-09	2E-08	--	--	--	--	--
			Benzo(a)pyrene	1.9E-07	1.5E-12	5.6E-08	2E-07	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	1.5E-08	1.2E-13	4.3E-09	2E-08	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	5.0E-07	4.5E-12	1.1E-07	6E-07	Liver	1.3E-01	1.9E-06	2.8E-02	2E-01
			Di-n-octylphthalate	--	--	--	--	Not available	6.7E-02	1.0E-06	1.5E-02	8E-02
			Indeno(1,2,3-cd)Pyrene	1.3E-08	9.9E-14	3.7E-09	2E-08	--	--	--	--	--
			Naphthalene	--	--	--	--	Whole body	8.4E-03	5.2E-02	2.5E-03	6E-02
			Toluene	--	--	--	--	Kidney	1.5E-02	6.0E-03	0.0E+00	2E-02
			Tetrachloroethene	3.5E-07	1.7E-07	0.0E+00	5E-07	Liver	4.5E-03	5.7E-02	0.0E+00	6E-02
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			Xylenes (total)	--	--	--	--	Whole body	7.5E-03	2.4E-01	0.0E+00	3E-01
			Arsenic	2.1E-07	3.2E-11	1.4E-08	2E-07	Skin; cardiovascular system	3.3E-02	1.7E-05	2.2E-03	4E-02
			Cadmium	--	8.5E-12	--	9E-12	--	6.4E-03	--	5.8E-04	7E-03
			Lead	--	--	--	--	--	--	--	--	--
			Vanadium	--	--	--	--	Hair cysteine	2.5E-03	--	0.0E+00	3E-03
			Chemical Total	**1.3E-06**	**1.7E-07**	**2.0E-07**	**2E-06**		**2.7E-01**	**3.6E-01**	**4.9E-02**	**7E-01**
		Exposure Point Total		1.3E-06	1.7E-07	2.0E-07	2E-06		2.7E-01	3.6E-01	4.9E-02	7E-01
	Exposure Medium Total			1.3E-06	1.7E-07	2.0E-07	2E-06		2.7E-01	3.6E-01	4.9E-02	7E-01
Medium Total				1.3E-06	1.7E-07	2.0E-07	2E-06		2.7E-01	3.6E-01	4.9E-02	7E-01

TABLE 3-35F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Group 3	1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	--	0.0E+00	--
			1,1,2-Trichloroethane	--	--	0.0E+00	--	Blood	--	--	0.0E+00	--
			1,1-Dichloroethane	--	--	--	--	Nervous system	--	--	0.0E+00	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	--	0.0E+00	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	--	2.6E-11	3E-11	Kidney	--	--	1.0E-07	1E-07
			1,2-Dichloromethane	--	--	--	--	Liver	--	--	--	--
			1,2-Dichloropropane	--	--	3.7E-11	4E-11	--	--	--	--	--
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,4-Dichlorobenzene	--	--	3.0E-10	3E-10	None observed	--	--	9.7E-06	1E-05
			1,4-Dioxane	--	--	1.8E-09	2E-09	Liver	--	--	1.2E-04	1E-04
			2,4-Dimethylphenol	--	--	--	--	Blood; whole body	--	--	1.5E-03	1E-03
			2-Butanone	--	--	--	--	Whole body	--	--	1.5E-03	2E-03
			2-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	2.7E-03	3E-03
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	4.6E-03	5E-03
			4-Methyl-2-pentanone	--	--	--	--	Whole body	--	--	1.2E-01	1E-01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	--	--	--	--
			Acetone	--	--	--	--	Kidney	--	--	8.7E-04	9E-04
			Acrylonitrile	--	--	1.1E-07	1E-07	Reproductive	--	--	1.5E-02	1E-02
			Alpha-BHC	--	--	--	--	--	--	--	--	--
			Aroclor 1254	--	--	0.0E+00	--	Eyes; immune system	--	--	0.0E+00	--
			Benzene	--	--	4.7E-10	5E-10	Blood; immune system	--	--	1.5E-04	2E-04
			Bis(2-Ethylhexyl)phthalate	--	--	2.0E-07	2E-07	Liver	--	--	4.9E-02	5E-02
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloroethane	--	--	--	--	--	--	--	--	--
			Chloroform	--	--	--	--	Liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Blood	--	--	0.0E+00	--
			Ethylbenzene	--	--	--	--	Liver; kidney	--	--	5.5E-02	6E-02
			Ethyl methacrylate	--	--	--	--	Kidney	--	--	8.4E-03	8E-03
			Isopropylbenzene	--	--	--	--	Kidney	--	--	0.0E+00	--
			Methylene Chloride	--	--	9.6E-09	1E-08	Liver	--	--	1.5E-03	1E-03
			Naphthalene	--	--	--	--	Whole body	--	--	4.0E-04	4E-04
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			n-Propylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	--	--	2.8E-03	3E-03
			Phenol	--	--	--	--	Development-Fetus	--	--	3.1E-03	3E-03
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--

TABLE 3-35F

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Group 3	Tetrachloroethene	--	--	1.1E-09	1E-09	Liver	--	--	1.4E-05	1E-05
			Tetrahydrofuran	--	--	--	--	--	--	--	--	--
			Toluene	--	--	--	--	Kidney	--	--	3.7E-01	4E-01
			Trichloroethene	--	--	4.2E-10	4E-10	--	--	--	--	--
			Vinyl chloride	--	--	2.6E-10	3E-10	Liver	--	--	8.3E-06	8E-06
			Xylenes (total)	--	--	--	--	Whole body	--	--	1.3E-01	1E-01
			Antimony	--	--	--	--	Blood; whole body	--	--	3.3E-04	3E-04
			Arsenic	--	--	6.6E-08	7E-08	Skin; cardiovascular system	--	--	1.0E-02	1E-02
			Barium	--	--	--	--	Kidney	--	--	1.1E-04	1E-04
			Beryllium	--	--	--	--	Intestines	--	--	0.0E+00	--
			Cadmium	--	--	--	--	--	--	--	4.2E-04	4E-04
			Cobalt	--	--	--	--	--	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	--	--	8.2E-02	8E-02
			Nickel	--	--	--	--	Whole body	--	--	7.7E-05	8E-05
			Silver	--	--	--	--	Skin	--	--	0.0E+00	--
			Thallium	--	--	--	--	Blood	--	--	3.3E-06	3E-06
			Vanadium	--	--	--	--	Hair; systemic	--	--	2.3E-04	2E-04
			Zinc	--	--	--	--	--	--	--	0.0E+00	--
			Chemical Total	0.0E+00	0.0E+00	3.9E-07	4E-07		0.0E+00	0.0E+00	8.6E-01	9E-01
		Exposure Point Total		0.0E+00	0.0E+00	3.9E-07	4E-07		0.0E+00	0.0E+00	8.6E-01	9E-01
	Exposure Medium Total			0.0E+00	0.0E+00	3.9E-07	4E-07		0.0E+00	0.0E+00	8.6E-01	9E-01
Medium Total				0.0E+00	0.0E+00	3.9E-07	4E-07		0.0E+00	0.0E+00	8.6E-01	9E-01
Air	Ambient Air (Trench)	Group 3	1,4-Dichlorobenzene	--	--	--	--	None observed	--	2.7E-08	--	3E-08
			Naphthalene	--	--	--	--	Whole body	--	5.1E-05	--	5E-05
			2-Nitrophenol	--	--	--	--	Not available	--	--	--	--
			1,1,1-Trichloroethane	--	--	--	--	Nervous system	--	--	--	--
			1,1,2-Trichloroethane	--	--	--	--	Blood	--	--	--	--
			1,1-Dichloroethane	--	--	--	--	Nervous system	--	--	--	--
			1,1-Dichloroethene	--	--	--	--	Liver	--	--	--	--
			1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			1,2-Dichloroethane	--	2.7E-12	--	3E-12	Kidney	--	3.0E-09	--	3E-09
			1,2-Dichloroethene	--	--	--	--	Liver	--	--	--	--
			cis-1,2-Dichloroethene	--	--	--	--	Blood	--	--	--	--
			1,2-Dichloropropane	--	--	--	--	--	--	1.8E-06	--	2E-06
			1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
			2-Butanone	--	--	--	--	Whole body	--	4.2E-05	--	4E-05
			4-Methyl-2-pentanone	--	--	--	--	Whole body	--	5.3E-04	--	5E-04
			Acetone	--	--	--	--	Kidney	--	9.6E-05	--	1E-04
			Acrylonitrile	--	1.1E-08	--	1E-08	Reproductive	--	3.2E-03	--	3E-03
			Benzene	--	1.0E-11	--	1E-11	Blood; immune system	--	3.1E-06	--	3E-06
			Carbon tetrachloride	--	--	--	--	Liver	--	--	--	--
			Chloromethane	--	--	--	--	--	--	6.7E-06	--	7E-06
			Chloroform	--	--	--	--	Liver	--	--	--	--
			Ethylbenzene	--	--	--	--	Liver; kidney	--	1.9E-04	--	2E-04
			Ethyl methacrylate	--	--	--	--	Kidney	--	2.8E-04	--	3E-04
			Methylene Chloride	--	3.4E-10	--	3E-10	Liver	--	1.7E-05	--	2E-05
			Isopropylbenzene	--	--	--	--	Kidney	--	--	--	--
			n-Propylbenzene	--	--	--	--	--	--	9.8E-06	--	1E-05
			Styrene	--	--	--	--	Blood; liver	--	--	--	--
			n-Butylbenzene	--	--	--	--	--	--	--	--	--
			tert-Butylbenzene	--	--	--	--	--	--	--	--	--
			p-Isopropyltoluene	--	--	--	--	Kidney	--	4.9E-06	--	5E-06
			Tetrachloroethene	--	3.4E-13	--	3E-13	Liver	--	1.2E-07	--	1E-07
			Tetrahydrofuran	--	--	--	--	--	--	4.1E-04	--	4E-04
			Toluene	--	--	--	--	Kidney	--	3.8E-04	--	4E-04
			Trichloroethene	--	2.3E-13	--	2E-13	--	--	1.3E-08	--	1E-08
			Vinyl chloride	--	8.3E-13	--	8E-13	Liver	--	1.3E-07	--	1E-07
			Xylenes (total)	--	--	--	--	Whole body	--	6.3E-03	--	6E-03
			Chemical Total	0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1.2E-02
		Exposure Point Total		0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1E-02
	Exposure Medium Total			0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1E-02
Medium Total				0.0E+00	1.1E-08	0.0E+00	1E-08		0.0E+00	1.2E-02	0.0E+00	1E-02
Receptor Total							2E-06				**Receptor HI Total**	**2E+00**
Site Related Receptor Risk Total							2E-06					**1E+00**
Reference Related Receptor Risk Total							2E-07					**1E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-35G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4. Upland	Benzo(a)anthracene	2.0E-07	5.2E-12	1.9E-07	4E-07	--	--	--	--	--
			Benzo(a)pyrene	1.2E-06	3.1E-11	1.2E-06	2E-06	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	8.5E-08	2.2E-12	8.3E-08	2E-07	--	--	--	--	--
			Benzo(k)fluoranthene	1.1E-08	2.8E-12	1.0E-08	2E-08	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	3.2E-09	--	2.4E-09	6E-09	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	2.7E-06	--	2.0E-06	5E-06
			Dibenzo(a,h)anthracene	2.1E-07	5.8E-12	2.0E-07	4E-07	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	5.1E-03	2.5E-07	3.8E-03	9E-03
			Indeno(1,2,3-cd)Pyrene	4.5E-08	1.2E-12	4.4E-08	9E-08	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	1.5E-03	3.5E-04	1.5E-03	3E-03
			2-Methylnaphthalene	--	--	--	--	Lungs	1.8E-03	2.5E-04	1.8E-03	4E-03
			Naphthalene	--	--	--	--	Whole body	3.3E-04	1.3E-02	3.2E-04	1E-02
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	1.2E-03	3.4E-03	9.0E-04	5E-03
			Arsenic	7.7E-08	3.8E-11	1.7E-08	9E-08	Skin; cardiovascular system	1.2E-02	2.1E-05	2.7E-03	1E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.2E-04	3.0E-04	0.0E+00	9E-04
			Vanadium	--	--	--	--	Hair cysteine	9.0E-04	--	0.0E+00	9E-04
			Chemical Total	**1.8E-06**	**8.7E-11**	**1.7E-06**	**4E-06**		**2.5E-02**	**1.7E-02**	**1.1E-02**	**5E-02**
		Exposure Point Total		1.8E-06	8.7E-11	1.7E-06	4E-06		2.5E-02	1.7E-02	1.1E-02	5E-02
	Exposure Medium Total			1.8E-06	8.7E-11	1.7E-06	4E-06		2.5E-02	1.7E-02	1.1E-02	5E-02
Medium Total				1.8E-06	8.7E-11	1.7E-06	4E-06		2.5E-02	1.7E-02	1.1E-02	5E-02
Air	Ambient Air	Group 4	Tetrachloroethene	--	5.3E-13	--	5E-13	Nervous system; eyes; respiratory system	--	1.8E-07	--	2E-07
			Trichloroethene	--	2.0E-13	--	2E-13	Nervous system; eyes	--	1.2E-08	--	1E-08
			Chemical Total	**0.0E+00**	**7.3E-13**	**0.0E+00**	**7E-13**		**0.0E+00**	**1.9E-07**	**0.0E+00**	**2E-07**
		Exposure Point Total		0.0E+00	7.3E-13	0.0E+00	7E-13		0.0E+00	1.9E-07	0.0E+00	2E-07
	Exposure Medium Total			0.0E+00	7.3E-13	0.0E+00	7E-13		0.0E+00	1.9E-07	0.0E+00	2E-07
Medium Total				0.0E+00	7.3E-13	0.0E+00	7E-13		0.0E+00	1.9E-07	0.0E+00	2E-07

TABLE 3-35G

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Group 4	1,1-Dichloroethane	--	--	--	--	None observed	--	--	5.1E-08	5E-08
			Bis(2-Ethylhexyl)phthalate	--	--	3.8E-10	4E-10	Liver	--	--	9.4E-05	9E-05
			Ethylbenzene	--	--	--	--	Development/fetus	--	--	1.5E-06	2E-06
			Tetrachloroethene	--	--	5.9E-10	6E-10	Nervous system; eyes; respiratory system	--	--	7.7E-06	8E-06
			Trichloroethene	--	--	1.3E-10	1E-10	Nervous system; eyes	--	--	--	--
			Xylenes (total)	--	--	--	--	Nervous system	--	--	1.2E-05	1E-05
			Arsenic	--	--	4.6E-09	5E-09	Not available	--	--	7.2E-04	7E-04
			Barium	--	--	--	--	Fetus	--	--	1.0E-07	1E-07
			Beryllium	--	--	--	--	Respiratory system	--	--	1.2E-04	1E-04
			Cadmium	--	--	--	--	--	--	--	4.9E-04	5E-04
			Cobalt	--	--	--	--	Respiratory system	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	Nervous system	--	--	4.1E-04	4E-04
			Nickel	--	--	--	--	Not available	--	--	5.3E-07	5E-07
			Silver	--	--	--	--	--	--	--	5.1E-05	5E-05
			Vanadium	--	--	--	--	--	--	--	6.6E-07	7E-07
			Zinc	--	--	--	--	--	--	--	2.4E-07	2E-07
			Chemical Total	**0.0E+00**	**0.0E+00**	**5.7E-09**	**6E-09**		**0.0E+00**	**0.0E+00**	**1.9E-03**	**2E-03**
		Exposure Point Total		0.0E+00	0.0E+00	5.7E-09	6E-09		0.0E+00	0.0E+00	1.9E-03	2E-03
	Exposure Medium Total			0.0E+00	0.0E+00	5.7E-09	6E-09		0.0E+00	0.0E+00	1.9E-03	2E-03
Medium Total				0.0E+00	0.0E+00	5.7E-09	6E-09		0.0E+00	0.0E+00	1.9E-03	2E-03
Receptor Total							**4E-06**				**Receptor HI Total**	**6E-02**
Site Related Receptor Risk Total							**3E-06**					**3E-02**
Reference Related Receptor Risk Total							**5E-07**					**3E-02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE A-35H

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)anthracene	6.6E-07	5.2E-12	1.9E-07	9E-07	--	--	--	--	--
			Benzo(a)pyrene	4.0E-06	3.1E-11	1.2E-06	5E-06	--	--	--	--	--
			Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
			Benzo(b)fluoranthene	2.8E-07	2.2E-12	8.3E-08	4E-07	--	--	--	--	--
			Benzo(k)fluoranthene	3.5E-08	2.8E-12	1.0E-08	5E-08	--	--	--	--	--
			Bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
			Carbazole	1.1E-08	--	2.4E-09	1E-08	--	--	--	--	--
			4-Chloro-3-methylphenol	--	--	--	--	Whole body	8.9E-06	--	2.0E-06	1E-05
			Dibenzo(a,h)anthracene	6.8E-07	5.8E-12	2.0E-07	9E-07	--	--	--	--	--
			Dibenzofuran	--	--	--	--	Not available	1.7E-02	2.5E-07	3.8E-03	2E-02
			Indeno(1,2,3-cd)Pyrene	1.5E-07	1.2E-12	4.4E-08	2E-07	--	--	--	--	--
			1-Methylnaphthalene	--	--	--	--	Lungs	5.0E-03	3.5E-04	1.5E-03	7E-03
			2-Methylnaphthalene	--	--	--	--	Lungs	6.0E-03	2.5E-04	1.8E-03	8E-03
			Naphthalene	--	--	--	--	Whole body	1.1E-03	1.3E-02	3.2E-04	1E-02
			Perylene	--	--	--	--	--	--	--	--	--
			C11-C22 Aromatics	--	--	--	--	Kidney	4.0E-03	3.4E-03	9.0E-04	8E-03
			Arsenic	2.6E-07	3.8E-11	1.7E-08	3E-07	Skin, cardiovascular system	4.0E-02	2.1E-05	2.7E-03	4E-02
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	--	6.1E-03	3.0E-04	0.0E+00	6E-03
			Vanadium	--	--	--	--	Hair cysteine	3.0E-03	--	0.0E+00	3E-03
			Chemical Total	**6.1E-06**	**8.7E-11**	**1.7E-06**	**8E-06**		**8.8E-02**	**1.7E-02**	**1.1E-02**	**1E-01**
		Exposure Point Total		6.1E-06	8.7E-11	1.7E-06	8E-06		8.8E-02	1.7E-02	1.1E-02	1E-01
	Exposure Medium Total			6.1E-06	8.7E-11	1.7E-06	8E-06		8.8E-02	1.7E-02	1.1E-02	1E-01
Medium Total				6.1E-06	8.7E-11	1.7E-06	8E-06		8.8E-02	1.7E-02	1.1E-02	1E-01
Air	Ambient Air	Group 4	Tetrachloroethene	--	5.3E-13	--	5E-13	Nervous system; eyes; respiratory system	--	1.8E-07	--	2E-07
			Trichloroethene	--	2.0E-13	--	2E-13	Nervous system; eyes	--	1.2E-08	--	1E-08
			Chemical Total	**0.0E+00**	**7.3E-13**	**0.0E+00**	**7E-13**		**0.0E+00**	**1.9E-07**	**0.0E+00**	**2E-07**
		Exposure Point Total		0.0E+00	7.3E-13	0.0E+00	7E-13		0.0E+00	1.9E-07	0.0E+00	2E-07
	Exposure Medium Total			0.0E+00	7.3E-13	0.0E+00	7E-13		0.0E+00	1.9E-07	0.0E+00	2E-07
Medium Total				0.0E+00	7.3E-13	0.0E+00	7E-13		0.0E+00	1.9E-07	0.0E+00	2E-07

TABLE 3-351I

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Group 4	1,1-Dichloroethane	--	--	--	--	None observed	--	--	1.3E-07	1E-07
			Bis(2-Ethylhexyl)phthalate	--	--	9.4E-10	9E-10	Liver	--	--	2.4E-04	2E-04
			Ethylbenzene	--	--	--	--	Development fetus	--	--	3.8E-06	4E-06
			Tetrachloroethene	--	--	1.5E-09	1E-09	Nervous system; eyes; respiratory system	--	--	1.9E-05	2E-05
			Trichloroethene	--	--	3.2E-10	3E-10	Nervous system; eyes	--	--	--	--
			Xylenes (total)	--	--	--	--	Nervous system	--	--	3.0E-05	3E-05
			Arsenic	--	--	1.2E-08	1E-08	Not available	--	--	1.8E-03	2E-03
			Barium	--	--	--	--	Fetus	--	--	2.5E-07	2E-07
			Beryllium	--	--	--	--	Respiratory system	--	--	3.0E-04	3E-04
			Cadmium	--	--	--	--		--	--	1.2E-03	1E-03
			Cobalt	--	--	--	--	Respiratory system	--	--	--	--
			Lead	--	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	Nervous system	--	--	1.0E-03	1E-03
			Nickel	--	--	--	--	Not available	--	--	1.3E-06	1E-06
			Silver	--	--	--	--	--	--	--	1.3E-04	1E-04
			Vanadium	--	--	--	--	--	--	--	1.7E-06	2E-06
			Zinc	--	--	--	--	--	--	--	6.1E-07	6E-07
			Chemical Total	**0.0E+00**	**0.0E+00**	**1.4E-08**	**1E-08**		**0.0E+00**	**0.0E+00**	**4.8E-03**	**5E-03**
		Exposure Point Total		0.0E+00	0.0E+00	1.4E-08	1E-08		0.0E+00	0.0E+00	4.8E-03	5E-03
	Exposure Medium Total			0.0E+00	0.0E+00	1.4E-08	1E-08		0.0E+00	0.0E+00	4.8E-03	5E-03
Medium Total				0.0E+00	0.0E+00	1.4E-08	1E-08		0.0E+00	0.0E+00	4.8E-03	5E-03
Receptor Total							**8E-06**				**Receptor III Total**	**1E-01**
Site Related Receptor Risk Total							**7E-06**					**6E-02**
Reference Related Receptor Risk Total							**1E-06**					**6E-02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-36A

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current/Future
Receptor Population: Area 3 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	4.1E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Arsenic	1.0E-05	--	8.5E-06	2E-05	Skin; cardiovascular system	1.4E-01	--	1.2E-01	3E-01
			Chemical Total	**1.1E-05**	**0.0E+00**	**9.9E-06**	**2E-05**		**1.4E-01**	**0.0E+00**	**1.2E-01**	**3E-01**
		Exposure Point Total		1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
	Exposure Medium Total			1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Medium Total				1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Receptor Total							**3E-05**				**Receptor HI Total**	**4E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-36B

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current/Future
Receptor Population: Area 3 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 3, Upland	Benzo(a)pyrene	1.7E-06	--	6.4E-07	2E-06	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	1.8E-06	--	5.3E-07	2E-06	Liver	4.1E-02	--	1.2E-02	5E-02
			Chemical Total	**5.9E-06**	**0.0E+00**	**1.4E-06**	**7E-06**		**8.8E-02**	**0.0E+00**	**2.1E-02**	**1E-01**
		Exposure Point Total		5.9E-06	0.0E+00	1.4E-06	7E-06		8.8E-02	0.0E+00	2.1E-02	1E-01
	Exposure Medium Total			5.9E-06	0.0E+00	1.4E-06	7E-06		8.8E-02	0.0E+00	2.1E-02	1E-01
Medium Total				5.9E-06	0.0E+00	1.4E-06	7E-06		8.8E-02	0.0E+00	2.1E-02	1E-01
Soil	Wetland Soil	Groups 5/6, Wetlands	Arsenic	1.9E-06	--	3.1E-07	2E-06	Skin; cardiovascular system	2.7E-02	--	4.3E-03	3E-02
			Chemical Total	**3.2E-06**	**0.0E+00**	**9.4E-07**	**4E-06**		**3.0E-02**	**0.0E+00**	**4.3E-03**	**3E-02**
		Exposure Point Total		3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
	Exposure Medium Total			3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Medium Total				3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	8.2E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Arsenic	2.0E-05	--	8.5E-06	3E-05	Skin; cardiovascular system	2.9E-01	--	1.2E-01	4E-01
			Chemical Total	**2.1E-05**	**0.0E+00**	**9.9E-06**	**3E-05**		**2.9E-01**	**0.0E+00**	**1.2E-01**	**4E-01**
		Exposure Point Total		2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
	Exposure Medium Total			2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Medium Total				2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Receptor Total							**4E-05**				**Receptor HI Total**	**6E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-36C

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	4.1E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Arsenic	1.0E-05	--	8.5E-06	2E-05	Skin; cardiovascular system	1.4E-01	--	1.2E-01	3E-01
			Chemical Total	**1.1E-05**	**0.0E+00**	**9.9E-06**	**2E-05**		**1.4E-01**	**0.0E+00**	**1.2E-01**	**3E-01**
		Exposure Point Total		1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
	Exposure Medium Total			1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Medium Total				1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Receptor Total							**3E-05**				**Receptor HI Total**	**4E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-36D

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Current
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Wetland Soil	Groups 5/6, Wetlands	Arsenic	1.9E-06	--	3.1E-07	2E-06	Skin; cardiovascular system	2.7E-02	--	4.3E-03	3E-02
			Chemical Total	**3.2E-06**	**0.0E+00**	**9.4E-07**	**4E-06**		**3.0E-02**	**0.0E+00**	**4.3E-03**	**3E-02**
		Exposure Point Total		3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
	Exposure Medium Total			3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Medium Total				3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	8.2E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Arsenic	2.0E-05	--	8.5E-06	3E-05	Skin; cardiovascular system	2.9E-01	--	1.2E-01	4E-01
			Chemical Total	**2.1E-05**	**0.0E+00**	**9.9E-06**	**3E-05**		**2.9E-01**	**0.0E+00**	**1.2E-01**	**4E-01**
		Exposure Point Total		2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
	Exposure Medium Total			2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Medium Total				2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Receptor Total							**4E-05**				**Receptor HI Total**	**5E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-36E

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)anthracene	2.9E-06	--	2.2E-06	5E-06	--	--	--	--	--
			Benzo(a)pyrene	1.8E-05	--	1.3E-05	3E-05	--	--	--	--	--
			Benzo(b)fluoranthene	1.2E-06	--	9.4E-07	2E-06	--	--	--	--	--
			Dibenzo(a,h)anthracene	3.0E-06	--	4.5E-06	8E-06	--	--	--	--	--
			Chemical Total	**2.6E-05**	**0.0E+00**	**2.2E-05**	**5E-05**		**3.2E-02**	**0.0E+00**	**4.7E-03**	**4E-02**
		Exposure Point Total		2.6E-05	0.0E+00	2.2E-05	5E-05		3.2E-02	0.0E+00	4.7E-03	4E-02
	Exposure Medium Total			2.6E-05	0.0E+00	2.2E-05	5E-05		3.2E-02	0.0E+00	4.7E-03	4E-02
Medium Total				2.6E-05	0.0E+00	2.2E-05	5E-05		3.2E-02	0.0E+00	4.7E-03	4E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	4.1E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Arsenic	1.0E-05	--	8.5E-06	2E-05	Skin; cardiovascular system	1.4E-01	--	1.2E-01	3E-01
			Chemical Total	**1.1E-05**	**0.0E+00**	**9.9E-06**	**2E-05**		**1.4E-01**	**0.0E+00**	**1.2E-01**	**3E-01**
		Exposure Point Total		1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
	Exposure Medium Total			1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Medium Total				1.1E-05	0.0E+00	9.9E-06	2E-05		1.4E-01	0.0E+00	1.2E-01	3E-01
Receptor Total							**7E-05**				**Receptor HI Total**	**4E-01**
Site Related Receptor Risk Total							**4E-05**					**8E-02**
Reference Related Receptor Risk Total							**3E-05**					**3E-01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-36F

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Trespasser/Recreational User
Receptor Age: Youth (ages 8-18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)anthracene	5.9E-06	--	2.2E-06	8E-06	--	--	--	--	--
			Benzo(a)pyrene	3.5E-05	--	1.3E-05	5E-05	--	--	--	--	--
			Benzo(b)fluoranthene	2.5E-06	--	9.4E-07	3E-06	--	--	--	--	--
			Dibenzo(a,h)anthracene	6.0E-06	--	2.3E-06	8E-06	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	1.3E-06	--	4.9E-07	2E-06	--	--	--	--	--
			Chemical Total	**5.2E-05**	**0.0E+00**	**1.9E-05**	**7E-05**		**6.3E-02**	**0.0E+00**	**4.7E-03**	**7E-02**
		Exposure Point Total		5.2E-05	0.0E+00	1.9E-05	7E-05		6.3E-02	0.0E+00	4.7E-03	7E-02
	Exposure Medium Total			5.2E-05	0.0E+00	1.9E-05	7E-05		6.3E-02	0.0E+00	4.7E-03	7E-02
Medium Total				5.2E-05	0.0E+00	1.9E-05	7E-05		6.3E-02	0.0E+00	4.7E-03	7E-02
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)pyrene	9.9E-07	--	4.9E-07	1E-06	--	--	--	--	--
			Arsenic	1.9E-06	--	3.1E-07	2E-06	Skin; cardiovascular system	2.7E-02	--	4.3E-03	3E-02
			Chemical Total	**3.2E-06**	**0.0E+00**	**9.4E-07**	**4E-06**		**3.0E-02**	**0.0E+00**	**4.3E-03**	**3E-02**
		Exposure Point Total		3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
	Exposure Medium Total			3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Medium Total				3.2E-06	0.0E+00	9.4E-07	4E-06		3.0E-02	0.0E+00	4.3E-03	3E-02
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	8.2E-07	--	1.5E-06	2E-06	--	--	--	--	--
			Arsenic	2.0E-05	--	8.5E-06	3E-05	Skin; cardiovascular system	2.9E-01	--	1.2E-01	4E-01
			Chemical Total	**2.1E-05**	**0.0E+00**	**9.9E-06**	**3E-05**		**2.9E-01**	**0.0E+00**	**1.2E-01**	**4E-01**
		Exposure Point Total		2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
	Exposure Medium Total			2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Medium Total				2.1E-05	0.0E+00	9.9E-06	3E-05		2.9E-01	0.0E+00	1.2E-01	4E-01
Receptor Total							**1E-04**				**Receptor HI Total**	**6E-01**
Site Related Receptor Risk Total							**7E-05**					**1E-01**
Reference Related Receptor Risk Total							**4E-05**					**4E-01**

Shaded = Concentrations of contaminant are consistent with refereuce concentrations.

TABLE 3-37A

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 3, Upland	Benzo(a)pyrene	8.6E-06	--	6.2E-06	1E-05	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	5.6E-06	--	3.1E-06	9E-06	Liver	2.1E-01	--	1.2E-01	3E-01
			Tetrachloroethene	3.9E-06	--	0.0E+00	4E-06	Liver	7.4E-03	--	0.0E+00	7E-03
			Arsenic	2.4E-06	--	3.9E-07	3E-06	Skin; cardiovascular system	5.4E-02	--	9.0E-03	6E-02
			Chemical Total	**2.3E-05**	**0.0E+00**	**1.1E-05**	**3E-05**		**4.4E-01**	**0.0E+00**	**2.0E-01**	**6E-01**
		Exposure Point Total		2.3E-05	0.0E+00	1.1E-05	3E-05		4.4E-01	0.0E+00	2.0E-01	6E-01
	Exposure Medium Total			2.3E-05	0.0E+00	1.1E-05	3E-05		4.4E-01	0.0E+00	2.0E-01	6E-01
Medium Total				2.3E-05	0.0E+00	1.1E-05	3E-05		4.4E-01	0.0E+00	2.0E-01	6E-01
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)pyrene	3.0E-06	--	1.4E-06	4E-06	--	--	--	--	--
			Arsenic	3.6E-06	--	4.2E-07	4E-06	Skin; cardiovascular system	8.2E-02	--	7.5E-03	9E-02
			Chemical Total	**7.5E-06**	**0.0E+00**	**2.3E-06**	**1E-05**		**9.1E-02**	**0.0E+00**	**7.5E-03**	**1E-01**
		Exposure Point Total		7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
	Exposure Medium Total			7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
Medium Total				7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	2.5E-06	--	3.0E-06	5E-06	--	--	--	--	--
			Arsenic	3.8E-05	--	1.1E-05	5E-05	Skin; cardiovascular system	8.7E-01	--	2.0E-01	1E+00
			Chemical Total	**4.0E-05**	**0.0E+00**	**1.4E-05**	**5E-05**		**8.7E-01**	**0.0E+00**	**2.0E-01**	**1E+00**
		Exposure Point Total		4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
	Exposure Medium Total			4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Medium Total				4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Groundwater	Indoor Air	Group 3	Acrylonitrile	--	3.0E-05	--	3E-05	Respiratory system	--	9.7E-01	--	1E+00
			Methylene Chloride	--	6.1E-06	--	6E-06	Liver	--	3.3E-02	--	3E-02
			Toluene	--	--	--	--	Nervous system	--	1.6E+00	--	2E+00
			Xylenes (total)	--	--	--	--	Nervous system	--	2.4E+01	--	2E+01
			Chemical Total	**0.0E+00**	**3.7E-05**	**0.0E+00**	**4E-05**		**0.0E+00**	**2.9E+01**	**0.0E+00**	**3E+01**
		Exposure Point Total		0.0E+00	3.7E-05	0.0E+00	4E-05		0.0E+00	2.9E+01	0.0E+00	3E+01
	Exposure Medium Total			0.0E+00	3.7E-05	0.0E+00	4E-05		0.0E+00	2.9E+01	0.0E+00	3E+01
Medium Total				0.0E+00	3.7E-05	0.0E+00	4E-05		0.0E+00	2.9E+01	0.0E+00	3E+01
Groundwater	Potable Groundwater	Groups 3-6	3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	1.9E+00	7.3E-01	1.5E-01	3E+00
			Aroclor 1254	2.3E-06	--	0.0E+00	2E-06	Eyes; immune system	2.7E+00	--	0.0E+00	3E+00
			Alpha-BHC	1.4E-06	--	3.8E-07	2E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	4.2E-05	4.8E-09	5.4E-05	1E-04	Liver	1.4E+00	6.2E-04	1.6E+00	3E+00
			Phenol	--	--	--	--	Development/Fetus	1.4E+00	2.7E-02	1.0E-01	2E+00
			1,1,2-Trichloroethane	1.9E-06	9.8E-07	1.6E-07	3E-06	Blood	7.7E-02	9.6E-02	5.7E-03	2E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	8.1E-01	1.8E+00	5.0E-02	3E+00
			1,2-Dichloroethane	2.0E-05	1.2E-05	8.4E-07	3E-05	Kidney	9.9E-03	4.0E-03	3.9E-04	1E-02
			1,4-Dioxane	1.6E-04	7.5E-06	5.0E-07	2E-04	Liver	1.3E+00	7.1E-03	3.8E-03	1E+00
			2-Butanone	--	--	--	--	Whole body	5.7E+00	6.0E-01	5.0E-02	6E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.1E+02	7.0E+00	3.9E+00	1E+02
			Acetone	--	--	--	--	Kidney	3.6E+00	1.3E+00	2.8E-02	5E+00
			Acrylonitrile	3.4E-03	4.5E-04	3.1E-05	4E-03	Reproductive	5.8E+01	4.2E+01	4.8E-01	1E+02
			Benzene	1.2E-05	4.4E-06	1.6E-06	2E-05	Blood; immune system	5.0E-01	4.2E-01	6.1E-02	1E+00
			Carbon tetrachloride	3.3E-05	7.9E-06	7.7E-06	5E-05	Liver	3.3E+00	4.7E+00	7.0E-01	9E+00
			Chloroform	8.6E-07	1.4E-06	6.9E-08	2E-06	Liver	2.6E-02	4.4E-03	1.8E-03	3E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	9.8E-01	9.3E-01	6.9E-02	2E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	3.8E+00	2.1E+00	1.8E+00	8E+00
			Ethyl methacrylate	--	--	--	--	Kidney	2.0E+00	2.4E+00	2.7E-01	5E+00

TABLE 3-37A

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	Methylene Chloride	8.0E-05	1.2E-05	2.6E-06	9E-05	Liver	1.6E+00	1.9E-01	4.9E-02	2E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			Tetrachloroethene	1.6E-05	3.5E-07	8.2E-06	2E-05	Liver	2.7E-02	3.7E-02	1.3E-02	8E-02
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	4.4E+01	4.1E+00	1.2E+01	6E+01
			Trichloroethene	1.2E-05	1.3E-07	1.8E-06	1E-05	--	--	2.3E-03	--	2E-03
			Vinyl chloride	5.2E-04	8.7E-06	2.4E-05	6E-04	Liver	1.1E+00	2.2E-01	4.4E-02	1E+00
			Xylenes (total)	--	--	--	--	Whole body	6.3E+00	7.0E+01	4.3E+00	8E+01
			Antimony	--	--	--	--	Blood; whole body	1.1E+01	--	2.3E-01	1E+01
			Arsenic	1.7E-02	--	5.8E-05	2E-02	Skin; cardiovascular system	3.5E+02	--	1.1E+00	3E+02
			Beryllium	--	--	--	--	Intestines	1.3E+01	--	5.6E+00	2E+01
			Cadmium	--	--	--	--	--	5.4E+00	--	3.3E-01	6E+00
			Chromium	--	--	--	--	None observed	2.7E+00	--	3.3E-01	3E+00
			Manganese	--	--	--	--	--	2.8E+01	--	2.2E+00	3E+01
			Silver	--	--	--	--	Skin	7.2E+00	--	3.3E-01	7E+00
			Thallium	--	--	--	--	Blood	2.7E+00	--	8.4E-03	3E+00
			Zinc	--	--	--	--	Blood	8.2E+00	--	1.5E-02	8E+00
			Chemical Total	**2.1E-02**	**5.1E-04**	**1.9E-04**	**2E-02**		**6.7E+02**	**2.3E+02**	**3.6E+01**	**9E+02**
		Exposure Point Total		2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
	Exposure Medium Total			2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Medium Total				2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Receptor Total							**2E-02**				**Receptor HI Total**	**1E+03**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-37B

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 3, Upland	Benzo(a)anthracene	1.8E-06	--	7.2E-07	3E-06	--	--	--	--	--
			Benzo(a)pyrene	1.8E-05	--	7.2E-06	3E-05	--	--	--	--	--
			Benzo(b)fluoranthene	1.4E-06	--	5.5E-07	2E-06	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	1.4E-05	--	4.4E-06	2E-05	Liver	4.1E-01	--	1.2E-01	5E-01
			Indeno(1,2,3-cd)Pyrene	1.2E-06	--	4.7E-07	2E-06	--	--	--	--	--
			Tetrachloroethene	9.8E-06	--	0.0E+00	1E-05	Liver	1.5E-02	--	0.0E+00	1E-02
			Arsenic	5.9E-06	--	5.6E-07	6E-06	Skin; cardiovascular system	1.1E-01	--	9.0E-03	1E-01
			Chemical Total	**5.2E-05**	**0.0E+00**	**1.4E-05**	**7E-05**		**8.8E-01**	**0.0E+00**	**2.0E-01**	**1E+00**
		Exposure Point Total		5.2E-05	0.0E+00	1.4E-05	7E-05		8.8E-01	0.0E+00	2.0E-01	1E+00
	Exposure Medium Total			5.2E-05	0.0E+00	1.4E-05	7E-05		8.8E-01	0.0E+00	2.0E-01	1E+00
Medium Total				5.2E-05	0.0E+00	1.4E-05	7E-05		8.8E-01	0.0E+00	2.0E-01	1E+00
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)pyrene	6.3E-06	--	2.1E-06	8E-06	--	--	--	--	--
			Arsenic	9.1E-06	--	7.8E-07	1E-05	Skin; cardiovascular system	1.6E-01	--	7.4E-03	2E-01
			Chemical Total	**1.7E-05**	**0.0E+00**	**3.5E-06**	**2E-05**		**1.8E-01**	**0.0E+00**	**7.4E-03**	**2E-01**
		Exposure Point Total		1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
	Exposure Medium Total			1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Medium Total				1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	5.2E-06	--	4.4E-06	1E-05		--	--		--
			Arsenic	9.5E-05	--	2.1E-05	1E-04	Skin; cardiovascular system	1.7E+00	--	2.0E-01	2E+00
			Chemical Total	**1.0E-04**	**0.0E+00**	**2.6E-05**	**1E-04**		**1.7E+00**	**0.0E+00**	**2.0E-01**	**2E+00**
		Exposure Point Total		1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
	Exposure Medium Total			1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Medium Total				1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Air	Ambient Air	Site	Benzene	--	1.7E-06	--	2E-06	Blood; immune system	--	2.1E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.7E-06**	**0.0E+00**	**2E-06**		**0.0E+00**	**1.7E-01**	**0.0E+00**	**2E-01**
		Exposure Point Total		0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
	Exposure Medium Total			0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Medium Total				0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Groundwater	Indoor Air	Group 3	Acrylonitrile	--	7.9E-05	--	8E-05	Respiratory system	--	9.7E-01	--	1E+00
			Methylene Chloride	--	1.6E-05	--	2E-05	Liver	--	3.3E-02	--	3E-02
			Toluene	--	--	--	--	Nervous system	--	1.6E+00	--	2E+00
			Xylenes (total)	--	--	--	--	Nervous system	--	2.4E+01	--	2E+01
			Chemical Total	**0.0E+00**	**9.7E-05**	**0.0E+00**	**1E-04**		**0.0E+00**	**2.9E+01**	**0.0E+00**	**3E+01**
		Exposure Point Total		0.0E+00	9.7E-05	0.0E+00	1E-04		0.0E+00	2.9E+01	0.0E+00	3E+01
	Exposure Medium Total			0.0E+00	9.7E-05	0.0E+00	1E-04		0.0E+00	2.9E+01	0.0E+00	3E+01
Medium Total				0.0E+00	9.7E-05	0.0E+00	1E-04		0.0E+00	2.9E+01	0.0E+00	3E+01

TABLE 3-37B

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	1.3E-06	--	6.9E-07	2E-06	None observed	3.0E-03	3.9E-03	1.5E-03	8E-03
			2-Methylphenol	--	--	--	--	Whole body; nervous system	1.7E+00	4.2E-02	1.5E-01	2E+00
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	3.5E+00	7.3E-01	2.6E-01	4E+00
			Aroclor 1254	7.9E-06	--	0.0E+00	8E-06	Eyes; immune system	5.0E+00	--	0.0E+00	5E+00
			Alpha-BHC	4.9E-06	--	1.2E-06	6E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	1.4E-04	1.3E-07	1.7E-04	3E-04	Liver	2.5E+00	2.9E-03	2.8E+00	5E+00
			Naphthalene	--	--	--	--	Whole body	4.6E-02	2.9E+00	2.3E-02	3E+00
			Phenol	--	--	--	--	Development/Fetus	2.6E+00	1.2E-01	1.8E-01	3E+00
			1,1,2-Trichloroethane	6.5E-06	2.8E-05	5.0E-07	3E-05	Blood	1.4E-01	4.4E-01	1.0E-02	6E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	1.5E+00	8.4E+00	8.7E-02	1E+01
			1,2-Dichloroethane	6.6E-05	3.3E-04	2.7E-06	4E-04	Kidney	1.8E-02	1.9E-02	6.7E-04	4E-02
			1,2-Dichloroethene	--	--	--	--	Liver	1.2E+00	2.6E+00	7.9E-02	4E+00
			1,2-Dichloropropane	4.0E-06	--	3.3E-07	4E-06	--	--	9.7E-01	--	1E+00
			1,4-Dioxane	5.4E-04	2.1E-04	1.6E-06	8E-04	Liver	2.5E+00	3.3E-02	6.6E-03	3E+00
			2-Butanone	--	--	--	--	Whole body	1.1E+01	2.8E+00	8.6E-02	1E+01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.0E+02	3.2E+01	6.9E+00	2E+02
			Acetone	--	--	--	--	Kidney	6.7E+00	6.2E+00	4.9E-02	1E+01
			Acrylonitrile	1.2E-02	1.3E-02	9.8E-05	2E-02	Reproductive	1.1E+02	1.9E+02	8.3E-01	3E+02
			Benzene	4.1E-05	1.2E-04	5.1E-06	2E-04	Blood; immune system	9.3E-01	1.9E+00	1.1E-01	3E+00
			Carbon tetrachloride	1.1E-04	2.2E-04	2.4E-05	4E-04	Liver	6.2E+00	2.2E+01	1.2E+00	3E+01
			Chloroform	2.9E-06	3.9E-05	2.2E-07	4E-05	Liver	4.7E-02	2.0E-02	3.2E-03	7E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	1.8E+00	4.3E+00	1.2E-01	6E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	7.0E+00	9.7E+00	3.1E+00	2E+01
			Ethyl methacrylate	--	--	--	--	Kidney	3.7E+00	1.1E+01	4.7E-01	2E+01
			Methylene Chloride	2.7E-04	3.4E-04	8.3E-06	6E-04	Liver	3.0E+00	8.6E-01	8.5E-02	4E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			Tetrachloroethene	5.3E-05	9.7E-06	2.6E-05	9E-05	Liver	5.0E-02	1.7E-01	2.2E-02	2E-01
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	8.1E+01	1.9E+01	2.1E+01	1E+02
			Trichloroethene	3.9E-05	3.6E-06	5.6E-06	5E-05	--	--	1.1E-02	--	1E-02
			Vinyl chloride	1.7E-03	2.4E-04	7.4E-05	2E-03	Liver	2.0E+00	1.0E+00	7.6E-02	3E+00
			Xylenes (total)	--	--	--	--	Whole body	1.2E+01	3.2E+02	7.5E+00	3E+02
			Antimony	--	--	--	--	Blood; whole body	2.1E+01	--	7.0E-01	2E+01
			Arsenic	5.7E-02	--	2.4E-04	6E-02	Skin; cardiovascular system	6.4E+02	--	3.3E+00	6E+02
			Beryllium	--	--	--	--	Intestines	2.3E+01	--	1.7E+01	4E+01
			Cadmium	--	--	--	--	--	1.0E+01	--	1.0E+00	1E+01
			Chromium	--	--	--	--	None observed	5.0E+00	--	1.0E+00	6E+00
			Manganese	--	--	--	--	--	5.2E+01	--	6.5E+00	6E+01
			Silver	--	--	--	--	Skin	1.3E+01	--	1.0E+00	1E+01
			Thallium	--	--	--	--	Blood	5.0E+00	--	2.5E-02	5E+00
			Zinc	--	--	--	--	Blood	1.5E+01	--	4.6E-02	2E+01
			Chemical Total	**7.2E-02**	**1.4E-02**	**6.6E-04**	**9E-02**		**1.2E+03**	**7.3E+02**	**7.6E+01**	**2E+03**
		Exposure Point Total		7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
	Exposure Medium Total			7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Medium Total				7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Receptor Total							**9E-02**				**Receptor HI Total**	**2E+03**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-37C

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 4, Upland	Benzo(a)anthracene	3.0E-05	--	2.1E-05	5E-05	--	--	--	--	--
			Benzo(a)pyrene	1.8E-04	--	1.3E-04	3E-04	--	--	--	--	--
			Benzo(b)fluoranthene	1.3E-05	--	9.1E-06	2E-05	--	--	--	--	--
			Benzo(k)fluoranthene	1.6E-06	--	1.2E-06	3E-06	--	--	--	--	--
			Dibenzo(a,h)anthracene	3.0E-05	--	2.3E-05	5E-05	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	6.6E-06	--	4.8E-06	1E-05	--	--	--	--	--
			Arsenic	2.8E-06	--	4.7E-07	3E-06	Skin; cardiovascular system	6.5E-02	--	1.1E-02	8E-02
			Chemical Total	**2.6E-04**	**0.0E+00**	**1.9E-04**	**5E-04**		**1.4E-01**	**0.0E+00**	**4.5E-02**	**2E-01**
		Exposure Point Total		2.6E-04	0.0E+00	1.9E-04	5E-04		1.4E-01	0.0E+00	4.5E-02	2E-01
	Exposure Medium Total			2.6E-04	0.0E+00	1.9E-04	5E-04		1.4E-01	0.0E+00	4.5E-02	2E-01
Medium Total				2.6E-04	0.0E+00	1.9E-04	5E-04		1.4E-01	0.0E+00	4.5E-02	2E-01
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)pyrene	3.0E-06	--	1.4E-06	4E-06	--	--	--	--	--
			Arsenic	3.6E-06	--	4.2E-07	4E-06	Skin; cardiovascular system	8.2E-02	--	7.5E-03	9E-02
			Chemical Total	**7.5E-06**	**0.0E+00**	**2.3E-06**	**1E-05**		**9.1E-02**	**0.0E+00**	**7.5E-03**	**1E-01**
		Exposure Point Total		7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
	Exposure Medium Total			7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
Medium Total				7.5E-06	0.0E+00	2.3E-06	1E-05		9.1E-02	0.0E+00	7.5E-03	1E-01
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	2.5E-06	--	3.0E-06	5E-06	--	--	--	--	--
			Arsenic	3.8E-05	--	1.1E-05	5E-05	Skin; cardiovascular system	8.7E-01	--	2.0E-01	1E+00
			Chemical Total	**4.0E-05**	**0.0E+00**	**1.4E-05**	**5E-05**		**8.7E-01**	**0.0E+00**	**2.0E-01**	**1E+00**
		Exposure Point Total		4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
	Exposure Medium Total			4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Medium Total				4.0E-05	0.0E+00	1.4E-05	5E-05		8.7E-01	0.0E+00	2.0E-01	1E+00
Groundwater	Potable Groundwater	Groups 3-6	3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	1.9E+00	7.3E-01	1.5E-01	3E+00
			Aroclor 1254	2.3E-06	--	0.0E+00	2E-06	Eyes; immune system	2.7E+00	--	0.0E+00	3E+00
			Alpha-BHC	1.4E-06	--	3.8E-07	2E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	4.2E-05	4.8E-09	5.4E-05	1E-04	Liver	1.4E+00	6.2E-04	1.6E+00	3E+00
			Phenol	--	--	--	--	Development/Fetus	1.4E+00	2.7E-02	1.0E-01	2E+00
			1,1,2-Trichloroethane	1.9E-06	9.8E-07	1.6E-07	3E-06	Blood	7.7E-02	9.6E-02	5.7E-03	2E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	8.1E-01	1.8E+00	5.0E-02	3E+00

TABLE 3-37C

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	1,2-Dichloroethane	2.0E-05	1.2E-05	8.4E-07	3E-05	Kidney	9.9E-03	4.0E-03	3.9E-04	1E-02
			1,4-Dioxane	1.6E-04	7.5E-06	5.0E-07	2E-04	Liver	1.3E+00	7.1E-03	3.8E-03	1E+00
			2-Butanone	--	--	--	--	Whole body	5.7E+00	6.0E-01	5.0E-02	6E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.1E+02	7.0E+00	3.9E+00	1E+02
			Acetone	--	--	--	--	Kidney	3.6E+00	1.3E+00	2.8E-02	5E+00
			Acrylonitrile	3.4E-03	4.5E-04	3.1E-05	4E-03	Reproductive	5.8E+01	4.2E+01	4.8E-01	1E+02
			Benzene	1.2E-05	4.4E-06	1.6E-06	2E-05	Blood; immune system	5.0E-01	4.2E-01	6.1E-02	1E+00
			Carbon tetrachloride	3.3E-05	7.9E-06	7.7E-06	5E-05	Liver	3.3E+00	4.7E+00	7.0E-01	9E+00
			Chloroform	8.6E-07	1.4E-06	6.9E-08	2E-06	Liver	2.6E-02	4.4E-03	1.8E-03	3E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	9.8E-01	9.3E-01	6.9E-02	2E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	3.8E+00	2.1E+00	1.8E+00	8E+00
			Ethyl methacrylate	--	--	--	--	Kidney	2.0E+00	2.4E+00	2.7E-01	5E+00
			Methylene Chloride	8.0E-05	1.2E-05	2.6E-06	9E-05	Liver	1.6E+00	1.9E-01	4.9E-02	2E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			Tetrachloroethene	1.6E-05	3.5E-07	8.2E-06	2E-05	Liver	2.7E-02	3.7E-02	1.3E-02	8E-02
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	4.4E+01	4.1E+00	1.2E+01	6E+01
			Trichloroethene	1.2E-05	1.3E-07	1.8E-06	1E-05	--	--	2.3E-03	--	2E-03
			Vinyl chloride	5.2E-04	8.7E-06	2.4E-05	6E-04	Liver	1.1E+00	2.2E-01	4.4E-02	1E+00
			Xylenes (total)	--	--	--	--	Whole body	6.3E+00	7.0E+01	4.3E+00	8E+01
			Antimony	--	--	--	--	Blood; whole body	1.1E+01	--	2.3E-01	1E+01
			Arsenic	1.7E-02	--	5.8E-05	2E-02	Skin; cardiovascular system	3.5E+02	--	1.1E+00	3E+02
			Beryllium	--	--	--	--	Intestines	1.3E+01	--	5.6E+00	2E+01
			Cadmium	--	--	--	--	--	5.4E+00	--	3.3E-01	6E+00
			Chromium	--	--	--	--	None observed	2.7E+00	--	3.3E-01	3E+00
			Manganese	--	--	--	--	--	2.8E+01	--	2.2E+00	3E+01
			Silver	--	--	--	--	Skin	7.2E+00	--	3.3E-01	7E+00
			Thallium	--	--	--	--	Blood	2.7E+00	--	8.4E-03	3E+00
			Zinc	--	--	--	--	Blood	8.2E+00	--	1.5E-02	8E+00
			Chemical Total	**2.1E-02**	**5.1E-04**	**1.9E-04**	**2E-02**		**6.7E+02**	**2.3E+02**	**3.6E+01**	**9E+02**
		Exposure Point Total		2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
	Exposure Medium Total			2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Medium Total				2.1E-02	5.1E-04	1.9E-04	2E-02		6.7E+02	2.3E+02	3.6E+01	9E+02
Receptor Total							**2E-02**				**Receptor HI Total**	**9E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-37D

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 4, Upland	Benzo(a)anthracene	6.2E-05	--	2.5E-05	9E-05	--	--	--	--	--
			Benzo(a)pyrene	3.7E-04	--	1.5E-04	5E-04	--	--	--	--	--
			Benzo(b)fluoranthene	2.6E-05	--	1.1E-05	4E-05	--	--	--	--	--
			Benzo(k)fluoranthene	3.3E-06	--	1.3E-06	5E-06	--	--	--	--	--
			Dibenzo(a,h)anthracene	6.3E-05	--	2.5E-05	9E-05	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	1.4E-05	--	5.5E-06	2E-05	--	--	--	--	--
			Arsenic	7.1E-06	--	6.8E-07	8E-06	Skin; cardiovascular system	1.3E-01	--	1.1E-02	1E-01
			Chemical Total	**5.5E-04**	**0.0E+00**	**2.2E-04**	**7.7E-04**		**2.7E-01**	**0.0E+00**	**4.5E-02**	**3.2E-01**
		Exposure Point Total		5.5E-04	0.0E+00	2.2E-04	8E-04		2.7E-01	0.0E+00	4.5E-02	3E-01
	Exposure Medium Total			5.5E-04	0.0E+00	2.2E-04	8E-04		2.7E-01	0.0E+00	4.5E-02	3E-01
Medium Total				5.5E-04	0.0E+00	2.2E-04	8E-04		2.7E-01	0.0E+00	4.5E-02	3E-01
Soil	Wetland Soil	Groups 5/6, Wetlands	Benzo(a)pyrene	6.3E-06	--	2.1E-06	8E-06	--	--	--	--	--
			Arsenic	9.1E-06	--	7.8E-07	1E-05	Skin; cardiovascular system	1.6E-01	--	7.4E-03	2E-01
			Chemical Total	**1.7E-05**	**0.0E+00**	**3.5E-06**	**2E-05**		**1.8E-01**	**0.0E+00**	**7.4E-03**	**2E-01**
		Exposure Point Total		1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
	Exposure Medium Total			1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Medium Total				1.7E-05	0.0E+00	3.5E-06	2E-05		1.8E-01	0.0E+00	7.4E-03	2E-01
Sediment	Sediment	Groups 5/6, Wetlands	Benzo(a)pyrene	5.2E-06	--	4.4E-06	1E-05	--	--	--	--	--
			Arsenic	9.5E-05	--	2.1E-05	1E-04	Skin; cardiovascular system	1.7E+00	--	2.0E-01	2E+00
			Chemical Total	**1.0E-04**	**0.0E+00**	**2.6E-05**	**1E-04**		**1.7E+00**	**0.0E+00**	**2.0E-01**	**2E+00**
		Exposure Point Total		1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
	Exposure Medium Total			1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Medium Total				1.0E-04	0.0E+00	2.6E-05	1E-04		1.7E+00	0.0E+00	2.0E-01	2E+00
Air	Ambient Air	Site	Benzene	--	1.7E-06	--	2E-06	Blood; immune system	--	2.1E-02	--	2E-02
			Chemical Total	**0.0E+00**	**1.7E-06**	**0.0E+00**	**2E-06**		**0.0E+00**	**1.7E-01**	**0.0E+00**	**2E-01**
		Exposure Point Total		0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
	Exposure Medium Total			0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Medium Total				0.0E+00	1.7E-06	0.0E+00	2E-06		0.0E+00	1.7E-01	0.0E+00	2E-01
Groundwater	Potable Groundwater	Groups 3-6	1,4-Dichlorobenzene	1.3E-06	--	6.9E-07	2E-06	None observed	3.0E-03	3.9E-03	1.5E-03	8E-03
			2-Methylphenol	--	--	--	--	Whole body; nervous system	1.7E+00	4.2E-02	1.5E-01	2E+00
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	3.5E+00	7.3E-01	2.6E-01	4E+00
			Aroclor 1254	7.9E-06	--	0.0E+00	8E-06	Eyes; immune system	5.0E+00	--	0.0E+00	5E+00
			Alpha-BHC	4.9E-06	--	1.2E-06	6E-06	--	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	1.4E-04	1.3E-07	1.7E-04	3E-04	Liver	2.5E+00	2.9E-03	2.8E+00	5E+00
			Naphthalene	--	--	--	--	Whole body	4.6E-02	2.9E+00	2.3E-02	3E+00
			Phenol	--	--	--	--	Development/Fetus	2.6E+00	1.2E-01	1.8E-01	3E+00
			1,1,2-Trichloroethane	6.5E-06	2.8E-05	5.0E-07	3E-05	Blood	1.4E-01	4.4E-01	1.0E-02	6E-01
			1,1-Dichloroethane	--	--	--	--	Nervous system	1.5E+00	8.4E+00	8.7E-02	1E+01
			1,2-Dichloroethane	6.6E-05	3.3E-04	2.7E-06	4E-04	Kidney	1.8E-02	1.9E-02	6.7E-04	4E-02
			1,2-Dichloroethene	--	--	--	--	Liver	1.2E+00	2.6E+00	7.9E-02	4E+00
			1,2-Dichloropropane	4.0E-06	--	3.3E-07	4E-06	--	--	9.7E-01	--	1E+00
			1,4-Dioxane	5.4E-04	2.1E-04	1.6E-06	8E-04	Liver	2.5E+00	3.3E-02	6.6E-03	3E+00

TABLE 3-37D

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Potable Groundwater	Groups 3-6	2-Butanone	--	--	--	--	Whole body	1.1E+01	2.8E+00	8.6E-02	1E+01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.0E+02	3.2E+01	6.9E+00	2E+02
			Acetone	--	--	--	--	Kidney	6.7E+00	6.2E+00	4.9E-02	1E+01
			Acrylonitrile	1.2E-02	1.3E-02	9.8E-05	2E-02	Reproductive	1.1E+02	1.9E+02	8.3E-01	3E+02
			Benzene	4.1E-05	1.2E-04	5.1E-06	2E-04	Blood; immune system	9.3E-01	1.9E+00	1.1E-01	3E+00
			Carbon tetrachloride	1.1E-04	2.2E-04	2.4E-05	4E-04	Liver	6.2E+00	2.2E+01	1.2E+00	3E+01
			Chloroform	2.9E-06	3.9E-05	2.2E-07	4E-05	Liver	4.7E-02	2.0E-02	3.2E-03	7E-02
			cis-1,2-Dichloroethene	--	--	--	--	Blood	1.8E+00	4.3E+00	1.2E-01	6E+00
			Ethylbenzene	--	--	--	--	Liver; kidney	7.0E+00	9.7E+00	3.1E+00	2E+01
			Ethyl methacrylate	--	--	--	--	Kidney	3.7E+00	1.1E+01	4.7E-01	2E+01
			Methylene Chloride	2.7E-04	3.4E-04	8.3E-06	6E-04	Liver	3.0E+00	8.6E-01	8.5E-02	4E+00
			n-Propylbenzene	--	--	--	--	--	--	1.8E+00	--	2E+00
			Tetrachloroethene	5.3E-05	9.7E-06	2.6E-05	9E-05	Liver	5.0E-02	1.7E-01	2.2E-02	2E-01
			Tetrahydrofuran	--	--	--	--	--	--	8.8E+01	--	9E+01
			Toluene	--	--	--	--	Kidney	8.1E+01	1.9E+01	2.1E+01	1E+02
			Trichloroethene	3.9E-05	3.6E-06	5.6E-06	5E-05	--	--	1.1E-02	--	1E-02
			Vinyl chloride	1.7E-03	2.4E-04	7.4E-05	2E-03	Liver	2.0E+00	1.0E+00	7.6E-02	3E+00
			Xylenes (total)	--	--	--	--	Whole body	1.2E+01	3.2E+02	7.5E+00	3E+02
			Antimony	--	--	--	--	Blood; whole body	2.1E+01	--	7.0E-01	2E+01
			Arsenic	5.7E-02	--	2.4E-04	6E-02	Skin; cardiovascular system	6.4E+02	--	3.3E+00	6E+02
			Beryllium	--	--	--	--	Intestines	2.3E+01	--	1.7E+01	4E+01
			Cadmium	--	--	--	--	--	1.0E+01	--	1.0E+00	1E+01
			Chromium	--	--	--	--	None observed	5.0E+00	--	1.0E+00	6E+00
			Manganese	--	--	--	--	--	5.2E+01	--	6.5E+00	6E+01
			Silver	--	--	--	--	Skin	1.3E+01	--	1.0E+00	1E+01
			Thallium	--	--	--	--	Blood	5.0E+00	--	2.5E-02	5E+00
			Zinc	--	--	--	--	Blood	1.5E+01	--	4.6E-02	2E+01
			Chemical Total	**7.2E-02**	**1.4E-02**	**6.6E-04**	**9E-02**		**1.2E+03**	**7.3E+02**	**7.6E+01**	**2E+03**
		Exposure Point Total		7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
	Exposure Medium Total			7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Medium Total				7.2E-02	1.4E-02	6.6E-04	9E-02		1.2E+03	7.3E+02	7.6E+01	2E+03
Receptor Total							**9E-02**				**Receptor HI Total**	**2E+03**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-37E

FINAL RISK SUMMARY

CENTRAL TENDENCY

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 1/2 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 1 & 2	1,4-Dichlorobenzene	1.3E-06	--	7.5E-07	2E-06	None observed	5.5E-03	2.9E-03	2.9E-03	1E-02
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	8.9E+00	3.5E+00	7.0E-01	1E+01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	9.8E+00	3.8E+00	7.7E-01	1E+01
			Naphthalene	--	--	--	--	Whole body	5.4E-01	1.4E+01	2.8E-01	1E+01
			N-Nitrosodi-n-butylamine	2.8E-05	3.0E-04	1.6E-06	3E-04	--	--	--	--	--
			N-Nitrosopyrrolidine	9.9E-05	5.1E-07	5.6E-07	1E-04	--	--	--	--	--
			o-Toluidine	3.7E-06	--	1.2E-07	4E-06	--	--	--	--	--
			Pyridine	--	--	--	--	Liver	1.9E+00	8.9E-01	5.1E-02	3E+00
			1,2-Dichloroethane	3.1E-06	1.8E-06	1.3E-07	5E-06	Kidney	1.5E-03	6.3E-04	6.0E-05	2E-03
			cis-1,2-Dichloroethene	--	--	--	--	Blood	2.0E+00	1.9E+00	1.4E-01	4E+00
			1,4-Dioxane	4.4E-05	2.1E-06	1.4E-07	5E-05	Liver	3.7E-01	2.0E-03	1.1E-03	4E-01
			2-Butanone	--	--	--	--	Whole body	2.0E+00	2.1E-01	1.7E-02	2E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	7.3E+00	4.8E-01	2.7E-01	8E+00
			Benzene	1.0E-05	3.8E-06	1.4E-06	2E-05	Blood; immune system	4.3E-01	3.5E-01	5.1E-02	8E-01
			Ethylbenzene	--	--	--	--	Liver; kidney	8.9E-01	5.0E-01	4.3E-01	2E+00
			Methylene Chloride	7.8E-05	1.2E-05	2.6E-06	9E-05	Liver	1.6E+00	1.8E-01	4.7E-02	2E+00
			n-Propylbenzene	--	--	--	--	--	--	5.0E+00	--	5E+00
			Tetrachloroethene	4.5E-05	9.8E-07	2.3E-05	7E-05	Liver	7.6E-02	1.0E-01	3.6E-02	2E-01
			Tetrahydrofuran	--	--	--	--	--	--	4.4E+01	--	4E+01
			Toluene	--	--	--	--	Kidney	1.2E+01	1.1E+00	3.2E+00	2E+01
			Trichloroethene	1.5E-04	1.6E-06	2.2E-05	2E-04	--	--	2.9E-02	--	3E-02
			Vinyl chloride	2.6E-04	4.3E-06	1.2E-05	3E-04	Liver	5.2E-01	1.1E-01	2.1E-02	7E-01
			Arsenic	1.5E-02	--	5.0E-05	1E-02	Skin; cardiovascular system	3.0E+02	--	9.3E-01	3E+02
			Cadmium	--	--	--	--	--	3.2E+01	--	2.0E+00	3E+01
			Manganese	--	--	--	--	--	1.9E+01	--	1.5E+00	2E+01
			Thallium	--				Blood	2.6E+00	--	8.2E-03	3E+00
			Chemical Total	**1.5E-02**	**3.3E-04**	**1.2E-04**	**2E-02**		**4.1E+02**	**8.0E+01**	**1.1E+01**	**5E+02**
		Exposure Peint Total		1.5E-02	3.3E-04	1.2E-04	2E-02		4.1E+02	8.0E+01	1.1E+01	5E+02
	Exposure Medium Total			1.5E-02	3.3E-04	1.2E-04	2E-02		4.1E+02	8.0E+01	1.1E+01	5E+02
Medium Total				1.5E-02	3.3E-04	1.2E-04	2E-02		4.1E+02	8.0E+01	1.1E+01	5E+02
Receptor Total							**2E-02**				**Receptor HI Total**	**5E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-37F

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 1/2 Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Potable Groundwater	Groups 1 & 2	1,4-Dichlorobenzene	4.3E-06	--	2.4E-06	7E-06	None observed	1.0E-02	1.3E-02	5.0E-03	3E-02
			3-Methylphenol/4-Methylphenol	--	--	--	--	Whole body; nervous system	1.7E+01	3.5E+00	9.3E-01	2E+01
			4-Methylphenol	--	--	--	--	Whole body; nervous system	1.8E+01	3.8E+00	1.0E+00	2E+01
			Naphthalene	--	--	--	--	Whole body	1.0E+00	6.3E+01	3.7E-01	6E+01
			N-Nitrosodi-n-butylamine	9.6E-05	3.0E-04	5.1E-06	4E-04	--	--	--	--	--
			N-Nitrosopyrrolidine	3.3E-04	5.1E-07	1.8E-06	3E-04	--	--	--	--	--
			o-Toluidine	1.2E-05	--	3.7E-07	1E-05	--	--	--	--	--
			Pyridine	--	--	--	--	Liver	3.5E+00	8.9E-01	6.8E-02	4E+00
			1,2-Dichloroethane	1.0E-05	5.1E-05	4.1E-07	6E-05	Kidney	2.9E-03	2.9E-03	7.9E-05	6E-03
			1,2-Dichloroethene	--	--	--	--	Liver	1.4E+00	3.0E+00	6.9E-02	4E+00
			cis-1,2-Dichloroethene	--	--	--	--	Blood	3.7E+00	8.7E+00	1.9E-01	1E+01
			1,2-Dichloropropane	3.8E-06	--	3.1E-07	4E-06	--	--	9.2E-01	--	9E-01
			1,4-Dioxane	1.5E-04	5.8E-05	4.4E-07	2E-04	Liver	6.9E-01	9.0E-03	1.4E-03	7E-01
			2-Butanone	--	--	--	--	Whole body	3.7E+00	9.7E-01	2.3E-02	5E+00
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.4E+01	2.2E+00	3.6E-01	2E+01
			Acetone	--	--	--	--	Kidney	1.9E+00	1.8E+00	1.1E-02	4E+00
			Benzene	3.4E-05	1.1E-04	4.3E-06	1E-04	Blood; immune system	7.9E-01	1.6E+00	6.8E-02	2E+00
			Chloroform	8.6E-07	1.2E-05	6.4E-08	1E-05	Liver	1.4E-02	6.1E-03	7.3E-04	2E-02
			Ethylbenzene	--	--	--	--	Liver; kidney	1.7E+00	2.3E+00	5.6E-01	5E+00
			Methylene Chloride	2.6E-04	3.3E-04	8.1E-06	6E-04	Liver	3.0E+00	8.4E-01	6.3E-02	4E+00
			n-Propylbenzene	--	--	--	--	--	--	5.0E+00	--	5E+00
			Tetrachloroethene	1.5E-04	2.7E-05	7.3E-05	3E-04	Liver	1.4E-01	4.8E-01	4.8E-02	7E-01
			Tetrahydrofuran	--	--	--	--	--	--	4.4E+01	--	4E+01
			Toluene	--	--	--	--	Kidney	2.2E+01	5.1E+00	4.3E+00	3E+01
			Trichloroethene	5.0E-04	4.5E-05	7.1E-05	6E-04	--	--	1.4E-01	--	1E-01
			Vinyl chloride	8.6E-04	1.2E-04	3.7E-05	1E-03	Liver	9.7E-01	4.9E-01	2.8E-02	1E+00
			Xylenes (total)	--	--	--	--	Whole body	2.0E-01	5.6E+00	9.9E-02	6E+00
			Arsenic	4.9E-02	--	2.1E-04	5E-02	Skin; cardiovascular system	5.5E+02	--	1.6E+00	6E+02
			Beryllium	--	--	--	--	Intestines	1.2E+00	--	5.2E-01	2E+00
			Cadmium	--	--	--	--	--	6.0E+01	--	3.5E+00	6E+01
			Manganese	--	--	--	--	--	3.6E+01	--	2.6E+00	4E+01
			Thallium	--	--	--	--	Blood	4.9E+00	--	1.4E-02	5E+00
			Chemical Total	**5.2E-02**	**1.0E-03**	**4.1E-04**	**5E-02**		**7.5E+02**	**1.6E+02**	**1.7E+01**	**9E+02**
		Exposure Point Total		5.2E-02	1.0E-03	4.1E-04	5E-02		7.5E+02	1.6E+02	1.7E+01	9E+02
	Exposure Medium Total			5.2E-02	1.0E-03	4.1E-04	5E-02		7.5E+02	1.6E+02	1.7E+01	9E+02
Medium Total				5.2E-02	1.0E-03	4.1E-04	5E-02		7.5E+02	1.6E+02	1.7E+01	9E+02
Receptor Total							**5E-02**				**Receptor HI Total**	**9E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-38A

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10')	Group 3, Upland	Tetrachloroethene	4.E-07	1.E-06	0.E+00	2.E-06	Liver	8.E-04	7.E-02	0.E+00	7.E-02
			Chemical Total	**2.E-06**	**1.E-06**	**1.E-06**	**4.E-06**		**5.E-02**	**4.E-01**	**5.E-02**	**5.E-01**
		Exposure Point Total		2.E-06	1.E-06	1.E-06	4.E-06		5.E-02	4.E-01	5.E-02	5.E-01
	Exposure Medium Total			2.E-06	1.E-06	1.E-06	4.E-06		5.E-02	4.E-01	5.E-02	5.E-01
Medium Total				2.E-06	1.E-06	1.E-06	4.E-06		5.E-02	4.E-01	5.E-02	5.E-01
Air	Indoor Air	Group 3	Acrylonitrile	--	5.E-06	--	5.E-06	Respiratory system	--	2.E-01	--	2.E-01
			Xylenes (total)	--	--	--	--	Nervous system	--	5.E+00	--	5.E+00
			Chemical Total	**0.E+00**	**6.E-06**	**0.E+00**	**6.E-06**		**0.E+00**	**6.E+00**	**0.E+00**	**6.E+00**
		Exposure Point Total		0.E+00	6.E-06	0.E+00	6.E-06		0.E+00	6.E+00	0.E+00	6.E+00
	Exposure Medium Total			0.E+00	6.E-06	0.E+00	6.E-06		0.E+00	6.E+00	0.E+00	6.E+00
Medium Total				0.E+00	6.E-06	0.E+00	6.E-06		0.E+00	6.E+00	0.E+00	6.E+00
Groundwater	Potable Groundwater	Groups 3-6	Bis(2-Ethylhexyl)phthalate	5.E-06	--	1.E-06	6.E-06	Liver	2.E-01	--	5.E-02	2.E-01
			1,2-Dichloroethane	2.E-06	--	2.E-08	2.E-06	Kidney	1.E-03	--	1.E-05	1.E-03
			1,4-Dioxane	2.E-05	--	1.E-08	2.E-05	Liver	2.E-01	--	1.E-04	2.E-01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.E+01	--	1.E-01	1.E+01
			Acrylonitrile	4.E-04	--	8.E-07	4.E-04	Reproductive	8.E+00	--	1.E-02	8.E+00
			Carbon tetrachloride	4.E-06	--	2.E-07	4.E-06	Liver	4.E-01	--	2.E-02	5.E-01
			Methylene Chloride	9.E-06	--	6.E-08	9.E-06	Liver	2.E-01	--	2.E-03	2.E-01
			Tetrachloroethene	2.E-06	--	2.E-07	2.E-06	Liver	4.E-03	--	4.E-04	4.E-03
			Toluene	--	--	--	--	Kidney	6.E+00	--	4.E-01	6.E+00
			Vinyl chloride	3.E-05	--	3.E-07	3.E-05	Liver	1.E-01	--	1.E-03	1.E-01
			Antimony	--	--	--	--	Blood; whole body	2.E+00	--	7.E-04	2.E+00
			Arsenic	2.E-03	--	1.E-07	2.E-03	Skin; cardiovascular system	5.E+01	--	3.E-03	5.E+01
			Beryllium	--	--	--	--	Intestines	2.E+00	--	2.E-02	2.E+00
			Manganese	--	--	--	--	--	4.E+00	--	6.E-03	4.E+00
			Chemical Total	2.E-03	0.E+00	3.E-06	2.E-03		9.E+01	0.E+00	8.E-01	9.E+01
		Exposure Point Total		2.E-03	0.E+00	3.E-06	2.E-03		9.E+01	0.E+00	8.E-01	9.E+01
	Exposure Medium Total			2.E-03	0.E+00	3.E-06	2.E-03		9.E+01	0.E+00	8.E-01	9.E+01
Medium Total				2.E-03	0.E+00	3.E-06	2.E-03		9.E+01	0.E+00	8.E-01	9.E+01
Receptor Total							**2.E-03**				**Receptor HI Total**	**1.E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-38B

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 3 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 3, Upland	Benzo(a)pyrene	1.7E-06	4.4E-11	1.4E-06	3E-06	--	--	--	--	--
			Bis(2-ethylhexyl)phthalate	4.4E-06	1.3E-10	2.9E-06	7E-06	Liver	4.4E-02	2.2E-06	2.9E-02	7E-02
			Tetrachloroethene	3.1E-06	4.9E-06	0.0E+00	8E-06	Liver	1.6E-03	6.6E-02	0.0E+00	7E-02
			Arsenic	1.9E-06	9.1E-10	3.7E-07	2E-06	Skin; cardiovascular system	1.2E-02	2.0E-05	2.3E-03	1E-02
			Chemical Total	**1.1E-05**	**4.9E-06**	**5.1E-06**	**2E-05**		**9.5E-02**	**4.1E-01**	**5.0E-02**	**6E-01**
		Exposure Point Total		1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01
	Exposure Medium Total			1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01
Medium Total				1.1E-05	4.9E-06	5.1E-06	2E-05		9.5E-02	4.1E-01	5.0E-02	6E-01
Air	Indoor Air	Group 3	Acrylonitrile	--	2.0E-05	--	2E-05	Respiratory system	--	2.3E-01	--	2E-01
			Methylene Chloride	--	4.0E-06	--	4E-06	Liver	--	8.0E-03	--	8E-03
			Xylenes (total)	--	--	--	--	Nervous system	--	5.8E+00	--	6E+00
			Chemical Total	**0.0E+00**	**2.4E-05**	**0.0E+00**	**2E-05**		**0.0E+00**	**6.8E+00**	**0.0E+00**	**7E+00**
		Exposure Point Total		0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00
	Exposure Medium Total			0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00
Medium Total				0.0E+00	2.4E-05	0.0E+00	2E-05		0.0E+00	6.8E+00	0.0E+00	7E+00
Groundwater	Potable Groundwater	Groups 3-6	Aroclor 1254	1.9E-06	--	0.0E+00	2E-06	Eyes; immune system	6.8E-01	--	0.0E+00	7E-01
			Bis(2-Ethylhexyl)phthalate	3.4E-05	--	1.6E-05	5E-05	Liver	3.4E-01	--	1.6E-01	5E-01
			1,1,2-Trichloroethane	1.6E-06	--	4.7E-08	2E-06	Blood	1.9E-02	--	5.7E-04	2E-02
			1,2-Dichloroethane	1.6E-05	--	2.5E-07	2E-05	Kidney	2.5E-03	--	3.9E-05	3E-03
			1,4-Dioxane	1.3E-04	--	1.5E-07	1E-04	Liver	3.4E-01	--	3.8E-04	3E-01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.7E+01	--	3.9E-01	3E+01
			Acrylonitrile	2.8E-03	--	9.2E-06	3E-03	Reproductive	1.5E+01	--	4.8E-02	1E+01
			Benzene	9.9E-06	--	4.8E-07	1E-05	Blood; immune system	1.3E-01	--	6.1E-03	1E-01
			Carbon tetrachloride	2.7E-05	--	2.3E-06	3E-05	Liver	8.4E-01	--	7.0E-02	9E-01
			Methylene Chloride	6.6E-05	--	7.8E-07	7E-05	Liver	4.1E-01	--	4.9E-03	4E-01
			Tetrachloroethene	1.3E-05	--	2.4E-06	2E-05	Liver	6.8E-03	--	1.3E-03	8E-03
			Toluene	--	--	--	--	Kidney	1.1E+01	--	1.2E+00	1E+01
			Trichloroethene	9.6E-06	--	5.2E-07	1E-05	--	--	--	--	--
			Vinyl chloride	2.1E-04	--	3.4E-06	2E-04	Liver	2.7E-01	--	4.4E-03	3E-01
			Xylenes (total)	--	--	--	--	Whole body	1.6E+00	--	4.3E-01	2E+00
			Antimony	--	--	--	--	Blood; whole body	2.8E+00	--	3.0E-03	3E+00
			Arsenic	1.4E-02	--	2.2E-06	1E-02	Skin; cardiovascular system	8.7E+01	--	1.4E-02	9E+01
			Beryllium	--	--	--	--	Intestines	3.2E+00	--	7.2E-02	3E+00
			Manganese	--	--	--	--	--	7.0E+00	--	2.8E-02	7E+00
			Silver	--	--	--	--	Skin	1.8E+00	--	4.3E-03	2E+00
			Zinc	--	--	--	--	Blood	2.1E+00	--	2.0E-04	2E+00
			Chemical Total	**1.7E-02**	**0.0E+00**	**3.8E-05**	**2E-02**		**1.7E+02**	**0.0E+00**	**2.7E+00**	**2E+02**
		Exposure Point Total		1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
	Exposure Medium Total			1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
Medium Total				1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
Receptor Total							**2E-02**				**Receptor HI Total**	**2E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-38C

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)anthracene	7.7E-07	3.7E-12	1.3E-06	2E-06	--	--	--	--	--
			Benzo(a)pyrene	4.6E-06	2.4E-10	7.9E-06	1E-05	--	--	--	--	--
			Dibenzo(a,h)anthracene	7.8E-07	1.1E-11	1.3E-06	2E-06	--	--	--	--	--
			Chemical Total	**7.0E-06**	**5.6E-10**	**1.2E-05**	**2E-05**		**1.5E-02**	**2.0E-02**	**1.1E-02**	**5E-02**
		Exposure Point Total		7.0E-06	5.6E-10	1.2E-05	2E-05		1.5E-02	2.0E-02	1.1E-02	5E-02
	Exposure Medium Total			7.0E-06	5.6E-10	1.2E-05	2E-05		1.5E-02	2.0E-02	1.1E-02	5E-02
Medium Total				7.0E-06	5.6E-10	1.2E-05	2E-05		1.5E-02	2.0E-02	1.1E-02	5E-02
Groundwater	Potable Groundwater	Groups 3-6	Bis(2-Ethylhexyl)phthalate	4.8E-06	--	1.3E-06	6E-06	Liver	1.8E-01	--	5.0E-02	2E-01
			1,2-Dichloroethane	2.3E-06	--	2.0E-08	2E-06	Kidney	1.3E-03	--	1.2E-05	1E-03
			1,4-Dioxane	1.9E-05	--	1.2E-08	2E-05	Liver	1.8E-01	--	1.2E-04	2E-01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	1.4E+01	--	1.2E-01	1E+01
			Acrylonitrile	4.0E-04	--	7.6E-07	4E-04	Reproductive	7.8E+00	--	1.5E-02	8E+00
			Carbon tetrachloride	3.8E-06	--	1.9E-07	4E-06	Liver	4.5E-01	--	2.2E-02	5E-01
			Methylene Chloride	9.3E-06	--	6.4E-08	9E-06	Liver	2.2E-01	--	1.5E-03	2E-01
			Tetrachloroethene	1.8E-06	--	2.0E-07	2E-06	Liver	3.6E-03	--	3.9E-04	4E-03
			Toluene	--	--	--	--	Kidney	5.9E+00	--	3.7E-01	6E+00
			Vinyl chloride	2.9E-05	--	2.7E-07	3E-05	Liver	1.4E-01	--	1.3E-03	1E-01
			Antimony	--	--	--	--	Blood; whole body	1.5E+00	--	6.6E-04	2E+00
			Arsenic	2.0E-03	--	1.3E-07	2E-03	Skin; cardiovascular system	4.6E+01	--	3.1E-03	5E+01
			Beryllium	--	--	--	--	Intestines	1.7E+00	--	1.6E-02	2E+00
			Manganese	--	--	--	--	--	3.7E+00	--	6.1E-03	4E+00
			Chemical Total	**2.4E-03**	**0.0E+00**	**3.1E-06**	**2E-03**		**9.0E+01**	**0.0E+00**	**8.4E-01**	**9E+01**
		Exposure Point Total		2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
	Exposure Medium Total			2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
Medium Total				2.4E-03	0.0E+00	3.1E-06	2E-03		9.0E+01	0.0E+00	8.4E-01	9E+01
Receptor Total							**2E-03**				**Receptor HI Total**	**9E+01**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-38D

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future
Receptor Population: Area 4 Facility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)anthracene	5.8E-06	1.4E-11	5.0E-06	1E-05	--	--	--	--	--
			Benzo(a)pyrene	3.5E-05	9.0E-10	3.0E-05	6E-05	--	--	--	--	--
			Benzo(b)fluoranthene	2.5E-06	7.5E-12	2.1E-06	5E-06	--	--	--	--	--
			Dibenzo(a,h)anthracene	5.9E-06	4.0E-11	5.1E-06	1E-05	--	--	--	--	--
			Indeno(1,2,3-cd)Pyrene	1.3E-06	3.4E-11	1.1E-06	2E-06	--	--	--	--	--
			Arsenic	2.2E-06	1.1E-09	4.4E-07	3E-06	Skin; cardiovascular system	1.4E-02	2.4E-05	2.8E-03	2E-02
			Chemical Total	**5.3E-05**	**2.1E-09**	**4.4E-05**	**1E-04**		**2.9E-02**	**2.0E-02**	**1.1E-02**	**6E-02**
		Exposure Point Total		5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
	Exposure Medium Total			5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
Medium Total				5.3E-05	2.1E-09	4.4E-05	1E-04		2.9E-02	2.0E-02	1.1E-02	6E-02
Groundwater	Potable Groundwater	Groups 3-6	Aroclor 1254	1.9E-06	--	0.0E+00	2E-06	Eyes; immune system	6.8E-01	--	0.0E+00	7E-01
			Bis(2-Ethylhexyl)phthalate	3.4E-05	--	1.6E-05	5E-05	Liver	3.4E-01	--	1.6E-01	5E-01
			1,1,2-Trichloroethane	1.6E-06	--	4.7E-08	2E-06	Blood	1.9E-02	--	5.7E-04	2E-02
			1,2-Dichloroethane	1.6E-05	--	2.5E-07	2E-05	Kidney	2.5E-03	--	3.9E-05	3E-03
			1,4-Dioxane	1.3E-04	--	1.5E-07	1E-04	Liver	3.4E-01	--	3.8E-04	3E-01
			4-Methyl-2-pentanone	--	--	--	--	Whole body	2.7E+01	--	3.9E-01	3E+01
			Acrylonitrile	2.8E-03	--	9.2E-06	3E-03	Reproductive	1.5E+01	--	4.8E-02	1E+01
			Benzene	9.9E-06	--	4.8E-07	1E-05	Blood; immune system	1.3E-01	--	6.1E-03	1E-01
			Carbon tetrachloride	2.7E-05	--	2.3E-06	3E-05	Liver	8.4E-01	--	7.0E-02	9E-01
			Methylene Chloride	6.6E-05	--	7.8E-07	7E-05	Liver	4.1E-01	--	4.9E-03	4E-01
			Tetrachloroethene	1.3E-05	--	2.4E-06	2E-05	Liver	6.8E-03	--	1.3E-03	8E-03
			Toluene	--	--	--	--	Kidney	1.1E+01	--	1.2E+00	1E+01
			Trichloroethene	9.6E-06	--	5.2E-07	1E-05	--	--	--	--	--
			Vinyl chloride	2.1E-04	--	3.4E-06	2E-04	Liver	2.7E-01	--	4.4E-03	3E-01
			Xylenes (total)	--	--	--	--	Whole body	1.6E+00	--	4.3E-01	2E+00
			Antimony	--	--	--	--	Blood; whole body	2.8E+00	--	3.0E-03	3E+00
			Arsenic	1.4E-02	--	2.2E-06	1E-02	Skin; cardiovascular system	8.7E+01	--	1.4E-02	9E+01
			Beryllium	--	--	--	--	Intestines	3.2E+00	--	7.2E-02	3E+00
			Manganese	--	--	--	--	--	7.0E+00	--	2.8E-02	7E+00
			Silver	--	--	--	--	Skin	1.8E+00	--	4.3E-03	2E+00
			Zinc	--	--	--	--	Blood	2.1E+00	--	2.0E-04	2E+00
			Chemical Total	**1.7E-02**	**0.0E+00**	**3.8E-05**	**2E-02**		**1.7E+02**	**0.0E+00**	**2.7E+00**	**2E+02**
		Exposure Point Total		1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
	Exposure Medium Total			1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
Medium Total				1.7E-02	0.0E+00	3.8E-05	2E-02		1.7E+02	0.0E+00	2.7E+00	2E+02
Receptor Total							**2E-02**				**Receptor HI Total**	**2E+02**

Shaded = Concentrations of contaminant are consistent with reference concentrations.

TABLE 3-39A

FINAL RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future

Receptor Population: Area 4 Construction Worker

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Upland Soil	Group 4, Upland	Benzo(a)pyrene	1.2E-06	3.1E-11	1.2E-06	2E-06	--	--	--	--	--
Medium Total				1.8E-06	8.7E-11	1.7E-06	4E-06		2.5E-02	1.7E-02	1.1E-02	5E-02
Receptor Total							**4E-06**				**Receptor HI Total**	**6E-02**

TABLE 3-39B

FINAL RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

Remedial Investigation and Feasibility Study

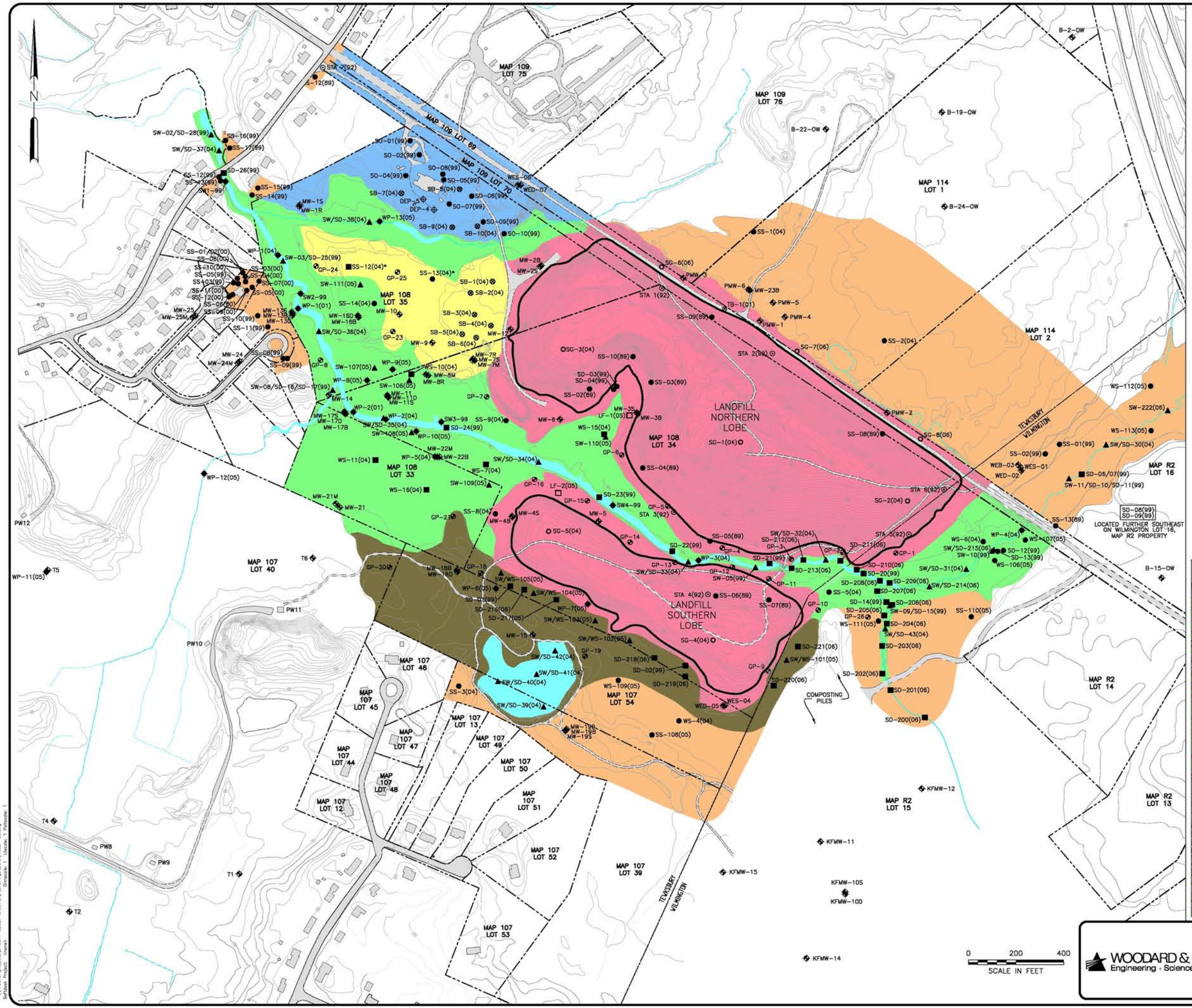
Sutton Brook Disposal Area Superfund Site-Tewksbury, Massachusetts

Scenario Timeframe: Future

Receptor Population: Area 4 Construction Worker

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Upland Soil (0-10' bgs)	Group 4, Upland	Benzo(a)pyrene	4.0E-06	3.1E-11	1.2E-06	5E-06	--	--	--	--	--
Medium Total				6.1E-06	8.7E-11	1.7E-06	8E-06		8.8E-02	1.7E-02	1.1E-02	1E-01
Receptor Total							**8E-06**				**Receptor HI Total**	**1E-01**



LEGEND

- MW-6 — MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)
- DEP-4 — MICROWELL LOCATION INSTALLED BY MA DEP (1999)
- WP-6 — STREAM PIEZOMETER LOCATION AND IDENTIFIER (1999, 2001, 2004, 2005)
- GP-1 — TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)
- SG-1 — LANDFILL GAS LOCATION AND IDENTIFIER (W&C 2004, 2006)
- SS-1 — SOIL SAMPLING LOCATION (NUS/FIT – OCT. 1989) (START – 1999) (WESTON – 2000) (WESTON – 2000 CONFIRMATORY POST-EXCAVATION LOCATIONS SENT TO LAB – DRUM DISPOSAL AREA) (W&C 2004)
- SW/SD-33 — SURFACE WATER AND SEDIMENT SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)
- SB-1 — SOIL BORING LOCATION (HEA – 2001) (W&C 2004)
- STA-7 — AMBIENT AIR SAMPLING LOCATION (US EPA – AUGUST 1992)
- SD-23 — SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)
- LF-1 — LEACHATE SAMPLING LOCATION AND IDENTIFIER (W&C 2005)

(99) – INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS, REFER TO TABLE 5-5)

- INTERPRETIVE LIMITS OF SOLID WASTE
- APPROXIMATE LOCATION OF PROPERTY LINES
- PAVED ROAD
- UNPAVED ROAD
- WATER
- DRIVEWAY
- FENCE
- BUILDING
- GROUP 1 NORTHERN LANDFILL LOBE AND GROUP 2 SOUTHERN LANDFILL LOBE
- GROUP 3 – FORMER DRUM DISPOSAL AREA AND ADJACENT DISTURBED AREA
- GROUP 4 – FORMER RESIDENCE, GARAGE, AND STORAGE AREA
- GROUP 5 – SUTTON BROOK AND ASSOCIATED TRIBUTARIES AND WETLAND AREAS
- GROUP 6 – AREA SOUTH OF SOUTHERN LOBE
- GROUP 7 – REFERENCE LOCATIONS

NOTE:

* SAMPLES SS-12(04) AND SS-13(04) WERE COLLECTED FROM A WETLAND MEDIUM (WETLAND SOIL OR SEDIMENT) AND THUS WERE CONSIDERED AS PART OF GROUP 5 IN THE HHRA.

ADDITIONAL REFERENCE LOCATIONS

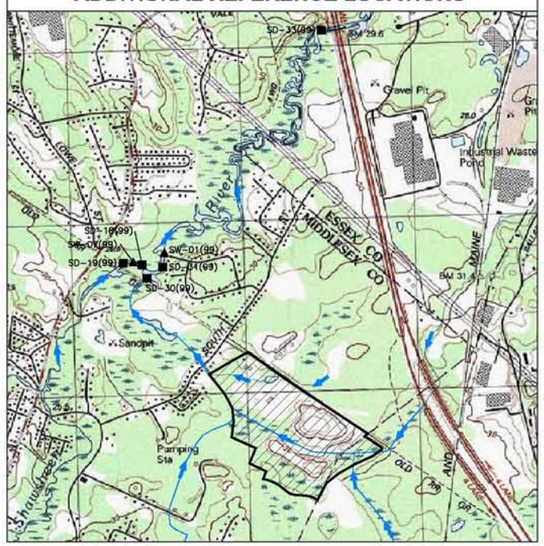


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FIGURE 3-1

HUMAN HEALTH RISK ASSESSMENT DATA GROUPS

SUTTON BROOK DISPOSAL AREA

4. BASELINE ECOLOGICAL RISK ASSESSMENT

This section presents the methodology and results of the Baseline Ecological Risk Assessment conducted at the Sutton Brook Disposal Area Superfund Site in Tewksbury, Massachusetts. This assessment uses data collected during the RI to evaluate the potential for adverse effects to biota as the result of exposure to site-related constituents in soil, surface water, and sediment.

4.1 INTRODUCTION

The following sections provide a brief background to the ecological risk assessment conducted at the Site and an outline of the section's organization. As indicated in the Workplan, activities associated with the RI, risk assessment, and FS were developed and implemented with the presumption that the existing waste material in the two landfill lobes will be closed in-place using current landfill capping technology. This allowed the RI/FS to focus on areas of potential impact outside of the landfill footprint. Additional soil characterization sampling within the landfill lobes for risk characterization was not performed; samples for physical characteristics of the cover material and from adjacent groundwater, surface water, and sediments were collected and included in the RI and risk characterizations. The conclusions of the risk characterizations are thus predicated on this presumption with regard to the landfill lobes.

4.1.1 Background

On May 4, 2006, a Draft Screening-Level Ecological Risk Assessment (SLERA) was prepared and submitted to the U.S. Environmental Protection Agency (EPA). The Draft SLERA evaluated five distinct habitat areas through the use of generic benchmarks and toxicity values. The SLERA was completed in accord with EPA, 1997 *Ecological Risk Assessment for Superfund*, and had as the primary objective the identification of exposure pathways and compounds that present a potential risk of adverse effects to ecological receptors. EPA provided comments on the SLERA on June 6, 2006 and August 22, 2006, and these comments were incorporated into the present document. The revised SLERA, incorporating EPA comments, is provided in Appendix O of this Baseline Risk Assessment.

In accord with EPA guidance, the SLERA approach compared maximum concentrations of identified contaminants of potential concern (COPCs) to generic no-effect or threshold-effect benchmarks to identify compounds that have a potential for adverse effect. The results of the SLERA identified compounds exceeding benchmarks in each of the five habitat areas, indicating that further evaluation of these COPCs was warranted.

This Baseline Ecological Risk Assessment (BERA) consists of the further evaluation of the pathways and COPCs identified in the SLERA. In this document, the conservative assumptions used in the SLERA are reviewed and, where appropriate, replaced by site-specific values to obtain a more accurate understanding of the ecological risks at the site. In addition, the results of additional sampling and site-specific toxicity tests are included to more accurately assess the potential for exposure and effect in selected portions of the Site. The goal of this assessment is to identify COPCs that present a potential risk to ecological receptors, and, for each of these COPCs, to describe the upper and lower bounds of the threshold of effects.

Some of the analysis contained in this report was presented previously as part of a "Preliminary Refinement" submitted as a separate, interim deliverable to EPA on September 19, 2006. The Preliminary Refinement was conducted to aid in identifying additional sampling or field analysis necessary to complete the BERA. EPA provided comments on this document on October 5, 2006. Following these comments and subsequent discussions, additional sampling was conducted in November

2006 and these data incorporated into this BERA.

On March 8, 2007, a draft Baseline Risk Assessment consisting of the human health risk assessment (HHRA) and the BERA was submitted to the EPA and MassDEP. This document reflected the comments on the previous interim deliverables and incorporated the results of all sampling conducted as part of the RI. Following submittal of this document, comments and discussions on the submittal were conducted with EPA in April and May 2007.

This BERA reflects the comments made by EPA and other reviewers on the previous deliverables and exists as part of the larger Remedial Investigation (RI) and Feasibility Study (FS) prepared for the site. Section 2 of this Baseline Risk Assessment provides a summary of the RI findings and Section 5 of the RI report provides a complete description of the nature and extent of site contamination in soil, surface water, groundwater and sediment. That extensive discussion provides the basis for the structure and evaluations presented in subsequent sections of this BERA.

Data usability was extensively discussed in Section 3 of the previously referenced RI report. This BERA considered the data set established for the RI, which excluded some historical data provided without laboratory reports, screening data, and data rejected via data validation methods. It should be noted that this assessment includes one exception to the general exclusion of data qualified as rejected ('R'-flagged). R-flagged data for non-detected compounds from select sediment samples with low percent moisture were retained in this evaluation as described below.

EPA Region I Functional Guidelines (1996) governing data validation defines sediment by the same criteria used to define soils, which is containing greater than 30% solids. As part of an aquatic system, many shallow sediments from quiescent water bodies do not meet this soils-based definition. As a result, and in accordance with the EPA 1996 guideline, all detected compound results were flagged as estimated (J) and non-detected compound results (e.g., reporting limits) are flagged as rejected (R). Samples typically contained about 15% solid material, which is typical for wetlands and slow-moving streams. In consequence, the sediment samples contain a high percentage of moisture, which cannot be removed in the field by conventional techniques. It was agreed to stay with the current sampling methods of extensive decanting in the field and collecting extra volume to compensate for the low percent solids.

With the addition of six samples collected in 2006, the Deep Marsh aquatic wetland is represented by 13 sediment samples, which provides adequate coverage of sample variability. Based on the total solids results detected in these sediment samples over the three separate sampling events and the use of decanting the free liquids along with collecting extra volume, the non-detected R-flagged data are considered to be representative of non-detected compounds at the reporting limits, with the understanding that these values are estimates. This is the same approach used for J-flagged data, which is used throughout the risk assessment. The non-detected values that were included in the risk assessment calculations at ½ their reported values typically had elevated detection limits. This approach, which provides qualified information, was considered preferable to eliminating the non-detected results entirely.

4.1.2 BERA Organization

As described above, this section represents a refinement of the assessment conducted in the SLERA, and uses for the most part similar tools and approaches. These tools and approaches (such as benchmark hierarchies and food chain modeling methodologies) were described in previous documentation, and appropriate sections of the SLERA are thus referenced where appropriate. For convenience and continuity, however, some sections of the SLERA (such as habitat descriptions) are reproduced or included as an appendix to this document, as an aid to understanding the BERA assumptions and results. A copy of the SLERA is provided in Appendix O.

As described in the SLERA, the Site includes a range of aquatic and terrestrial habitats that reflect the diverse hydrological and topographical characteristics of the site. For analysis, regions of ecological similarity were grouped into Habitat Areas, which are distinct habitats that may have similar area-specific receptors and exposure pathways. These five Habitat Areas evaluated in the SLERA and in this BERA are as follows, and are depicted in Figure 4-1:

1. Upper Sutton Brook (Site channel, Eastern reach, Southern tributary)
2. Aquatic Wetlands
3. Site Pond
4. Wetland Soils
5. Upland Soils

Also depicted on Figure 4-1 is the landfill area, which as described previously has not been included in this BERA. Given that it has been assumed that the landfill lobes will be capped, the risk assessment, consistent with the RI/FS, has focused on areas of potential impact adjacent to/outside the landfill footprint, because it is presumed that the existing waste material (identified through test pits, borings and well installation) will be closed in-place using current landfill capping technology. We also assumed an approximate 50 foot perimeter around the extent of waste limit and other adjacent areas of debris, which represents an area that may potentially be included/disturbed during the remedy implementation. The risk assessment assumes that direct exposure to constituents within the landfill soils will be eliminated; therefore, soil from this area of the Site was not considered further in the risk assessment.

These Habitat Areas were evaluated separately in the SLERA in accord with a common methodology and criteria. This document follows the same approach, and thus comprises essentially five separate risk assessments. As noted, it includes in summary form some of the descriptive information from the SLERA, where necessary for a complete understanding of the Site setting and evaluative approach. The report is organized as follows:

Section 4.2: BERA Methodology: This section describes the risk assessment evaluation process implemented at each of the five habitat areas. The standard risk assessment framework of the Problem Formulation, Analysis, and Risk Characterization is defined and described, and the specific logic and procedures used to evaluate risk in each of the five areas is explained. This section presents the basic strategies and information used in the remainder of the report: the method of interpreting risk relative to contaminant distribution, the source and rationale for BERA toxicity values, life history and toxicity values for wildlife receptors, and other factors.

Sections 4.3 – 4.7: These sections present in sequence the evaluation of risk at each of the five Habitat Areas, conducted by implementing the BERA methodology described above. In each area, the key steps in the ecological risk assessment process (Problem Formulation, Analysis, and Risk Characterization) are presented and revised as appropriate. Many elements remain unchanged from the SLERA, and these are presented in summary form, with reference to the SLERA for more detailed rationale. However, in some cases the enhanced site understanding provided by the SLERA and subsequent sampling events suggested a refinement of assessment endpoints, measures of effect, and other alternative approaches to evaluation, and these are integrated into the revised analysis as appropriate. In all sections, a revised list of contaminants of potential concern (COPCs), that reflects the findings of the SLERA, is presented as part of the Problem Identification.

Section 4.8: Uncertainty Analysis: In this section, uncertainties associated with the estimation and calculation of risk, and the bias those uncertainties may add to the final result, are presented.

Section 4.9: Summary and Conclusions: A summary of the methodology and BERA findings are presented by Habitat Area.

A brief description of the site and the findings of the RI are presented in Section 2 of the overall Baseline Risk Assessment.

4.2 BERA METHODOLOGY

As described by EPA (1997), the BERA consists primarily of a re-evaluation of each of the major steps of the SLERA, using the more in-depth site understanding provided by the results of the SLERA. These risk assessment components consist of the following:

- Problem Formulation
- Analysis
- Risk Characterization

A generic description of each of these steps and how they are implemented in this BERA is presented in detail below. In subsequent sections, these components are presented separately for each Habitat Area. Thus, each Habitat Area is assessed in its entirety in Sections 4.3-4.7, using the approach and methodology described below. The data used to support this BERA is provided in Appendix A.

4.2.1 Problem Formulation Methodology

The purpose of the problem formulation is to determine the focus and scope of the BERA by using the enhanced site understanding provided by the SLERA to identify the stressor characteristics, the ecosystems potentially at risk, and the ecological effects to be evaluated. Components of the Problem Formulation include: the identification of BERA COPCs; confirmation (or modification) of exposure pathways, potential receptors, and the ecological conceptual site model; and identification of assessment endpoints and measures of effects. While many of these characteristics are the same as presented in the SLERA, for clarity and completeness they are re-presented in this document as part of the discussion for each Habitat Area. Descriptions of habitat incorporate the findings of an Ecological Characterization conducted of the site by Woodlots Alternatives Inc.; this report was included as part of the Draft SLERA and as Appendix G of the February 2007 RI report (as such it is not provided as an Appendix for this BERA; refer to Appendix G of the February 2007 RI report).

COPCs for this study are those compounds that exceeded conservative benchmarks in the SLERA. In the SLERA, detected concentrations of compounds were selected and evaluated in sequence by a variety of characteristics: value of chemical-specific octanol-water partition coefficients (organics with a K_{ow} greater than 3.5 were retained); essential nutrient status (potassium, calcium, magnesium, and sodium were deleted from further evaluation), and magnitude of maximum detected concentrations relative to receptor-specific no-effect level toxicity values. Compounds retained by this process were identified for further evaluation in this BERA. Thus, the results of the SLERA are the starting point for this BERA evaluation, and a summary of the results of the SLERA benchmark comparisons is presented as part of the Problem Formulation for each of the Habitat Area discussions.

Exposure pathways, potential receptors, and the conceptual site model identify and visually portray how contaminants could reach potential receptors. These are described for each Habitat Area. Because the SLERA showed that some pathways present little potential for risk, pathways and receptors evaluated in this BERA vary in some areas from the comprehensive list used in the SLERA.

Assessment endpoints are “the explicit expression of the ecological value to be protected” (USEPA,

1997). Assessment endpoints are the ultimate focus of the BERA and are linked by the measures of effects to the risk estimation process for the Site. Assessment endpoints are usually defined relative to a group of organisms or an ecological guild of organisms (e.g., game fish in a river, or wading carnivorous birds) that are considered to have ecological value. An assessment endpoint consists of an ecological receptor and a characteristic of that entity (e.g., survival and reproduction). These are identified for each Habitat Area.

Assessment endpoints use in this BERA fall into the following general categories:

1. Survival and growth of directly exposed animals (aquatic and soil invertebrates, amphibians, fish)
2. Abundance and diversity of plant species
3. Survival and growth of wildlife species

Inherent in the evaluation of each of these assessment endpoints is the resolution of the following corresponding risk questions:

1. Is the survival and growth of directly exposed animals (e.g. aquatic and soil invertebrates, amphibians, fish) adversely affected by the existing concentrations of COPCs in site media?
2. Is the abundance and diversity of plant species adversely affected by the existing concentrations of COPCs in site soils?
3. Is the survival and growth of wildlife receptors adversely affected by the existing concentrations of COPCs in site media?

These questions will be considered in the Risk Characterization section for each Habitat Area.

Measures of effect are measurable responses of ecological receptors to a stressor. Since assessment endpoints usually cannot be measured directly, measures of effect are used as an indirect means of evaluating potential effects on potential receptor species. Measures of effect typically quantify potential impacts on or impairment of the components of the assessment endpoint. Ecological benchmarks are an example of a measurement endpoint. Measures of effect used in this BERA are described in detail in Section 4.2.2.

<u>Rare, Threatened, and Endangered Species</u>

As part of the Ecological Characterization conducted in 2004, a database and field check for rare, threatened and endangered species was conducted. At that time, none were recorded or were considered likely to exist near the site. As part of this BERA, this review was updated by a direct inquiry to the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) and to the US Fish and Wildlife Service. Request and confirmation letters supporting this effort are included in Appendix N. No new rare, threatened or endangered species were identified by the U.S. Fish and Wildlife Service.

A response by the MNHESP indicated that the New Jersey Tea Inchworm (*Apodrepanulatrix liberaria*) (an Endangered moth) and frosted elfin (*Callophrys irus*) (a Special Concern butterfly) have been documented in the vicinity of the site. The search also indicated that the project area is located within a priority habitat, *Priority Habitat 380* (PH X380). This designation means that the project area falls within a large map polygon numbered PH X380 that contains potential habitat for one or more rare species. A review of original files indicated that no polygon overlaid the site at the time of the original review in 2004, and that the frosted elfin butterfly was not a listed species in June of 2004, when the initial review was conducted. The listings of these two species thus represents new information added to the Natural Heritage database after the completion of the original Ecological Characterization.

Additional investigations into the ecology and habitat requirements of these species was thus conducted as part of this BERA, with the goal of assessing their potential to be present on-site. Both are upland

species that are dependent on one or two specific host plants for reproduction and/or feeding, a characteristic that limits the suitability of many apparently appropriate habitats. Further details are provided in Appendix N. Based on this assessment, neither of these species is considered likely to occur at the Site because of the lack of available populations of critical host plants. However, further evaluation of the potential effects of contaminants on these species is considered in Section 4.7, Upland Soils.

4.2.2 Analysis Methodology

As defined by USEPA (1998a) the analysis phase is the process that examines the two primary components of risk--exposure and effects--and their relationships between each other and ecosystem characteristics. The goal is to provide the components necessary for determining or predicting ecological responses to stressors. For each Habitat Area, the analysis section describes how exposure and effects are analyzed to support the final Risk Characterization. For most Areas, the data and evaluation methodologies are similar to those in the SLERA, and the detailed modeling and assessment descriptions provided in the SLERA are referenced where appropriate. The Analysis phase typically consists of the characterization of exposure and effect, which are described in the following sections.

4.2.2.1 Characterization of Exposure

This section describes how the exposure of receptors to site contaminants is estimated. In this BERA, exposure is based on direct sampling of site soils, surface water, and sediment; no sampling of prey or food media was conducted. For most Habitat Areas, the data used to assess exposure in each area is the same as in the SLERA. However, in the Upper Sutton Brook and Deep Marsh Habitat Areas, additional samples have been collected, and data from these samples is presented in detail, along with new data summary tables in subsequent sections. A list of the samples used in this risk assessment, showing the new Upper Sutton Brook and Aquatic Wetland samples, is provided in Table 4-1. Analyses conducted on each of these samples is shown in the Analytical Testing Summaries in Tables 4-2, 4-3, and 4-4. A full discussion of data quality is provided in Section 3 of the RI report.

The data used in this report was collected during the RI, and was presented in detail in that document. For the most part, data used for this BERA is the same data set presented for the RI. However, some of the RI data were not used. Specifically, the 1989 and the 1995 historic sediment data (a total of 6 samples) were not used in this BERA because the data were more than 10 years old and more recent data have been collected which is more representative of current and future conditions. Additionally, some of the 1989 and 2000 soil data were excluded from the BERA dataset because the data were more than 10 years old (1989 data) or located on the slopes of the landfill (presumed to be capped), or the data was not situated in one of habitat areas evaluated as part of this ecological risk. Specifically, soils data from 2000 that was collected from the residential neighborhood was not included, since these areas are not within a defined Habitat Area.

Seasonal and trend groundwater and surface water monitoring was conducted at the Site in 2006, during the preparation of this risk assessment. These activities were conducted as part of a pre-ROD monitoring program. Additional samples were collected from site locations SW-33 (Upper Sutton Brook), and SW-36 and SW-37 (Aquatic Wetland) on February 16, 2006 and October 5, 2006. At the same time, samples were also collected from reference location SW-30. Because the risk assessment was underway at that time, these site data were not included as part of the ecological risk assessment dataset, but the site samples SW33, SW-36, and SW-37 were reviewed for consistency with the SLERA dataset on an area-by-area basis. This analysis showed that nearly all detected concentrations of constituents were well below maximum concentrations detected in the previous sampling included in the SLERA dataset. Compounds detected at concentrations greater than previously detected were compared to SLERA ecological screening benchmarks, and all concentrations were below these benchmarks. Because these

monitoring data would not affect the conclusions of the risk assessment, the results of the on-going seasonal and trend monitoring sampling are not included quantitatively as part of the risk assessment dataset. As such, the concentrations used to represent these surface water sampling locations is the maximum detected during the 2004 or 2005 sampling events.

In the data summary tables for this BERA, a 95%UCL is calculated to estimate the upper limit of the mean. If insufficient data is available to run the UCL, this condition is indicated with a NA designation in the UCL column. In this instance, exposure is evaluated by using the maximum concentration, the value for which is listed in a separate column. If the calculated 95% UCL exceeds the maximum detected, however, the maximum value is listed in the 95%UCL column.

In addition, averages are calculated on the data summary tables for each media. For the purposes of averaging, non-detected compounds are represented by ½ the reported detection limit. If ½ the reported detection limit is greater than the maximum detected, then the non-detect value is not included in the averaging calculation. In some cases, two analyses are listed for analytes, usually reflecting the analysis of an initial and a diluted sample. Different detection limits will be reported for each, in consequence of the dilution. In accord with a generally conservative approach to multiple analyses of the same sample, the higher of the reporting limits was used to calculate the average values. Thus, the average is based on ½ the highest reporting limit for non-detects, plus detected values.

For terrestrial receptors, exposure is estimated by food chain modeling of avian and mammalian receptors, using a combination of site-specific and literature data to estimate the body dose of each COPC. The representative receptors, food chain modeling equations, bioaccumulation estimation techniques, and hazard quotient (HQ) calculations methodologies remain as described in detail in the SLERA. The wildlife exposure modeling methodology, including descriptions of each of the species considered in either the SLERA or this BERA, is provided in Appendix J. However, some exposure parameters have been changed to reflect more site-specific conditions, and these are noted in the specific discussions of the relevant Habitat Areas. Life history exposure parameters used for food chain modeling are shown in Table 4-5.

4.2.2.2 Characterization of Effect

For each Habitat Area, this section describes how potential effects in each Habitat Area are characterized. For most areas, toxicity is evaluated by comparison to ecological benchmarks or toxicity reference values. However, for portions of the Upper Sutton Brook Habitat Area, toxicity testing was used to obtain site-specific toxicity data, as described in Section 4.3.3.

The toxicity data and other relevant information used to evaluate effects in this BERA differ from that used in the SLERA. The SLERA relied on maximum exposures and conservative, no-effect values for exposure and effects analysis to provide a conservative assessment of compounds associated with either negligible or potential risk. In consequence, media or doses were compared to values associated with no effect or a low probability of effect. The nomenclature for this class of values varies by media and author and methodology; in sediment, terms are used such as “threshold effects levels” (TECs) or “effects-range low” (ERLs) values, indicating concentrations below which effects are unlikely. For toxicity reference values (TRVs) used to evaluate calculated body dose of terrestrial receptors, this level is termed the “no-observed adverse effect level” or NOAEL. In both instances, however, these values represent a lower boundary for the potential threshold of effect, since they represent values at or below which effects are unlikely, or, in the case of TRVs, where effects were not observed.

This BERA seeks to more accurately quantify the potential for risk, and thus uses values associated with the actual onset of effects, or a probability of effects. In sediment, terms such as “probable effect levels”

(PECs) or "effects-range medium" (ERM) values are used, and for doses or water concentrations the term "lowest observed adverse effect level" or LOAEL is used. As opposed to the no-effect values described above, these low-effect values define an upper threshold boundary for risk and true likelihood of adverse effect. Because the value chosen is typically the lowest value identified in the literature, they still reflect a measure of conservatism. These values, combined with the no- or low-effect values, serve to bound the threshold for risk.

For simplicity, consistent effects-level terminology across media will be used in this report. Values reflective of little potential for effect (e.g., sediment TECs or NOAEL TRVs) will be referred to categorically by the generic term "NOAEL-based" values, while concentrations associated with a higher potential for effect (e.g. PECs or LOAEL TRVs) are termed "LOAEL-based" values. The use of NOAEL and LOAEL as the basis for categorizing potential for effect allows a consistent conceptual understanding of the toxicity data across media.

LOAEL-based effects values used in this BERA were drawn or calculated directly from the scientific literature. For many sediment compounds, LOAEL-based values, in the form of PECs, ERMs, or other benchmarks, are available, and these are used directly. Some surface water COPCs have water quality criteria (WQC), which are "To Be Considered" standards for the Site, and where available these are used directly. These values are the same as used in the SLERA and are used in this BERA as evaluation criteria. For surface water compounds without WQC, LOAEL values are drawn from the scientific literature.

For aquatic values, the lowest fish or invertebrate value available for the ecologically relevant endpoints of growth, mortality and reproduction of a freshwater species was typically used, where available. The primary data source for this information was EPA's database Ecotox, which lists a variety of surface water toxicity data by species. In many cases, only LC50 data (representing the concentration lethal to 50% of the test population) was available, and this value was then divided by an uncertainty factor of 10 for use as a representative LOAEL. Because most NOAEL-based benchmarks are calculated from large data sets, some specific LOAEL values may actually be lower than the NOAEL-based benchmark. In this instance, the lowest LOAEL (actual or calculated) that is higher than the NOAEL-based benchmark is used.

Aquatic surface water LOAEL values were used to both evaluate surface water COPCs and to calculate sediment LOAELs for organic compounds through the use of equilibrium-partitioning equations. Equilibrium-partitioning was conducted as described in the SLERA, using average total organic carbon (TOC) concentrations identified in that document (SLERA Tables 4-10 and 4-8; see also site data in BERA Appendix A) for each Habitat Area (25.4% for the Aquatic Wetlands and 2.3% for Upper Sutton Brook). This approach is appropriate because the stream and wetlands sediments differed significantly in the amount of organic carbon in the sediment, and organic carbon plays a key role in the retention of organic contaminants. Data from within each Habitat Area are combined to obtain an average TOC value which reflects the natural variability of this parameter among samples.

Table 4-6a, b, and c presents the LOAEL-based values used in this study for surface water, sediment, and soils, respectively. Full identification of the source and calculation metholology for each value is provided. Full backup information for values drawn from the Ecotox database are provided in Appendix N.1.

In a similar manner, LOAEL-based values were used as TRVs for comparison to the estimated body dose of terrestrial receptors. LOAEL-based TRVs were drawn from the scientific literature, and consist of the actual or estimated LOAEL produced by the same study as the NOAEL value used in the SLERA. Where available, LOAEL and NOAEL TRVs have been updated to reflect values used by EPA in the

generation of ecological soil screening levels. Avian LOAEL TRVs and sources used in this study are indicated in Table 4-7. Mammalian toxicity data is indicated in Table 4-8. The shrew TRV for manganese (Table 4-9) was estimated from a literature value for mammalian toxicity by allometric scaling, which adjusts estimated TRV values to account for the specific body weight of the receptor species. This manganese value is consistent with that used in the SLERA. The TRVs for arsenic and vanadium, however (Table 4-8), consist of values used by EPA in the development of the Eco-SSLs for these two compounds (EPA 2005b, 2005c). Because EPA's toxicity values are typically the lowest bounded NOAEL for any species, as drawn from a large and rigorously evaluated dataset, they are considered to be sufficiently conservative to cover body size effects, and thus EPA did not scale TRV values to match receptor body weight. Consistent with EPA's approach, this BERA uses the same TRV values for arsenic and vanadium to evaluate mammalian receptors, in this case the shrew and the rabbit.

4.2.3 Risk Characterization Methodology

For each Habitat Area, the exposure and effects data from the sources identified above or from site-specific toxicity tests was evaluated together to obtain a realistic assessment of potential risk, based on exceedances of LOAEL-based values representing the upper bound of the threshold for risk. For each Habitat Area, this assessment followed the following general approach.

4.2.3.1 Risk Characterization of Non-Wildlife Receptors

Non-wildlife receptors (e.g. benthic populations, plants, soil invertebrates) were evaluated by the following sequential approach:

Step One: Evaluation of the Magnitude and Number of NOAEL-based HQs Exceedances

COPCs were first reviewed with specific regard to the number and magnitude of NOAEL-based HQ exceedances, as produced in the SLERA. A full list of the NOAELs used in the SLERA is provided in Appendix K, and all NOAELs cited in this BERA are consistent with these values. COPCs with NOAEL-based HQs that are low (< 3) and which occur in only a few locations were qualitatively evaluated further by identifying the location, magnitude and potential source (particularly in regard to off-site influences) for the HQs exceedances. Typically, concentrations which only slightly exeed the conservative NOAEL-based HQ in widely separately locations, or which likely reflect an offsite effect such as roadway runoff, are not considered to present a significant risk, and are not evaluated further.

From an ecological standpoint, HQ exceedances in a single sample, or in two or three widely separated samples, are not likely to reflect a widespread adverse impact, unless the exceedance is large (defined here as approximately 3 times the NOAEL-based benchmark values or greater). Evaluating the magnitude of the HQ in this manner reflects the calculation methodology of the benchmarks, which are typically based on probabilities of effect (not direct correlation), or on values that incorporate uncertainty factors typically greater than three.

For example, NOAEL-based surface water and sediment values for organics calculated by Oak Ridge National Laboratory follow or are based on EPA Tier II water quality criteria methodology, which involves the use of uncertainty factors ranging from 3.5 to 242, based on the number of species used to calculate the value and whether or not those species included a daphnid (Suter and Tsao 1996). The surface water benchmark for carbon disulfide from this source was used in the SLERA, and includes the maximum uncertainty factor of 242, so a factor of three used to initiate further evaluation of this compound is well within the conservatism of the original calculation method. Likewise, the ratio between sediment probable-effects level and threshold effects levels for metals is also typically large; the ratio between the Effects Range-Medium and Effects-Range Low values for metals in sediments cited by Long

et al. 1995 and used by the National Oceanic & Atmospheric Administration (NOAA) ranges from 2.5 to 8.5, with an average ratio of 5.25. A factor of three was thus chosen as an appropriately conservative estimate of potential, but likely minimal, effects. A single large exceedance could, because of its localized area, potentially suggest minimal effect also; however, single large exceedances (greater than an HQ 3) are evaluated further.

Step 2: Comparison to LOAEL-based Toxicity Values

Compounds not eliminated by Step 1, above, are further evaluated by comparison to LOAEL-based values. LOAEL-based values were obtained from the scientific literature, and are presented on Table 4-6. The methodology for selecting these values was described in Section 4.2.2.

As part of this analysis, media concentrations were evaluated with regard to the following:

a. *relationship to cited LOAEL or LOAEL-based values (above or below).* Compounds with maximum concentrations exceeding LOAEL values are identified.

b. *number and magnitude of LOAEL exceedances.* The number, location, and magnitude of samples with concentrations exceeding the LOAEL are identified. This approach helps to identify "hot spots" that may represent very localized areas of potential effect, as opposed to more widespread areas that would have a potentially higher ecological effect.

c. *scientific strength and representativeness of the LOAEL value*. For this evaluation, the representativeness of the LOAEL (relative to other LOAELs), the degree of uncertainty associated with the chosen value, the chemical state of the test substance, and similar factors were considered to further assess the potential for risk represented by the LOAEL HQ. As noted earlier, LOAEL values are typically the lowest identified in the toxicological literature. In some cases, this value may be significantly less than large numbers of other LOAEL values, or may reflect a chemical state not reflective of site conditions. These factors will be reviewed to evaluate the representativeness of the chosen LOAEL relative to potential toxicity of site samples.

4.2.3.2 Risk Characterization of Wildlife Receptors

In the SLERA, wildlife effects were evaluated using maximum media concentrations only, which reflects the assumption that receptors feed continuously and exclusively at the location of samples with the highest detected contaminant concentrations. In this BERA, wildlife effects were evaluated by the following:

a. use of refined exposure and life history parameters. These include media average and 95% upper confidence limits (UCLs). 95% UCL values were generated by the program ProUCL, and program outputs for the wildlife COPCs in each Habitat Area are provided in Appendix N.3.

b. comparison to LOAEL TRVs. As described previously, these are taken directly from the toxicity literature (see Section 4.2.2.2).

4.2.3.3 Identification of Potential Risk

For both wildlife and non-wildlife receptors, a potential for risk is generally considered to exist for COPCs that meet the following characteristics:

a. substantially exceed representative NOAEL and LOAEL values (LOAEL HQ > 1), and

b. where applicable, show adverse effects above reference levels in toxicity tests.

In the following sections, the approach described above will be implemented for each of the five Habitat Areas.

4.2.4 Consideration of Reference Concentrations

In some instances, concentrations of COPCs that are naturally occurring inorganics are subsequently compared to concentrations in reference samples. When the COPCs exceeds LOAELs, a comparison and discussion relative to reference concentrations is provided for an additional perspective on detected values. In no instance, however, are reference concentrations used to ascertain the potential for risk. In this document, potential risk is based on relation to LOAEL values only, as described in Section 4.2.3.1.

For COPCs associated with potential risk, the comparison of site data to reference data was conducted to determine whether the risks identified in the Risk Characterization are reflective of natural or non-site related conditions. This is an important understanding for subsequent risk management decisions.

As part of the RI, samples from reference areas were collected (refer to Figure 4-1). Samples used in defining reference areas included samples collected from areas that have similar physical, chemical, geological, and biological characteristics as the site, but have not been affected by site activities or releases. These may be impacted from other "sources" not related to the site. For example, potential other sources include the adjacent composting facility, all-terrain vehicle use of dirt roads in the area, vehicular traffic, etc. Concentrations of naturally occurring inorganic COPCs (e.g., iron, manganese, barium, and others) are compared to concentrations in these reference locations to determine if detected concentrations reflect natural conditions around the Site. For this comparison, data in specific site samples were compared to specific ranges in directly-related reference locations, such as upstream surface water or sediment.

4.3 UPPER SUTTON BROOK

The following presents the evaluation and description of potential risks in the Upper Sutton Brook.

4.3.1 Upper Sutton Brook (USB) Habitat Description

The Upper Sutton Brook Habitat Area consists generally of the reach of Sutton Brook from the dirt access road at the northern boundary of the Site down to and including sample location SD/SW-34 (Figure 4-2). It also includes the lower reaches of a small tributary, referred to in this document as the Southern Tributary that enters Sutton Brook from the southeast. The Upper Sutton Brook is a medium-gradient, sandy bottomed creek approximately 15 to 30 feet in width and 12 to 60 inches in depth, with depth increasing downstream (west). Fine sand comprises the majority of the substrate near the eastern end of this reach; however, areas of deep, very soft, loose sediment, with a thickness up to approximately two feet or more, comprise some of the substrate further downstream, near the location of SW/SD-33(04) and SW/SD-34(04). The channel is distinct, with cut banks and little or no aquatic vegetation, to a point close to SW/SD-34(04). Water is medium to dark brown, as is typical of New England wetland water. The access road that crosses Sutton Brook at the top of this reach is comprised of dirt, which becomes deeply rutted loose mud during wet periods and after precipitation events, resulting in significant potential for particulate runoff from the road to the brook.

Although originally evaluated as a single Habitat Area in the SLERA, data from the RI showed three distinctly different chemical characteristics in different parts of Upper Sutton Brook and its tributaries. Because these differences may affect remedial approaches, risks are estimated separately for each of these three sections of the brook, although these section are all still are considered to be part of the USB Habitat

Area. These three sections are as follows.

USB Eastern Reach: This reach extends from the access road crossing west to the point where the landfill road crosses Sutton Brook, just upstream of sample SD-21(99). This section of the USB would receive contaminants primarily from surface runoff and to a lesser extent from site groundwater, since most of the eastern end of this reach is hydrogeologically upgradient of the site. It also receives flow from the Southern Tributary, which enters the Upper Sutton Brook upstream of both the Northern and Southern Lobes. The unpaved access road to the composting facility at the top of the reach is potentially a significant contributor of particulates because of the lack of curbing and the frequently wet and muddy nature of the road surface. COPC concentrations in the Eastern Reach were typically lower than downstream areas between the site lobes. This area is thus evaluated separately from more impacted downstream areas.

USB Southern Tributary: The Southern Tributary drains a watershed that includes largely offsite areas, plus a small area of wetland near the confluence with Sutton Brook. The Southern Tributary is hydrogeologically upgradient of the landfill lobes, but could receive surface water runoff from flat areas around the confluence. Further upstream from the confluence, the tributary would receive both groundwater and surface runoff from upstream areas, which include the spreading fields and storage piles of the composting facility located west of the Southern Tributary and Krochmal Farm. South of the access road to the composting facility and farm, the tributary exists in a large forest and shrub-scrub wetland.

Although this tributary reflects a drainage area comprised largely of areas beyond the geographic or hydrogeologic range of landfill activities, for the purposes of this BERA, the entire reach from the access road to the confluence with Sutton Brook is considered to be part of the Upper Sutton Brook Habitat Area. This inclusion was made to ensure that all COPCs that have the potential, however remote, to arise from site operations were evaluated in the risk assessment. However, because this area clearly reflects significant off-site contributions, it is evaluated separately from other reaches of Upper Sutton Brook. Areas upstream of the access road are considered to be reference areas for the purposes of evaluating the condition of sediment and surface water upstream of this area.

USB Site Channel: This is the reach of the USB that passes directly between the landfill lobes, and extends from SW/SD – 21(99) to SW/SD-34(04) (Figure 4-2). It receives groundwater discharge from beneath both lobes as well as surface water contributions from the Southern Tributary and the rest of Upper Sutton Brook. Surface water runoff from the steeply sloping sides of both landfill lobes may also be a potential contributor.

4.3.2 USB Problem Formulation

For this evaluation, the components of the Problem Formulation presented in the SLERA were revisited and refined as necessary.

4.3.2.1 USB Exposure Pathways and Potential Receptors

As described in the RI, all areas of the Upper Sutton Brook have the potential to be affected by both surface water runoff and groundwater from the landfill lobes. However, these pathways differ in their importance at each of the three areas. For the Eastern Reach, surface water runoff is the primary pathway in all areas except the extreme western edge of the reach, near the landfill lobes, where groundwater contributions may increase. For the Southern Tributary, surface runoff is also the primary route for contaminants, except for potential groundwater effects near the confluence with Sutton Brook. For the Site Channel, however, discharging groundwater from beneath the landfill lobes is the main pathway,

with additional contributions from surface water runoff from the steeply sloped sides of the Northern and Southern Lobes. Thus, both surface runoff and groundwater are potential pathways for each of the three reaches, to different extents. A conceptual site model illustrating these connections is shown in Figure 4-3.

In all reaches of the brook, potential receptors with the highest exposure to stream COPCs would include benthic (bottom-dwelling) and pelagic (water column) macroinvertebrates that live in or on the sediment on structures or vegetation above the sediments. Seining activities were conducted in the brook in 2005 to determine whether the brook contained fish; this activity consisted of spanning the brook with a net and disturbing the upstream reach in an effort to drive any fish towards the net. This was repeated at three locations, and no fish were observed. Although these seining activities suggested that Upper Sutton Brook does not contain fish, fish are assumed to be present as a conservative approach and so are also included as a potential receptor in this evaluation. Terrestrial mammals and birds may be exposed primarily by the ingestion of stream water, since the presence of fur or feathers usually minimizes dermal exposures for most species. If fish are present, piscivorous birds may be exposed through ingestion of contaminated fish and other aquatic prey items. However, in much of the Brook the surface water is too deep for even long-legged wading birds, such as the heron.

Sediment may also be a potential exposure pathway for other receptors such as amphibians, although this pathway is expected to be minor for most of the Upper Sutton Brook. Specifically, in shallower reaches near the road, the water is moving in riffles areas, which is not preferred habitat for amphibians. From approximately the location of SW/SD 31(04) the water becomes deep, and this feature, combined with the very dark color would prevent light penetration and thus a robust growth of algae and periphyton, which is the primary food of developing tadpoles. Little or no riparian aquatic vegetation exists in this area, which would diminish its value to the more aquatic herptiles such as bullfrogs and green frogs. Habitat characteristics within Sutton Brook thus render this a marginal amphibian habitat.

4.3.2.2 USB Contaminants of Potential Concern (COPCs)

COPCs for all sections of the Upper Sutton Brook consist of those compounds that exceeded NOAEL-based benchmarks in any section of the brook. These compounds were identified in the SLERA. Table 4-10 summarizes the results of the evaluation of the SLERA and shows the number and magnitude of NOAEL-based HQ exceedances throughout the Habitat Area. As shown by this summary, seven surface water compounds and sixteen sediment compounds exceeded NOAEL-based benchmarks in at least one Upper Sutton Brook sample, and so are included as COPCs in this BERA. These compounds are listed in Table 4-11. Not all of these COPCs were detected in each of the three reaches. Where detected, they are further evaluated for each section of the USB.

Toxicity profiles for these and other COPCs evaluated in this BERA are provided in Appendix L.

4.3.2.3 USB Assessment Endpoints and Measures of Effect

In accord with the exposure pathways identified in the previous section, assessment endpoints for all reaches of Upper Sutton Brook and the Southern Tributary are as follows:

1. survival and growth of the benthic and pelagic macroinvertebrate community in the stream;
2. survival and growth of potential fish communities.

In this study, measures of effect differed slightly among reaches. For all reaches, measures of effect included the following:

- comparison of all COPC concentrations to benchmarks reflecting lowest levels of effect on survival, growth, or reproduction (LOAEL-based ecological benchmarks; see Section 4.2.2.2) except for surface water and sediment in the Site Channel habitat area. Based on the results of the SLERA and the preliminary refinement performed as part of this assessment and conversations with EPA during the development of this assessment, it was agreed to base a conclusion of potential risk to aquatic receptors in the Site Channel on the SLERA screening data. This was based on the assumption of presumed remedial actions (e.g., landfill cover and resulting brook rehabilitation), that will adequately address sediment and resulting transport of COPCs to surface water in the Site Channel. Based on this presumption, it was agreed that no further refinement or evaluation of the Site Channel surface water data or sediment beyond the SLERA would be performed.

In addition, in the Southern Tributary, particularly elevated sediment concentrations of arsenic detected in 1999 exceeded NOAEL-based benchmarks in the SLERA by large margins. For this reach of stream, an additional measure of effect was used:

- estimation of effects of whole sediment on benthic organism survival and growth using whole-sediment toxicity tests

Southern Tributary sediments were subject to toxicity testing to identify potential effects associated exclusively with arsenic, which is the only COPC detected in most Southern Tributary samples. The results were then used to estimate potential effects of arsenic in other parts of the site.

4.3.3 USB Analysis of Exposure and Effect

As shown in Table 4-10, several constituents produced maximum HQs considerably greater than one. Of these, arsenic in sediment had both the highest NOAEL-based HQs (93.5) and the greatest number of samples exceeding benchmarks (9). Arsenic is a naturally occurring compound that was detected in highest concentrations in the Southern Tributary, a reach that is subject to off-site contributions from the adjacent composting facility and farm. To further define both potential exposure of benthic organisms to arsenic as well as potential effects, additional sampling of arsenic and iron was conducted in November 2006 at various locations in the Southern Tributary and the Eastern Reach. Also, additional full-suite sampling was conducted in the Eastern Reach to further confirm conditions in the eastern end of that relatively unaffected reach. These additional samples are described in the sections below, and are compared to LOAEL-based benchmarks in Section 4.3.4.

4.3.3.1 USB Analysis of Exposure

Analysis of exposure in all reaches of the Upper Sutton Brook Habitat Area were evaluated by direct measurement of COPC concentrations in surface water and sediment. For this, the data set presented in the RI was used. The location of samples is shown in Figure 4-2, and samples are identified on Table 4-1. Analyses conducted for each sample are shown in Table 4-2 and 4-3.

Southern Tributary: As noted earlier, the Southern Tributary receives drainage from both site and upstream areas. This area is represented by 2 surface water samples and 9 sediment samples, six of which were collected in November 2006 to more completely delineate arsenic concentrations. Sample SD-206(06) was collected from the location of former samples SD-14(99) and SD-15(99), which contained 406 mg/kg and 767 mg/kg of arsenic respectively, the highest detected at the site. Two reference samples (SD-201(06) and SD-200(06)) were also collected at that time from upstream portions of the tributary. Reference sample SD-201(06) was collected from just upstream of the road crossing, in a large pool that forms due to restricted passage through the road culvert. Reference sample SD-200(06)

was collected approximately 150 feet further upstream, in a forested shrub wetland that typifies the southern reach in this area.

Eastern Reach: The Eastern Reach of the Upper Sutton Brook Habitat Area is represented by 11 sediment samples and 5 surface water samples, collected from 1999 to 2006.

Site Channel: The Site Channel portion directly between the landfill lobes was evaluated by five sediment samples and five surface water samples. As discussed previously, additional assessment of surface water and sediment is this reach was not conducted beyond that performed in the SLERA.

The results from this sampling is evaluated in Section 4.3.4.

4.3.3.2 USB Analysis of Effects

Potential effects of COPCs on site receptors in all reaches of the Upper Sutton Brook, with the exception of surface water and sediment in the site channel, were evaluated by LOAEL-based benchmarks, as described in Section 4.2.2. LOAEL values and sources were presented in Table 4-6. The potential toxicity of selected sediments in the Southern Tributary were also evaluated by whole sediment toxicity tests, as described below.

Five samples from the Southern Tributary were selected for use in toxicity tests. Samples were selected based on arsenic concentrations, and were chosen to represent a range of concentrations and locations (reference vs. site). The following five samples were used for toxicity testing:

Sample Selected for Toxicity Testing	Arsenic Concentration, mg/kg
SD-200 (upstream reference)	5.4
SD-201 (upstream reference)	110
SD-204	130
SD-206	58
SD-207	94

Toxicity testing consisted of 10-day whole sediment toxicity tests using the amphipod *Hyalella azteca* (Method 100.1HA) and the oligochaete *Chironomus tetans* (Method 100.2CT). This is a static bioassay that evaluates effects on survival and growth of organisms over a 10-day exposure period. Toxicity testing was done by Aquatec Biological Services of Williston, Vermont. The full analytical report is provided in Appendix M and discussed in Section 4.3.4.1.

4.3.4 Upper Sutton Brook Risk Characterization

As described previously, while the Upper Sutton Brook is considered to be a single Habitat Area from the standpoint of potential pathways and receptors, it is evaluated as three different sections to help refine the understanding of the areas associated with potential risk. This evaluation is presented below, starting with the Southern Tributary, which contributes flow to both the Eastern Reach and the Site Channel.

4.3.4.1 USB Southern Tributary Risk Characterization

As described previously, the USB Southern Tributary was the site of additional sediment sampling and testing in 2006. Risk evaluations for surface water and sediment are presented below.

Surface Water: Toluene was the only USB COPC detected in the surface water of the Southern Tributary (Table 4-12). Toluene was detected in sample SW-43(04) at a concentration of 0.001 mg/l, which is well below the NOAEL-based benchmark of 0.0098 mg/l. Toluene was not detected in sample SW-09(99), at a detection limit of 0.010 mg/l. Using ½ the detection limit as a representative,

conservative estimated concentration of toluene produces an estimated concentration of 0.005 mg/l, a concentration that is also below the NOAEL-based benchmark.

Because toluene concentrations in both of these Southern Tributary samples are well below conservative NOAEL-based benchmarks used in the SLERA, no potential for risk is anticipated from surface water in the Southern Tributary.

Sediment: Sediment in the Southern Tributary were evaluated by two lines of evidence: comparison to LOAEL-based benchmarks and toxicity tests. These are described separately below.

Comparison to Sediment Benchmarks

Six of the Upper Sutton Brook COPCs were detected in the Southern Tributary sediment: acetone, toluene, benzo(a)pyrene, arsenic, iron, and manganese (Table 4-13). The maximum concentration of manganese was below the NOAEL-based benchmarks; therefore, manganese was not considered to present a potential risk and was not evaluated further.

Benzo(a)pyrene was detected in one sample (SD-14(99)) at a concentration of 0.440 mg/kg, producing a NOAEL-based HQ of 1.7. This compound is a component of heavy oils and combustion products, and concentrations similar to this are commonly found in urban soils (Bradley et al 1994). No other samples in the Upper Sutton Brook contained this compound. The detected concentration is well below the LOAEL-based benchmark of 4.4 mg/kg, shown on Table 4-13, and therefore it is not expected to be associated with potential risk.

Sediment acetone, toluene, arsenic, and iron exceeded NOAEL-based benchmarks by a factor of 6 or more in at least one sample in the Southern Tributary so were compared to LOAEL-based benchmarks. This comparison is shown in Table 4-13. As shown, toluene was detected in one of two samples and produced a LOAEL-based HQ of 0.1, well below estimated levels of effect. Little or no potential risk is expected from this compound. Acetone was also detected in one of two samples, producing a LOAEL-based HQ of 1.6. Acetone is a common laboratory solvent that is frequently detected in environmental samples as a result of the preservation and extraction process, and detected concentrations may results at least in part from this phenomenon. Acetone was not detected in more recent sample SD-43(04), and the assumption of a concentration at ½ the detection limit in SD-43(04) produced an estimated concentration well below LOAEL-based benchmarks (HQ = 0.6). As a small organic molecule, acetone is a readily biodegradable and not likely to persist for long periods in sediment. For these reasons, a large measure of uncertainty is associated with both the reported concentration and the resulting LOAEL for acetone, and results are considered to be overly conservative. Potential risk is thus not indicated for acetone.

Iron in the 1999 sediment samples SD-14(99) and SD-15(99) exceeded the LOAEL-based benchmarks, producing LOAEL-based HQs of 1.1 and 2.1, respectively. The highest concentration was in SD-15(99), which contained 85,300 mg/kg of iron. All other samples were approximately half of this concentration or less, and the highest concentration of iron detected in the more recent 2006 samples was 21,000 mg/kg in SD-204(06), which produced a LOAEL-based HQ of 0.5 and a NOAEL-based HQ of 1.1. Iron is a naturally occurring compound that is frequently elevated in organic environments. Because of the natural contribution of iron and the consistently lower concentrations detected in more recent 2006 samples, the elevated detection of iron from 1999 is not considered to be reflective of a current risk.

Arsenic exceeded the LOAEL-based benchmark of 33 mg/kg in eight of the nine sediment samples from the Southern Tributary. Arsenic concentrations in these samples ranged from 42 mg/kg (LOAEL HQ of 1.3) to 767 mg/kg (LOAEL HQ of 23.2 from SD-15(99)). The maximum arsenic concentration detected in 2006 during the additional delineation sampling, including in the area of the highest previous sample results, was 130 mg/kg (LOAEL HQ of 3.9).

Toxicity Test Results

As described previously, five sediment samples from the Southern Tributary were subjected to whole sediment 10-day toxicity tests using *Hyalella azteca* and *Chironomus tetans*. These tests evaluate effects on survival and growth over a 10-day exposure period for two typical freshwater sediment invertebrates. The testing was conducted to further evaluate potential effects of arsenic on benthic invertebrates, since the concentration of arsenic in some sediment samples significantly exceeded ecological benchmarks, thus suggesting a potential for adverse effect. The purpose of the tests was to determine whether the toxicity suggested by the benchmark exceedances is occurring in Southern Tributary sediments.

The results of the toxicity tests are shown in Table 4-14 for both *H. azteca* and *C. tentans* with the full results presented in Appendix M. The results of these tests were as follows:

- no statistically significant reductions in survival occurred for either species in any sample; and
- statistically significant reductions in growth were detected in all samples for *H. azteca*, and for all samples except SD-206 for *C. tetans.*

Substantial variability was observed in the results for both species. For both species, lowest growth was associated with the highest arsenic concentration (130 mg/kg in SD-204), but for neither species was the highest growth associated with the lowest arsenic concentration. The lowest arsenic concentration (5.4 mg/kg) was detected in the furthest upstream reference sample (SD-200), but for both species, growth in this sample was lower than in samples with much higher arsenic concentrations (see SD-206, 207 and 201 with 58- 110 mg/kg for *H. azteca*, and SD-206 with 58 mg/kg for *C. tetans*). Linear regression of both data sets showed a poor relationship between arsenic concentration and growth, with a correlation coefficient (r^2) of 0.06 for *H. azteca* and 0.38 for *C. tetans.*

This inconsistency may reflect the influence of inhibiting factors other than arsenic at the reference sample SD-200, or the insensitivity of organisms to arsenic concentrations below 58 mg/kg. This is indicated by similar growth at varying concentrations: for *H. azteca*, SD-206 and SD-207 produced nearly similar growth (0.087 and 0.086 mg, respectively), despite having arsenic concentrations of 58 and 94 mg/kg, respectively. Likewise, for *C. tetans*, samples SD-204 and SD-207 produced essentially the same growth (1.37 and 1.38 mg, respectively), despite differing arsenic concentrations of 130 and 94 mg/kg, respectively. No relationship of results with grain size was found to support these variations.

No apparent trend was observed when growth was correlated with iron-normalized arsenic concentration (r^2 value of 0.15 for *H. azteca* and 0.023 for *C. tentans*). The highest iron-normalized arsenic concentration of 12.4 mg As/g Fe occurred in sample SD-201 (collected just upstream of the road crossing), but for both species this produced the median value for growth. For both species, samples with lower concentrations of iron-normalized arsenic produced both less and greater amounts of growth. This suggests that the relationship between arsenic and iron do not affect the level of growth in organisms.

In summary, although the concentration of arsenic in most sediment samples exceeded LOAEL-based benchmarks, the results of the toxicity testing indicated that arsenic concentrations up to 130 mg/kg had no effect on the survival of either *H. azteca* or *C. tentans.* Growth of both species was reduced at nearly all concentrations, but growth reductions did not correlate well with arsenic concentration. These data suggest that other factors may be causing growth effects on test species.

Since the toxicity test species are appropriate surrogates for actual benthic invertebrates likely to be present at the site, little or no effect on growth or survival of benthic invertebrates is expected as the result of measured arsenic concentrations in Southern Tributary sediment. Although detected arsenic concentrations exceed LOAEL-based benchmarks, the results of the site-specific toxicity tests provide a

more accurate guide to actual levels of effect at the site, since many site-specific factors can affect toxicity in ways not reflected in generic benchmarks. Some of these factors, such as substrate, may have been the cause of the reduced growth observed in test organisms.

Although toxicity tests did not indicate potential arsenic effects, site concentrations in sediment were also compared to sediment concentrations in upstream reference locations to obtain further understanding of the nature and extent of arsenic distribution. No Southern Tributary reference samples from 1999 are available, so comparisons are based on the 2006 data, which contains contemporaneous site and reference data. In 2006, arsenic concentrations in downstream samples ranged from 42 to 130 mg/kg. Arsenic concentrations in 2006 reference sample SD-201(06), collected from upstream of the access road to the composting facility contained 110 mg/kg arsenic. Reference sample SD-200(06), collected further upstream from the middle of a large shrub swamp, contained 5.4 mg/kg arsenic, likely reflecting its distance from the edge of the facility's roads and fields. These upstream concentrations suggest that much of the arsenic in the stream may arise from upstream areas. As described previously, the Southern Tributary collects surface water drainage and groundwater discharge from the storage piles and spreading fields of the composting facility, which composts a variety of lawn and wood wastes, and Krochmal Farm. Natural degradation in these fields has the potential to produce reducing conditions in groundwater, which can mobilize naturally occurring arsenic in soils. Because most of the Southern Tributary, except for a small area near the confluence, is hydrogeologically upgradient of the landfill, most of the flow and conditions in the Southern Tributary are considered to reflect upstream and local streamside effects.

In summary no site-related COPCs have been identified as contributing to a potential risk associated with USB Southern Tributary sediment or surface water:

4.3.4.2 USB Eastern Reach Risk Characterization

USB Eastern Reach surface water data, benchmark comparisons, and summary statistics are presented in Table 4-15. Similar data for sediment is presented in Table 4-16.

***Surface Water**:* As shown by Table 4-15, four of the Upper Sutton Brook surface water COPCs listed in Table 4-11 were detected in USB Eastern Reach surface water, and maximum concentrations of three -- barium, iron, and manganese—produced NOAEL-based benchmarks over 1.0. All of these constituents are naturally occurring. Iron was detected at one location (SW-32(04)) at a concentration slightly higher (1.4 mg/l) than the NOAEL benchmark of 1.0 mg/l, but because of the ubiquitous nature of this compound in natural environments, a significant proportion of this concentration can be expected to reflect natural conditions. The NOAEL for iron is a WQC developed by EPA in 1985, although iron is identified by EPA as a non-priority pollutant in the water quality criteria documents. As a point of comparison, the lowest toxicity value listed in EPA's Ecotox database for this compound for a freshwater species (a mayfly) was an LC_{50} of 73.1 mg/l. However, since the maximum concentrations exceeds a WQC, which is a "To Be Considered" standard for the site, iron has conservatively been considered to present a potential risk.

The remaining two compounds, barium and manganese, are also naturally occurring, and were compared to LOAEL-based benchmarks to determine if concentrations approach those associated with observed effects. As shown by Table 4-15, detected concentrations of barium and manganese are well below lowest LOAEL values, producing LOAEL-based values of 0.01 and 0.2 respectively. Because the concentrations of barium and manganese in USB Eastern Reach surface water are well below values associated with potential effects, little or no potential for adverse effect is likely from these compounds for site receptors exposed to USB surface water.

***Sediment**:* Benchmark comparisons and summary statistics for USB Eastern Reach sediments are presented in Table 4-16. As shown, eight USB COPCs were detected in USB Eastern Reach sediment, and five of these – carbon disulfide, naphthalene, xylenes (here represented by p/m-xylene only), arsenic, and iron – exceeded NOAEL-based benchmarks.

Iron slightly exceeded its NOAEL benchmark in one sample, producing an HQ of 1.4. A slight exceedance by a single sample of a conservative NOAEL benchmark is not considered to reflect a significant risk, especially with a constituent such as iron that is frequently elevated in anaerobic sediments such as those in Sutton Brook. This constituent was thus not evaluated further.

Xylene, as represented by p/m-xylene, was detected in a single sample at a concentration only slightly higher than the NOAEL-based benchmark, producing a NOAEL-based HQ of 1.3. However, it was also subject to further analysis because of the presence of this COPC at elevated concentrations in downstream samples. All other constituents were compared to LOAEL-based values to estimate the potential for adverse effect.

Comparisons of sediment concentrations of carbon disulfide, naphthalene, xylenes, and arsenic are shown on Table 4-16. As shown, all COPCs except for arsenic had LOAEL-based HQs of 0.2 or less, indicating that maximum concentrations of COPCs are well below levels associated with adverse effects.

Arsenic exceeded the LOAEL-based benchmark in 5 of the 11 sediment samples from the Eastern Reach with HQs ranging from 1.7 to 4.2. As shown in Figure 4-2, all samples with LOAEL-based HQs > 1.0 (SD-20 (99), SD-210 (06), SD-212 (06), SD-213 (06), and SD-32 (04)) are located downstream of the confluence of the USB Eastern Reach with the Southern Tributary, and reflect the contribution of elevated arsenic that is characteristic of that stream. All locations upstream of the confluence (SD-209(06), SD-214(06), SD-215(06), and SD-31(04) had concentrations of 7.2 mg/kg to 25 mg/kg, which are below the LOAEL-benchmark of 33 mg/kg and close to or below the NOAEL-based benchmark of 8.2 mg/kg. In particular, recent arsenic in SD-209(06) directly upstream of the confluence was 9.5 mg/kg, and at SD-210(06) downstream of the confluence 140 mg/kg. SD-210(06) had the highest arsenic concentrations detected in the Eastern Reach, and produced an LOAEL-based HQ of 4.2. As described previously, the Southern Tributary is historically and currently the site of elevated sediment arsenic from upstream areas; a maximum concentration of 767 mg/kg of arsenic was detected in the stream in 1999 (SD-14(99)).

As described in the previous section, toxicity testing of the Southern Tributary sediments indicated that concentrations of arsenic in the range detected in the Eastern Reach were not associated with mortality effects and could not be correlated with reductions in growth in two species of invertebrates. As described above, the distribution of arsenic in the Eastern Reach suggests that detected concentrations arise largely from recent or historical contributions from the Southern Tributary. The 2006 sediment sampling in the Southern Tributary produced arsenic concentrations ranging up to 130 mg/kg, and up to 110 mg/kg in reference samples well upstream from the site, and these concentrations are generally equivalent to the maximum of 140 mg/kg detected in the Eastern Reach.

Although the arsenic in the Eastern Reach exceeds standard LOAEL-based benchmarks, samples with similar concentrations did not show adverse effects on benthic invertebrate growth or survival that could be attributed to arsenic, suggesting that the toxicity suggested by the benchmark exceedance does not occur in Site sediments. Based on the results of this evaluation, adverse effects to benthic organisms as the result of exposure to Eastern Reach sediment is not expected.

4.3.4.3 USB Site Channel Risk Characterization

The USB Site Channel consists of the narrow channel directly between the landfill lobes. As described in Section 4.3.2.3, the Site Channel was not evaluated further in this BERA, but rather was represented by

the evaluation presented in the SLERA (Appendix O). Potential risk from the SLERA is described below.

Surface Water: USB surface water was evaluated in the SLERA by comparison to NOAEL-based benchmarks. This comparison for Site Channel surface water is shown in Table 4-17. As shown, maximum concentrations of six compounds (DDT, ethylbenzene, toluene, xylenes, barium, and manganese) exceeded NOAEL-based benchmarks. Barium and manganese are naturally occurring compounds that were detected in upstream samples as well. Based on this evaluation, a potential risk to fish and pelagic invertebrates is assumed.

Sediment: USB sediment was also evaluated in the SLERA by comparison to NOAEL-based benchmarks. USB Site Channel sediment data is shown in Table 4-18. As shown, 15 of the 16 Upper Sutton Brook COPCs were detected in this reach. However, iron and naphthalene did not exceed NOAEL-based benchmarks, so are not considered to present a potential for risk. All other listed compounds (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methyl-2-pentanone, acetone, carbon disulfide, chloroethane, ethylbenzene, xylenes, toluene, arsenic, and manganese) exceed NOAEL-based benchmarks. Manganese is a naturally occurring compound that was detected in upstream samples as well. Based on this evaluation, a potential risk to benthic invertebrates is assumed.

4.4 AQUATIC WETLANDS

The following presents an evaluation of exposures and potential risks to receptors in the Aquatic Wetland.

4.4.1 Aquatic Wetlands Habitat Description

This area consists primarily of emergent, shrub-scrub and forested wetlands that exist at various locations around the Site. In general, wetlands in this category consist of Phragmites, cattails, and shrubs (northern arrowwood, winterberry, and others) wetlands, and waterways connected to these habitats. This wetland type exists at three general locations around the site.

The first is the lower reach of Sutton Brook, from the location of SW/SD-34(04) to downstream samples SW/SW-37(04) (Figure 4-4). It includes a large forested and shrub-scrub wetland and the lower reach of Sutton Brook, and associated tributaries, since these slow-moving watercourses share contaminant migration pathways and many habitat attributes. The wetland area between SW/SD-34(04) and SW/SD-36(04) is a forested wetland characterized by generally shallow (6 inches to 4 feet deep), stagnant water, with a shrub understory and green ash, white pine, and quaking aspen tree species. The riparian wetland area to the north of Sutton Brook contains large areas of open water with intermittent stands of shrubs. The riparian wetland south of Sutton Brook, plus the small wetland tucked in a ravine of the Northern Lobe (at WS-15(04)) are characterized by a denser growth of shrubs surrounded by pools and pockets of water up to 2 feet deep. This southern section of the riparian wetland is separated from the main channel of Sutton Brook by a berm for part of the length, but is connected hydraulically through groundwater or surface water pathways. Both wetland areas tend to go dry in late summer, although the main channel of Sutton Brook continues to flow.

This Habitat Area also includes the lower section of a tributary that enters Sutton Brook from the South, plus the lower section of Sutton Brook itself and a small, highly vegetated braided tributary that enters from the north (location of SW/SD-38(04)). These areas are connected to the forested wetland, and share many of the habitat characteristics.

The second location of this wetland type is at the western boundaries of the former Drum Disposal Area adjacent to the wetland north of the stream and consists of a phragmites marsh, which includes samples SS-12(04) and SW-111(05). Because of its proximity to the lower Sutton Brook wetland and the similarity in habitat, it is considered to be part of the Aquatic Wetlands Habitat group.

The third location of Aquatic Wetland habitat is along the base of the southern and eastern face of the Southern Lobe. This marsh, referred to as the Deep Marsh wetland, consists of an area of relatively deep (> 3 ft.) standing water at the western end, with a transition to a forested shrub-scrub wetland along the southern and eastern edge of the Southern Lobe. Standing water at the western end may be permanent, based on apparent depth and vegetation (cattails), while the standing water elsewhere along the southern and eastern sides is likely to be present during wet periods only.

The wetlands included in the Aquatic Wetland habitat area are a suitable environment for a variety of waterfowl, such as ducks and herons, which have been observed in the area. Because of the likely lack of fish predation through much of the shrub wetland, this area is well suited for wetland reptiles and amphibians, which have also been observed. Beaver are active in the area, and other wetland mammals, such as muskrat, are likely present.

4.4.2 Aquatic Wetlands Problem Formulation

For this evaluation, the components of the Problem Formulation were generally similar to the SLERA, with the exception of COPCs. The components of the Problem Formulation are presented below.

4.4.2.1 Aquatic Wetland Exposure Pathways and Potential Receptors

As described in the SLERA and the RI, contaminants can reach the Aquatic Wetlands by three primary means:

- discharge of groundwater,
- flooding of surface water from upstream Sutton Brook (lower Sutton Brook only),
- surface water runoff from the landfill lobes or former Drum Disposal Area.

Exposure media would thus be surface water and sediment within the stream channel and associated flooded wetlands.

A variety of potential receptors exist in the wetlands. While low dissolved oxygen concentrations in wetlands typically preclude robust fish populations, this habitat would be suitable for amphibians and aquatic macroinvertebrates, and would provide feeding and nesting areas for water birds, wetland mammals such as raccoons and beaver, wetland reptiles such as the ribbon snake, and other semi-aquatic or wetland species. Higher level receptors may be exposed to bioaccumulateable compounds through the ingestion of contaminated prey.

A conceptual site model describing potential exposure pathways and receptors for the Aquatic Wetland Aquatic Habitat Area is shown in Figure 4-5. This model is consistent with the SLERA.

To evaluate these exposure pathways, the SLERA evaluated effects on a number of receptors: benthic and pelagic aquatic organisms, amphibians, and wildlife herbivores, omnivores, and carnivores. The results of that assessment showed no exceedance of NOAEL-based benchmarks for wildlife carnivores, suggesting little potential for effect for that feeding guild. This result is reflected in the selection of COPCs, assessment endpoints, and measures of effect, described in the following sections.

4.4.2.2 Aquatic Wetlands Contaminants of Potential Concern

COPCs for the Aquatic Wetlands consist of those compounds that exceeded NOAEL-based benchmarks in the SLERA for one or more receptors. Table 4-19 summarizes the results of the evaluation of the SLERA for aquatic receptors and amphibians, and Table 4-20 shows summarized results for wildlife receptors. Compounds that produced a NOAEL-based HQ greater than 1.0 were identified as COPCs for this BERA. In addition, sample SD-02(99), previously not included in this habitat area, was added to the Aquatic Wetland dataset. Concentrations of toluene and chlorethane in this sample resulted in the addition of these compounds as COPCs (Appendix N.2). Aquatic Wetland COPC for surface water and sediment are listed, by receptor, in Table 4-21. Summary statistics for surface water and sediment COPCs are presented in Tables 4-22 and 4-23.

4.4.2.3 Aquatic Wetland Assessment Endpoints and Measures of Effect

Assessment endpoints for the Aquatic Wetland reflect the exposure pathways described previously for both aquatic, semi-aquatic, and wildlife receptors. Assessment endpoints for this area are as follows:

Assessment Endpoints for the Aquatic Wetland

1. survival and growth of pelagic and benthic invertebrate communities in the wetland;
2. survival and growth of amphibian communities in the wetland; and
3. survival and growth of higher trophic level herbivores and omnivores in the wetland. Consistent with the SLERA, herbivores are represented by the mallard, and omnivores are represented by the black duck. Both have been observed feeding in the Aquatic Wetland.

In this assessment, several measures of effects were used to assess potential effects on receptors in the stream and the wetland. In general, methods for measuring effect in this assessment consist of the following:

- comparison of all COPC concentrations to toxicological values reflecting effects on survival, growth, and reproduction;
- comparison of the estimated body dose of receptors, as estimated from food chain modeling of higher trophic level receptors using calculated values for COPCs in plant and prey items, to literature-based toxicity reference doses reflecting effects on survival, growth, or reproduction.

The exposure of amphibians to Aquatic Wetland sediments was not evaluated because the dominant exposure pathway for amphibians is water, and in consequence this is the medium for which toxicity data are available. Developing amphibians, either tadpoles or salamanders, are typically herbivores, and occasionally rest on the bottom but normally spend their time swimming in the water column to feed on periphyton or algae on vegetation or substrate surfaces, before metamorphosing into carnivorous adults. Adults of most species are riparian or terrestrial, and the most aquatic species, such as bullfrogs and green frogs, tend to rest on structures above the sediment during the active season. For these reasons, researchers have focused their attention on the water route of exposure, since this is the primary medium of exposure, particularly during the physiologically sensitive stage of eggs and larvae. In consequence, this BERA evaluates surface water as the exposure medium for amphibians.

4.4.3 Aquatic Wetland Analysis of Exposure and Effect

Methods used to evaluate exposure and effect in the Aquatic Wetlands are described below.

4.4.3.1 Aquatic Wetland Analysis of Exposure

Exposure of site receptors to COPCs was evaluated by media samples of site sediment and surface water collected during the RI and previous sampling events. In the SLERA data set, surface water in the Aquatic Wetland was represented by 23 samples from 21 locations, and by 21 sediment samples. These data were presented in the SLERA. As previously discussed, additional sediment samples (SD-215 to SD-221) were collected from the Deep Marsh in November 2006 (Figure 4-4). These data were combined with the existing data set used in the SLERA for this evaluation. A full list of samples used in the evaluation of the Aquatic Wetland was presented in Table 4-1, and analyses conducted for both the 2006 and previous sampling is shown in Table 4-3. The 2006 results were screened against NOAEL-based benchmarks to identify any new COPCs, and none resulted from this evaluation. In addition, SD-02(99) was redesignated as an Aquatic Wetland sediment, since the potential exists that it may remain exposed after the landfill cover is complete. This sample, as well as the November 2006 field program samples, were thus added to the Aquatic Wetland sediment dataset. Sample SD-02(99) was screening against NOAEL-based benchmarks to identify any new COPCs detected in this sample, and this screening is presented in Appendix N.2. As noted earlier, inclusion of SD-02(99) resulted in the addition of chloroethane and toluene to the COPC sediment COPC list.

Exposure to wildlife receptors were evaluated by food chain modeling, according to the methods described in the SLERA. In this modeling, average and 95% Upper Confidence Limit (UCL) concentrations of COPCs in surface water and sediment, in addition to maximum values, are used to estimate a body dose, in mg/kg body weight /day, received by each receptor. The concentration of COPCs in prey and vegetation was estimated from surface water and sediment data; no sampling of food items was conducted. For this evaluation, species representative of each of the feeding guilds remained the same as in the SLERA: the mallard for omnivores and the black duck for herbivores. As noted earlier, both of these species have been observed at the site and are species typical of forested and shrub wetlands. Detailed life history accounts were provided in the SLERA and quantitative life history parameters used in the modeling are provided in Table 4-5. The modeling methodology is presented in Appendix J.

Because these waterfowl have large home ranges, they are assumed to feed in both the Aquatic Wetland and the Site Pond, which lies in proximity to the Deep Marsh portion of the Aquatic Wetland. Because these habitats would both be attractive to waterfowl, receptor species are assumed to roam freely between them. However, because these areas are of different sizes, data sets were not weighted equally in the calculation of exposure point concentrations; rather, waterfowl were assumed to occupy each area for a period proportional to the respective size of the area. Combined data for the evaluation of waterfowl in these areas were thus area-weighted, in the following proportions:

Aquatic Wetlands:	5.61 hectares	87%
Pond:	0.82 hectares	13%

4.4.3.2 Aquatic Wetland Analysis of Effect

Potential effects were evaluated by LOAEL-based benchmarks (for aquatic and amphibian receptors) and LOAEL TRVs (for waterfowl). LOAEL-based benchmarks were presented in Table 4-6. Avian LOAEL-based TRVs are provided in Table 4-7. Avian TRVs are the same as presented in the SLERA, with the exception of the TRV for lead, which has been updated to reflect values from the study used by EPA to select NOAEL values for the generation of Ecological Soil Screening Levels (Eco-SSLs). The study from which EPA selected a NOAEL value of 1.63 mg/kg/day for lead also identified a LOAEL value of 3.26 mg/kg/day, and this value was used as a representative LOAEL for avian receptors at the Site.

4.4.4 Aquatic Wetland Risk Characterization

Potential risk was estimated for aquatic receptors, using surface water and sediment data, and for amphibians, using surface water data only. Both surface water and sediment data was used to estimate risks to wildlife. Risks to aquatic receptors, amphibians, and wildlife are described in separate sections, below.

4.4.4.1 Aquatic Wetland Aquatic Life Risk Characterization

Aquatic life in the Aquatic Wetland was evaluated by both surface water and sediment data. These are discussed separately, below.

Aquatic Receptors: Surface Water Risk

As presented in Table 4-19, maximum surface water concentrations of eight COPCs produced a NOAEL-based HQ > 1.0 when compared to aquatic benchmarks. However, three of these COPCs, ethyl benzene, aluminum, and lead, exceeded benchmarks in only one of 14 or more samples. The maximum concentration of ethylbenzene (0.0079 mg/l) only slightly exceeded the conservative benchmark of 0.0073 mg/l, and because of the conservatism of this benchmark, which was developed by EPA's Tier II methodology and so includes significant uncertainty factors, this slight exceedance is not expected to indicate a potential for risk.

Lead and aluminum were both only detected in one of 14 samples. The concentrations in this single sample exceeded the NOAEL-based benchmark. This single detection for both compounds occurred in sample SW-108(05), which is located in the downstream portion of the Aquatic Wetland, just south of the main Sutton Brook channel. Nearby (within 150 ft.) samples SW-3(99) and SW-35(04) did not contain either of these constituents, indicating that these concentrations are not widespread. Both of these single detections produced a NOAEL-based HQ of 2.5. However, because of the single point of detection and the relatively low detected concentrations, actual ecological effects associated with these concentrations is likely to be minimal and, if present, highly localized. Detected concentrations of lead and aluminum are thus not expected to reflect a significant potential risk.

Five COPCs, consisting of toluene, xylene, barium, iron, and manganese, exceeded aquatic NOAEL-based benchmarks in three or more samples. Toluene, which had the highest HQ of the organics, exceeded benchmarks in five samples. The likely on-site source for toluene and other organics in the Aquatic Wetland surface water is impacted groundwater from the Southern Lobe and/or the Former Drum Disposal Area.

To further evaluate the risk potential identified in the SLERA, surface water concentrations of toluene, xylene, barium, and manganese were evaluated further through the use of LOAEL-based benchmarks to more accurately estimate the potential for risk.

Table 4-24 shows the comparison of maximum surface water values to LOAEL-based benchmarks. As shown, maximum COPC concentrations are well below these effects-based benchmarks. This suggests that, although some samples exceed the more conservative estimates, actual toxicity effects may not be occurring in the environment. Barium and manganese were detected in all or nearly all of the samples, reflecting their natural presence in wetlands and surface waters in general. Concentrations of barium and manganese in many Aquatic Wetland surface water samples were similar to or lower than upstream reference station SW-30(04), further suggesting natural contributions.

Iron was not compared to LOAEL-based values given its frequency of detection and that the NOAEL for this compound used in the SLERA is a chronic water quality criteria, which is a "To Be Considered"

standard for the site. As shown by Table 4-19a, iron concentrations exceeded the criteria of 1.0 mg/l in 10 of 14 locations, although sometimes by small margins. This high frequency of detection is consistent with iron's ubiquitous nature in natural environments. Iron concentrations in the Aquatic Wetlands ranged from 0.12 mg/l to 5.3 mg/l. Concentrations in upstream reference samples SW-30(05) and SW-222(06) ranged from 0.22 mg/l to 0.27 mg/l. However, since the exceedances of this WQC are numerous and widespread, a potential risk from iron in Aquatic Wetlands surface water has conservatively been assumed.

The surface water data suggest that, with the exception of iron, the potential risk to aquatic receptors due to exposure from COPCs in surface water is low.

Aquatic Receptors: Sediment Risk

As shown in Table 4-19b, seven COPCs (acetone, benzoic acid, arsenic, beryllium, iron, mercury, and selenium) were found in the SLERA to be present at maximum concentrations exceeding NOAEL-based benchmarks. Toluene and chloroethane, which exceeded NOAEL benchmarks in SD-02(99), were also added to this list. These are discussed separately below.

Beryllium and iron both exceeded NOAEL-based benchmarks in one or two of 20 – 22 samples, with NOAEL-based HQs of 1.2 (iron) and 1.9 (beryllium). These maximums did not occur in the same location (Table 4-19b). Iron is a common naturally occurring compound that frequently is present in stagnant water at elevated concentrations. Beryllium exceeded the NOAEL-benchmark of 1.1 mg/kg at two widely separate samples: WS-11(04), at the western end of the Aquatic Wetland had 2.1 mg/kg of beryllium (HQ = 2.1) and WS-103(05), adjacent to the Southern Lobe, had 1.5 mg/kg (HQ of 1.4). The low NOAEL-based HQ and wide spacing of these two exceedance suggest little potential for risk.

Mercury exceeded the NOAEL benchmark of 0.150 mg/kg in two samples: WS-102(05) (0.22 mg/kg) and SD-01(99) (0.20 mg/kg), both from the Deep Marsh portion of the aquatic wetlands. In the 2006 samples, however, three additional samples, all from the Deep Marsh portion of the Aquatic Wetlands, also exceeded NOAEL-based values, producing a NOAEL-based HQ of up to 2.0. Because of these additional detections, mercury was subject to additional evaluation.

Acetone, benzoic acid, arsenic, mercury, and selenium all exceeded NOAEL based benchmarks in four or more samples, so were subject to additional review along with chloroethane and toluene from SD-02(99). This revised assessment is shown in Table 4-25. As shown by this assessment, all compounds except for arsenic and selenium had LOAEL-based HQs less than 1.0, indicating a low potential for risk to aquatic invertebrates from these compounds.

Point-by-point sediment data for the Aquatic Wetland is shown in Table 4-26 and illustrates the samples containing arsenic and selenium concentrations over the LOAEL-based benchmarks of 33 mg/kg and 4 mg/kg, respectively.

As shown by Table 4-26, arsenic exceeded the LOAEL benchmark of 33 mg/kg in three samples. The sample with the highest arsenic concentration, SD-38(04), was located in the small tributary that enters Sutton Brook from the north. The arsenic concentration in this sample was 64 mg/kg, producing a LOAEL-based HQ of 2.0. The two other samples, SD-24(99) and SD-36(04), contained 48.9 mg/kg and 39 mg/kg of arsenic respectively, producing LOAEL HQs of 1.5 and 1.2, respectively. Although these concentrations exceed LOAEL benchmarks, concentrations up to 130 mg/kg were found to have no effect on survival and no effect on growth attributable to arsenic in the Southern Tributary, an aquatic environment similar to the location of these samples. In addition, an arsenic concentration of 41.1 mg/kg was detected in reference sample SD-06(99), which was collected in a shrub/phagmites marsh upstream of the Site, and a arsenic concentration of 110 mg/kg was detected in reference sample SD-

201(06), which was located in the Southern Tributary. Because the concentration of arsenic does not exceed the LOAEL benchmark by a large margin, and is well below concentrations found in toxicity testing to have no arsenic-associated effect, the detected arsenic in Aquatic Wetland sediment is not expected to suggest a potential risk.

Selenium was detected in only one sample (WS-11(04)) at a concentration above the 4 mg/kg benchmark. This exceedance produced a LOAEL-based HQ of 1.3. This sample was located near the southern edge of the large forested wetland south of the Sutton Brook channel, and is separated from the landfill and Sutton Brook by a large area of stagnant wetland. Selenium concentrations in all other samples were well below the LOAEL benchmark, producing HQs of 0.4 or less. Because the selenium LOAEL exceedance occurred in a single sample only and selenium concentrations near LOAEL values were not detected in any other samples, no potential for risk to aquatic receptors is expected from this single exceedance of selenium.

Based on this evaluation, detected concentrations of COPCs in Aquatic Wetland sediment are not expected to present a potential risk to benthic invertebrates.

4.4.4.2 Aquatic Wetland Amphibian Risk Characterization

As shown in Table 4-19, maximum surface water concentrations of eight compounds exceeded NOAEL-based amphibian benchmarks and produced HQs > 1.0. Of these, three compounds, toluene (HQ of 1.1 in one location), arsenic (HQ of 2.1 or less, at two locations) and copper (HQ of 1.3 in one location) exceeded NOAEL-based benchmarks by a small margin at one or two locations out of 14 or more locations sampled. The single exceedance for toluene was in a sample from 1999 (SW-08(99)), which is located in the tributary that enters the Aquatic Wetlands from the south. This sample location is located about 400 feet away and downhill from a residential area, which is a source of roadway and lawn runoff. Since concentrations in this tributary may not reflect site values, and given that toluene has not exceeded amphibian NOAEL-based benchmarks in any sample since 1999, toluene is unlikely to present a risk to amphibians.

Copper was detected in three Aquatic Wetland surface water samples, and slightly exceeded the amphibian NOAEL-based benchmark in one location, SW-101(05), located off the southeast face of the Southern Lobe. Copper concentrations in this sample were 0.004 mg/l, just above the amphibian NOAEL benchmark of 0.003 mg/l (HQ of 1.3). Because the amphibian benchmark for copper is the geometric mean of LC10 values for sensitive species (spring peeper and the pickerel frog), it includes a large measure of conservatism. The geometric mean of LC50s for these same species is 0.028 mg/l (Westerman, 2003). Because the copper exceedance was small, and the conservative benchmark reflects a range of low-effect values to sensitive receptors, the copper HQ of 1.3 is not considered to reflect a significant potential for risk.

Arsenic exceeded NOAEL-based benchmark of 0.01 mg/l in two samples: SW-35(04) with 0.0206 mg/l arsenic (HQ of 2.1); and SW-36, collected in October 2004, with 0.0127 mg/l arsenic (HQ of 1.3). However, SW-36 sampling in September 2005 contained much lower arsenic concentrations (0.007 mg/l; HQ of 0.7) and 2006 sampling at both SW-36 and SW-37 showed either no detectable arsenic or concentrations below the NOAEL benchmark, suggesting that elevated arsenic concentrations are not continuous. Likewise, arsenic concentrations in sample SW-108(05), located about 150 ft. away from SW-35(04), contained 0.047 mg/l arsenic (HQ of 0.5). As above, the benchmark value for arsenic consists of the geometric mean of the LC10 value for sensitive species, so is biased towards the most sensitive members of this receptor group. Because the arsenic in this area does not appear to be consistently above the conservative benchmark or exceeds it over a wide area, the two small NOAEL exceedances observed in 2004 are not considered to reflect an on-going risk to amphibians.

Surface water concentrations of aluminum, iron, manganese, nickel, and zinc exceeded amphibian benchmarks in three or more samples, or, in the case of aluminum, by a large margin. For these compounds, additional benchmarks were identified to help bracket the range of potential risk. For most of these compounds, the original benchmarks consisted of the geometric mean of LC10 values for sensitive species of amphibians at the embryo-larvae life stage. Species sensitivity was designated based on response to metals, in general. For the BERA benchmarks, estimated LOAEL-based values were used to evaluate the potential for effect, and these values and revised HQs based on them are presented in Table 4-27. Use of these values helps to bracket the range of impact estimated by detected concentrations.

As shown in Table 4-27, only amphibian HQs for aluminum and iron exceed 1.0 based on this comparison. Point-by-point data for amphibian COPCs are shown in Table 4-28.

The iron LOAEL-based HQs exceeded 1.0 in three locations: SW-101(05), HQ of 1.8; SW-105(05), HQ of 1.1; and SW-35(04), HQ of 1.2 (Table 4-28). Samples SW-101(05) and SW-105(05) are both located in wetland areas included as part of the Deep Marsh, near the toe of the Southern Lobe slope, while SW-35(05) is located in the middle of the forested wetland east of the landfill lobes. Concentrations in these samples ranged from 3.3 mg/l to 5.3 mg/l. Iron is naturally occurring in wetlands surface water, where the anoxic conditions and often low pH will mobilize it from sediments as part of the sediment cycling of iron (Elder, 1988). The presence of soluble iron in the anoxic environments of the Aquatic Wetland is thus considered to be a reflection of natural iron processes. While a risk to amphibians may exist in the vicinity of SW-101(05), where the highest iron was detected, effects are likely to be highly localized; 11 of the 14 locations had iron concentrations of half (2.6 mg/l) of the maximum concentration or less. Thus, the potential for widespread risk to amphibians is low.

Aluminum was detected in only one out of 14 samples; the single detection of 0.22 mg/l was at SW-108(04), in the approximate middle of the wetland area downstream of the Northern and Southern Lobes, produced a LOAEL-based HQ of 2.5. This area was represented by eight other surface water samples, none of which contained detectable quantities of aluminum. Aluminum was also detected in one of two reference samples (SW-222) at a concentration of 0.1 mg/l . However, aluminum can exist in a range of concentrations in small quiescent waterbodies frequented by amphibians; aluminum concentrations in the range of 0.2 mg/l to 1.850 mg/l were documented in 50 temporary ponds in Pennsylvania (Horne and Dunstan, 1995). Aluminum solubility is related to water pH, which can vary throughout the day as the result of temperature and photosynthetic activity.

Based on this evaluation, the potential risk to amphibian populations from exposure to most surface water COPCs is expected to be low. However, localized effects from aluminum may exist in some locations due to the magnitude of the LOAEL HQ (2.5).

4.4.4.3 Aquatic Wetland and Site Pond Wildlife Risk Characterization

As described in Table 4-20, potential risk to herbivores (the black duck) and omnivores (the mallard) were identified in the SLERA, based on the use of maximum exposures and NOAEL-based TRVs. Specifically, risks to the black duck were associated with maximum concentrations of lead and selenium, and risks to the mallard were associated with maximum concentrations of aluminum and iron. As described previously, the present assessment incorporates exposures based on both average and 95% UCL data, and reflects the assumption that these receptors roam freely across the site, so would be exposed to both the Site Pond and the Aquatic Wetlands in a ratio proportional to the size of these areas. Exposure concentrations for surface water and sediment were thus averaged in proportion to area size (87% for the Aquatic Wetland, 13% for the Site Pond; see Section 4.4.3.1). These size-weighted exposure concentrations are shown in Table 4-29. For effects, both NOAEL- and LOAEL-based TRVs are used, to

more accurately bracket the ranges of effects. Results for each of these receptors are presented separately below.

Risk Characterization for Herbivores: the Black Duck

The black duck has been observed at the site and is assumed to consume only plant material, which is consistent with its life history on inland water bodies. Bioaccumulation into plant tissue is shown in Table 4-30, and exposure doses and hazard quotients are shown in Table 4-31.

Results from Table 4-31 are summarized below:

COPC	Average HQs		95% UCL HQs		Maximum HQs	
	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
lead	0.2	0.1	0.3	0.2	**1.1**	0.5
selenium	0.3	0.2	0.5	0.2	**1.2**	0.6

As shown, HQs greater than one are only produced under the maximum exposure scenario. Under more realistic exposure assumptions of average or 95% UCL exposures, which assume that the black duck feeds more uniformly across the site, no doses exceeded NOAEL-based TRVs. No measured doses under any scenario approached the LOAEL-based TRVs associated with potential for adverse effect. Based on the results of this analysis, no potential risk to the black duck is expected as the result of exposure to COPCs in the Aquatic Wetland and Site Pond.

Risk Characterization for Omnivores: the Mallard

The mallard was assumed to consume both invertebrates and aquatic vegetation, in equal proportions. If available, bioaccumulation factors specific to bioaccumulation in aquatic plants was used, and bioaccumulation was assumed to occur primarily through the roots of plants. Calculated concentrations in plant leaves were used as representative of concentrations in seeds and other vascular portions of plants (EPA 2003).

Bioaccumulation of COPCs into plant and invertebrate tissue is calculated on Tables 4-32 and 4-33, respectively. Calculated exposure doses under the three exposure scenarios are presented in Table 4-34. HQs for compounds that produced HQs greater that 1.0 for the mallard are summarized from Table 4-34, below:

COPC	Average HQs		95% UCL HQs		Maximum HQs	
	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
aluminum	0.6	0.06	0.7	0.07	**1.3**	0.13
iron	0.3	0.03	0.4	0.04	1.0	0.1

As shown, HQs $\geq$ 1.0 were obtained only under the scenario of maximum exposure, which is based on the assumption that the mallard feeds exclusively at the one location with the highest detected concentrations of all COPCs. Since maximum concentrations of COPCs are not co-located, this scenario is impossible, as well as unlikely. Under no scenario was the estimated dose approach associated with actual effects. Thus, no potential risk to the mallard is expected as the result of exposure to COPCs in the Aquatic Wetland and Site Pond.

4.4.5 Aquatic Wetland: Summary of Potential Risks

To address the assessment endpoints for the Aquatic Wetlands, risks to benthic and pelagic invertebrates, amphibians, and wildlife species in all three feeding guilds (carnivore, omnivore, and herbivore) were evaluated. Invertebrates and amphibians were evaluated by use of benchmarks and wildlife were evaluated by food chain modeling. Exposures and doses were compared to LOAEL-based values to evaluate potential for effect.

This evaluation showed that potential for risk to pelagic invertebrates exists due to the presence of iron in surface water, and to amphibians due to the presence of aluminum in surface water. Effects are expected to be localized. Little potential for risk was identified for benthic invertebrates, since all COPC values were either below LOAELs or infrequently detected. No risks were identified for wildlife receptors.

4.5 SITE POND

The Site Pond was evaluated both as a separate habitat area and, for wildlife receptors, in conjunction with the Aquatic Wetland. This evaluation is presented below.

4.5.1 Site Pond Habitat Area Description

This Habitat Area includes the small, shallow man-made pond south of the Southern Lobe. The Pond lies just to the south of the Deep Marsh portion of the Aquatic Wetland Habitat Area adjacent to the Southern Lobe. The Pond is sandy-bottomed, and is not believed to contain fish. No fish were observed in the pond during sampling, which involved moving around much of the pond by boat and inspecting the pond bottom, which is visible over the large shallow areas. In addition, hundreds of tadpoles were observed moving in large groups in shallow water areas; such abundance is atypical of water bodies containing fish, which typically feed on amphibian eggs and embryos. Water depth is less than four feet over much of the area of the pond, extending to approximately 7 feet or so near the eastern end.

Based on the RI findings, the Site Pond is on the hydraulically up-gradient portion of the site, in relation to groundwater flow. However, it is included for evaluation in this risk assessment because of its proximity to the landfill.

As described in the SLERA, the Pond is represented by 4 surface water and 4 sediment samples. Surface water and sediment samples associated with this area are listed in Table 4-1. Analyses performed on each samples are identified in Tables 4-2 and 4-3.

4.5.2 Site Pond Problem Formulation

For this evaluation, the components of the Problem Formulation were generally similar to the SLERA, with the exception of COPCs. No new data has been collected from this area since the SLERA. The components of the Problem Formulation are presented below.

4.5.2.1 Site Pond Exposure Pathways and Potential Receptors

Although the Pond appears to be hydrogeologically upgradient of the landfill lobes, the potential exists that groundwater may be a migration pathway for site contaminants under some circumstances. Since the Pond is separated from the Southern Lobe by the Deep Marsh wetland, surface run-off from the landfill is unlikely to reach the Pond even during high water periods. Media potentially affected by discharging groundwater consist of sediment and surface water.

The Pond is not believed to contain fish. It has no surface water inlet or outlet, and is believed to have

been created as a borrow pit. High numbers of tadpoles (both bullfrogs and green frogs) were clearly visible in shallow waters during the Habitat Assessment site visit in June 2004, suggesting a lack of predation pressure from fish, which normally feed on amphibian eggs and tadpoles. The pond is a habitat for amphibians, which would provide a food source for higher trophic level receptors such as the blue heron. The shallow, still waters also provide resting and feeding areas for other waterfowl, such as the black duck or mallard, which have been observed here or elsewhere at the Site.

The conceptual site model describing potential exposure pathways and receptors for the Site Pond is shown in Figure 4-6.

4.5.2.2 Site Pond Contaminants of Potential Concern

COPCs for the Site Pond are shown on Table 4-35**,** which illustrates the results of the SLERA evaluation of surface water and sediment of the Site Pond. As shown by this table, three compounds in both surface water and sediment exceeded the NOAEL-based benchmarks used in the SLERA. These compounds, which were identified as COPCs for this study, consist of the following:

Surface Water	Sediment
Barium, Dissolved (aquatic receptors)	Acetone
Manganese, Dissolved (amphibians)	Carbon disulfide
Zinc, Dissolved (amphibians)	Arsenic

4.5.2.3 Site Pond Assessment Endpoints and Measures of Effect

Assessment endpoints for the Site Pond reflect the exposure pathways that were shown by the SLERA to have the potential for adverse effect. As part of the SLERA, potential effects on benthic organisms, amphibians, and wildlife were evaluated. Wildlife were evaluated by waterfowl representative of the herbivore, omnivore, and carnivore feeding guilds. Waterfowl were evaluated by both Site Pond and Aquatic Wetland data, to reflect the movement of receptor species across those two habitat areas. That evaluation showed that estimated doses of COPCs to the carnivores (the heron) were below NOAEL-based TRVs, suggesting no potential for risk to members of that feeding guild. This conclusion of the SLERA is reflected in the conceptual site model and the identification of assessment endpoints.

Assessment endpoints for this area are as follows:

<u>Assessment Endpoints for the Site Pond</u>

1. survival and growth of invertebrate communities;
2. survival and growth of amphibian communities; and
3. survival, growth, and reproduction of higher trophic level herbivores and omnivores. As described previously, herbivores are represented by the black duck, and omnivores are represented by the mallard.

As with other areas, measures of effect consisted of the following:

- comparison of all COPC concentrations to ecological reflecting effects on survival, growth, and reproduction;
- comparison of the estimated body dose of receptors, as estimated from food chain modeling of higher trophic level receptors using calculated values for COPCs in plant and prey items, to literature-based toxicity reference doses reflecting effects on survival, growth, or reproduction.

4.5.2.4 Site Pond Analysis of Exposure and Effect

Exposure in the Site Pond was evaluated by the same data set used in the SLERA. These data are from four surface water and four sediment samples, which are identified on Table 4-1. Analyses performed on each of these samples are shown in Tables 4-2 and 4-3. Results of these samples were used directly to evaluate effects on benthic organisms and amphibians.

Exposure to wildlife receptors were evaluated by food chain modeling, as described in Section 4.4.2.4. As noted earlier, waterfowl receptors are expected to roam freely between both the Aquatic Wetland and the Site Pond, so risks to these receptors from both Habitat Areas was estimated by combining the data sets on an area-weighted basis.

Potential effects were evaluated by LOAEL-based benchmarks (for aquatic and amphibian receptors) and LOAEL TRVs (for waterfowl). LOAEL-based benchmarks were described in Section 4.2.2.2, and LOAEL-based values were presented in Table 4-6. Avian LOAEL-based TRVs are provided in Table 4-7.

4.5.3 Site Pond Risk Characterization

In the SLERA, the Site Pond data was evaluated for potential effects to aquatic receptors and amphibians, and combined with the Aquatic Wetland data to evaluate potential effects on wildlife receptors, represented by waterfowl. Hazard quotients for aquatic receptors and amphibians, based on conservative, threshold-level benchmarks, were summarized in Table 4-35. As shown, maximum detected values of most compounds produced only small exceedances of conservative benchmarks.

In surface water (an exposure media for both aquatic life and amphibians), barium, manganese, and zinc exceeded NOAEL-based benchmarks, but by low margins; maximum NOAEL-based HQs ranged from 1.4 to 2.3. Barium exceeded NOAEL-based aquatic life benchmarks, and zinc and manganese exceeded NOAEL-based amphibian benchmarks. As discussed in Section 4.2.2.2, these exceedances are within the range of conservatism of NOAEL-based values generally. In addition, a review of LOAEL values in Table 4-6a indicates that maximum concentrations of all three compounds fell well below LOAEL-based benchmarks. Barium, manganese, and zinc are naturally occurring metals typically found in ponds and other surface waters, and detected concentrations are reflective of natural sources in soil and parent rock. Because of the low magnitude of the NOAEL-based HQ and the fact that no concentrations exceed LOAEL-based values, potential risks from these inorganics are expected to be minimal.

As shown by Table 4-35, sediment arsenic concentrations slightly exceeded the NOAEL benchmark in one of the four sediment samples (SD-39(04), with 15 mg/kg arsenic); the other samples had arsenic concentrations of 7.8 mg/kg or lower, less than the NOAEL-based benchmark of 8.2 mg/kg. All of these values are well below the LOAEL-based benchmark for arsenic of 33 mg/kg (Table 4-6). Because of the low magnitude of this single exceedance and its general consistency with natural levels, arsenic is not considered to present a potential for risk in the Site Pond.

Although inorganics in the Site Pond surface water are not considered reflective of risk, concentrations were also compared to reference concentrations. This review showed that concentrations of all three of these inorganics were higher in off-site reference sample SW-30(05), which was collected in the marsh area of Upper Sutton Brook, well north of the access road (Figure 4-4). Concentrations of barium, manganese, and zinc in that sample were 0.03 mg/l, 0.35 mg/l, and 0.044 mg/l respectively, higher than the respective site concentrations of 0.006 mg/l, 0.02 mg/l, and 0.007 mg/l. Likewise, concentrations in reference sample SW-222(06) were also higher than the Site Pond samples; concentrations of barium, manganese, and zinc in SW-222(06) were 0.01 mg/l, 0.043 mg/l, and 0.025 mg/l, respectively. Site values are thus consistent with reference concentrations.

Carbon disulfide and acetone in sediment both produced NOAEL-based HQs > 3.0 in the Site Pond. The threshold sediment benchmarks for both of these COPCs were generated by equilibrium partitioning using conservative surface water values. In the case of carbon disulfide, the surface water value used was 0.00092 mg/l, which was a calculated value generated from modeling equations.

Detected concentrations of these compounds in sediment were thus compared to LOAEL-based values. LOAEL-based benchmarks for acetone and carbon disulfide were generated using lowest reported LOAEL surface water values from the literature and the pond-specific TOC used in the SLERA. These values are shown in Table 4-6b.

The LOAEL-based acetone benchmark is 0.05 mg/kg. When the maximum acetone sediment concentration of 0.024 mg/kg is compared to this value, it produces a LOAEL-based HQ of 0.5. Likewise, the LOAEL-based sediment benchmark for carbon disulfide is 0.024 mg/kg. When the maximum concentration of carbon disulfide in sediment (0.0016 mg/kg) is compared to this value, an HQ of 0.07 is obtained. Both of these values are well below levels of potential actual effect, so the potential for risk is suggested by this evaluation is low.

In summary, because detected concentrations of site pond COPCs were below LOAEL-based values, these COPCs are not expected to present a potential for risk. As discussed previously in Section 4.4.2.3, little potential risk to waterfowl is indicated.

4.6 WETLAND SOILS HABITAT AREA

The Wetland Soils Habitat Area borders both the Aquatic Wetland and Upper Sutton Brook. An evaluation of potential exposures and risk is presented below.

4.6.1 Wetland Soils Habitat Description

This Habitat Area consists of saturated, but not routinely inundated, soils that exist adjacent to the Aquatic Wetland areas described above (Figure 4-7). These areas are typically forested, with moist saturated soils and groundwater within a few inches of the surface, but are not submerged enough to support aquatic or semi-aquatic species. These soils would be affected by site contaminants primarily through groundwater, occasional surface water flooding, or surface water runoff. They do not provide a breeding habitat for receptors such as amphibians, but would support wetland plants and invertebrates that may accumulate contaminants from the soil pore water.

4.6.2 Wetland Soil Problem Formulation

Components of the Problem Formulation are presented below.

4.6.2.1 Wetland Soil Exposure Pathways and Potential Receptors

As described above, soils in these areas are saturated by groundwater much of the year, and may be briefly inundated by floodwaters during spring snowmelt or precipitation events. Contaminants may thus reach this area through both groundwater and by surface water deposition. In the Lower Sutton area particularly, these soils are occasionally subject to deposition from floodwaters of Sutton Brook, and so in some areas reflect the chemical composition of upstream areas.

Because these areas are not submerged, they do not provide habitat for aquatic species but may support a variety of wetland plants and animals. Wetland plants could provide food for a variety of songbirds and small mammals, as well as riparian species such as rabbits and moles. Although amphibians would not breed in this area, they and other wetland herptiles would use it for feeding and over wintering.

A conceptual site model describing potential exposure pathways and receptors for the Wetland Soils Habitat Area is shown in Figure 4-8.

4.6.2.2 Wetland Soils Contaminants of Potential Concern

As described previously, wetland soils were evaluated against NOAEL-based screening values in the SLERA, and 12 compounds were found to exceed one or more benchmarks for at least one receptor. The results of this comparison are summarized in Table 4-36. A list of COPCs, based on the results of the SLERA, is shown in Table 4-37. Summary statistics for each of these COPCs is shown in Table 4-38.

4.6.2.3 Wetland Soils Assessment Endpoints and Measures of Effect

Assessment endpoints for the Wetland Soils Habitat Area are the same as those used in the SLERA; no additional information was obtained to modify or expand these study objectives. Assessment endpoints for this area are as follows:

Assessment Endpoints for the Wetland Soils

1. abundance and diversity of plant species in wetland soils;
2. survival and growth of invertebrate species in wetland soils; and
3. survival, growth and reproduction of riparian carnivores and herbivores.

In this assessment, two measures of effects were used to assess potential effects on receptors in the stream and the wetland. Measures of effect are similar to those used in the SLERA. In general, methods for measuring effect are similar to those used in the SLERA, and consist of the following:

- comparison of all COPC concentrations to toxicological values reflecting levels of effect on survival, growth, and reproduction;
- comparison of the estimated body dose of receptors, as estimated from food chain modeling of higher trophic level receptors using calculated values for COPCs in plant and prey items, to literature-based toxicity reference doses reflecting effects on survival, growth, or reproduction.

4.6.3 Wetland Soils Analysis of Exposure and Effect

Methods for evaluating exposure and effect are described below.

4.6.3.1 Analysis of Exposure

Exposure of site receptors to COPCs was evaluated by media samples of wetland soil collected during the RI and previous sampling events. The Wetland Soils Habitat Area is represented by 13 soil samples, illustrated on Figure 4-7. Wetland soil samples associated with this area are listed in Table 4-1, and are the same as the SLERA. Analyses performed on each sample are identified in Table 4-4.

Exposure of wildlife receptors to COPCs was evaluated by food chain modeling, according to the methods described in the SLERA and provided in Appendix J. For this study, species representative of the carnivore and the herbivore consisted of the short-tailed shrew (carnivore) and the cottontail rabbit (herbivore). Both of these species are typical of herbaceous wetland habitats. Natural history descriptions of these two species were presented in the SLERA, and quantitative aspects of life history are provided in Table 4-5. For this assessment, the worm and soil ingestion rate for the short-tail shrew have been updated to reflect values used by EPA in generating Ecological Soil Screening Levels (Eco-SSLs;

EPA 2003, 2005a). As part of this effort, EPA conducted extensive background studies on both exposure parameters and TRVs, and these values are considered to be more accurate than single-study toxicity data or exposure values previously obtained from EPA's Wildlife Exposure Factors Handbook (EPA, 1993).

In this modeling, average and 95% Upper Confidence Limit (UCL) concentrations of COPCs in surface water and sediment are used to estimate a body dose, in mg/kg body weight /day, received by each receptor. Concentration of COPCs in prey (invertebrates) and vegetation was estimated directly from wetland soil data; no sampling of food items was conducted. Both the shrew and the rabbit were assumed to obtain drinking water from the Aquatic Wetland; thus Aquatic Wetland surface water values were used in the equations. In the SLERA, surface water values from the Site Channel portion of the Upper Sutton Brook were used to represent ingested surface water, as part of the conservative approach used in that assessment. However, this reach of the Upper Sutton has relatively little habitat of suitability for both species: the channel has steep banks and deep water, and adjoining land rises onto the landfill sideslopes. Greater populations of both shrews and rabbits are thus expected to exist in the larger, more herbaceous areas around the Aquatic Wetland, particularly the area downgradient of the landfills, so values from the Aquatic Wetland Habitat area were used in this assessment as part of more realistic refinement of risk estimates. While the Eastern Reach portion of the Upper Sutton Brook also provides a small area of suitable habitat, surface water concentrations of the wildlife COPCs (arsenic, manganese, and vanadium) are significantly lower than detected in the Aquatic Wetland. Exposure doses to wildlife in areas adjoining the Eastern Reach would thus be less than calculated in the Aquatic Wetland.

4.6.3.2 Analysis of Effect

Potential effects of Wetland Soil COPCs were evaluated by LOAEL-based benchmarks for plant and soil invertebrate receptors (Table 4-6), and LOAEL TRVs for the shrew and the rabbit. TRVs used to evaluate potential effects on the shrew and the rabbit are shown in Table 4-8 and 4-9. The shrew TRV for manganese (Table 4-9) was obtained from mammalian toxicity data by allometric scaling, which adjusts estimated TRV values to account for the specific body weight of the receptor species. This value is consistent with that used in the SLERA. The TRVs for arsenic and vanadium, however (Table 4-8), were updated to reflect values used by EPA in the development of the Eco-SSLs for these two compounds (EPA 2005b, 2005c). Consistent with EPA's approach for the Eco-SSLs, the same TRV values for arsenic and vanadium were used to evaluate effects on both the shrew and the rabbit, which have different body weights. EPA did not scale toxicity values in accord with mammalian body weight; rather they considered their approach of using the lowest bounded NOAEL from a large and comprehensive dataset to be sufficiently conservative to cover body size effects.

4.6.4 Wetland Soils Risk Characterization

Wetland soils were evaluated in regard to the four receptors described above: plants, soil invertebrates, mammalian carnivores (shrews) and mammalian herbivores (rabbit). These are discussed separately below. Full data results are provided in Appendix A.

4.6.4.1 Wetland Soils Plant Risk Characterization

As shown on Table 4-36, maximum concentrations of 11 COPCs were detected in soil in excess of NOAEL-based benchmarks for plants. However, six of these compounds (aldrin, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene) exceeded benchmarks in a single sample only, SD-12(99), which is located near the streambank opposite the landfill in a floodplain area about 200 ft. downstream from the crossing of the access road to the composting facility (Figure 4-7). Aldrin is a pesticide used mainly against termites and soil insects which attack field, forage, vegetable, and fruit crops. The five other compounds are components of heavy oil, such as engine oil, and asphalt products.

The area around SD-12(99) receives floodwater and surface water runoff from the uncurbed, very muddy and rutted dirt access road, and likely reflects the effect of heavy truck traffic to the composting facility, rather than specific landfill effects. Concentrations of constituents in these samples are consistent with levels found in urban soil generally, as the result of vehicle traffic and air emissions (Bradley et al. 1994). Exceedances of these six compounds were not large (HQ of 2.2 or less) and are based on conservative NOAEL-based benchmarks, so these exceedances are not expected to reflect significant risk to plants. Of note is that elevated concentrations of these constituents were not detected in other samples proximate to SD-12(99).

Manganese was detected in three locations at concentrations resulting in plant-based NOAEL-HQs of 2.4 or less. Two of these locations, WS-106(05) and WS-107(05), were located near SD-12(99), and were in the floodplain area of Sutton Brook adjacent to or near the access road (Figure 4-7). Both samples were on the opposite side of Sutton Brook from the landfill lobes, so would be inaccessible to normal landfill surface water runoff due to the intervening stream channel. The third location, GP-07(04), is located in the wet soils adjacent to the Aquatic Wetland area near the southwestern edge of the Northern Lobe. All of these locations are wet floodplain areas subject to periodic inundation and anoxic soil conditions, and the presence of manganese is often a natural consequence of these conditions. However, because manganese has been detected in groundwater near the location of sample GP-07(04), manganese concentrations were also compared to LOAEL-based benchmarks, shown in Table 4-39. The maximum LOAEL-based HQ was 0.2. Because maximum concentrations of this compound are well below actual effects levels and the location of elevated concentrations suggests non-site influences, this compound is not expected to be associated with potential risk.

Arsenic exceeded the NOAEL-based plant benchmark of 18 mg/kg (Appendix K) in only one of twelve locations (SS-9(04)), producing an HQ of 1.7. This sample is in the floodplain area adjacent to the Aquatic Wetland. This single low exceedance is not expected to present a potential risk to widespread plant abundance.

Mercury, selenium and vanadium exceeded plant NOAEL-based benchmarks in 3 or more of the 12 wetland soil samples collected. Mercury exceeded the value used as a plant NOAEL benchmark in nine samples, which reflects a high level of conservatism used in selecting this benchmark in the SLERA. The plant benchmark used in the SLERA was based on Efroymson, et al 1997a, which lists 0.3 mg/kg as the recommended mercury benchmark for plants Efroymson et al. based the benchmark on two studies, one of which indicated unspecified toxic effects (a LOAEL) at 0.3 mg/kg mercury, and a second which indicated a NOAEL at 34.9 mg/kg and a LOAEL of 64 mg/kg. Efroymson thus recommended a plant benchmark of 0.3 mg/kg. To convert this value to a true NOAEL, we applied an uncertainty factor of 10 to obtain a NOAEL of 0.03, which was the benchmark used in the SLERA. In this BERA, 0.3 mg/kg is used as a conservative plant LOAEL, to be consistent with the LOAEL selection methodology used for other COPCs.

To evaluate the potential for effect, maximum values of mercury, selenium, and vanadium were compared to LOAEL-based plant benchmarks, which represent the lowest concentration at which effects are likely. These values were shown on Table 4-6. This comparison is presented in Table 4-39. As shown on this table, maximum concentrations of selenium and vanadium exceeded LOAEL-based benchmarks, producing HQs of 1.4 and 6.4, respectively. Mercury did not exceed the LOAEL-based benchmark.

Selenium exceeded LOAEL-benchmarks in two samples, SS-5(04) with an HQ of 1.1 and WS-106(05) with a HQ of 1.4. Selenium concentrations in these samples were 1.8 mg/kg and 2.4 mg/kg, respectively, and concentrations of selenium in Wetland Soil samples generally ranged from 0.24 mg/kg to 1.8 mg/kg (Appendix A). The low exceedance in a few samples suggests that effects are not likely to be large or widespread.

Vanadium exceeded benchmarks in nearly all samples from both wetland soil and reference locations, suggesting that observed concentrations of this metal may be widespread in this area and not specifically related to landfill operations. In addition, the cited LOAEL value from the literature is likely to overestimate potential risk levels. In accord with the practice of using the lowest LOAEL, site values were compared to a plant LOAEL of 2.5 mg/kg, which was the lower of LOAEL values from two studies listed by Efroymson et al 1997. However, the second of the two studies suggested a LOAEL of 50 mg/kg, indicating that the 2.5 mg/kg value may be conservative; Efroymson herself has "low confidence" in the NOAEL benchmark based on it. Since the maximum concentration detected was well below the second LOAEL value of 50 mg/kg, and since a large measure of uncertainty attends the cited 2.5 mg/kg LOAEL, detected concentrations of vanadium cannot be assumed to present a potential risk to plant receptors.

As an additional point of comparison, selenium and vanadium concentrations were also compared to reference concentrations. Site selenium concentrations ranged from 0.24 mg/kg to 1.8 mg/kg. Concentrations in six wetland soil reference samples ranged from 0.47 mg/kg to 2.5 mg/kg. Thus, detected site concentrations of selenium are within natural ranges detected in reference samples. Maximum site concentrations are lower than detected in reference samples.

Vanadium concentrations in Wetland Soil site samples ranged from 2.6 mg/kg to 16 mg/kg. Similar concentrations were detected in reference samples, where vanadium concentrations ranged from 2.2 mg/kg to 14 mg/kg. Vanadium concentrations in all reference samples except one exceeded the 2.5 mg/kg LOAEL.

Based on this assessment, detected concentrations of COPCs in Wetland Soil are not expected to present a potential risk to plant communities. Detected concentrations are either close to NOAELs, or below representative LOAEL values.

4.6.4.2 Wetland Soils Invertebrate Risk Characterization

In the SLERA, maximum concentrations of benzoic acid and mercury exceeded NOAEL-based benchmarks for invertebrates, as shown in Table 4-36. Both of these exceedances are discussed in turn, below.

Benzoic acid concentrations exceeded the NOAEL-based benchmark of 0.035 mg/kg in two samples: SS-13(04), near the former Drum Disposal Area and SS-9(04), near a construction debris pile west of the Northern Lobe (Figure 4-7). However, due to the lack of data on invertebrate effects, the soils benchmark for benzoic acid used in the SLERA had a high level of uncertainty. Because no soils-based toxicity data was available, the benchmark for that report was generated by equilibrium partitioning using surface water benchmarks for aquatic invertebrates developed by Suter and Tsao, 1996. The surface water benchmark cited in that document is actually based on toxicity data for fish.

To more accurately access benzoic acid effects in this BERA, recent research by Saha et al 2006 on benzoic acid effects on various freshwater invertebrate species was used. This research indicated a 96-hour LC_{50} of 39.47 mg/l for oligochaete worms, which was divided by 10 to estimate a LOAEL concentration. This concentration, along with an average wetland soil total organic carbon value of 7.4% for wetland soils (Appendix A) was incorporated into the equilibrium partioning equation described in the SLERA to obtain a revised benchmark. The resulting value, 4.2 mg/kg, was used as a revised LOAEL-based benchmark for wetland soils invertebrates.

No concentrations of benzoic acid in wetland soils exceed the LOAEL-based benchmark. The highest value, 0.780 mg/kg in SS-9(04), produced a revised LOAEL-based HQ of 0.19. No risk is thus anticipated to wetland soil invertebrates from this compound.

Mercury was detected in wetland soils at concentrations ranging from 0.032 to 0.3 mg/kg, and exceeded the invertebrate NOAEL-based benchmark of 0.1 mg/kg (Efroymson, et al 1997b) at three locations (Table 4-36). This NOAEL-based benchmark was obtained by Efroymson et al by the application of an uncertainty factor to a literature-based LOAEL value of 0.5 mg/kg. Thus, the original LOAEL of 0.5 mg/kg was used as the invertebrate LOAEL-based benchmark for mercury. No concentrations of mercury exceeded this LOAEL value. Because these data indicate that mercury concentrations are below documented effects levels, no potential risk to invertebrates is expected.

Mercury concentrations in Wetland Soil were also similar to reference concentrations. Wetland Soil concentrations ranged from 0.027 to 0.3 mg/kg, while reference soil concentrations ranged from 0.019 mg/kg to 0.24 mg/kg (based on reference soil samples in the BERA data set, which differs somewhat from human health risk assessment data set; see Section 4.2.2.1).

In general, this assessment indicates that detected concentrations of COPCs in Wetland Soil are not expected to adversely affect soil invertebrates. Maximum concentrations of both benzoic acid and mercury are below LOAEL values associated with the onset of effects.

4.6.4.3 Wetland Soil Wildlife Risk Characterization: The Short-Tailed Shrew

Potential effects to carnivores were evaluated by estimating exposures to the short-tailed shrew. Estimated concentrations in earthworm prey are shown in Table 4-40, while estimated exposure doses and LOAEL-based HQs are shown in Table 4-41. Values for average, 95% UCL, and maximum soil concentrations are used to estimate a range of exposures; however, because of the small home range size of the shrew (0.39 ha, or about an acre), only maximum values are used to evaluate potential effects.

As shown, no LOAEL-based HQs for manganese or vanadium exceed 1.0 under maximum exposure conditions. The arsenic LOAEL-based HQ produced an HQ of 1.1 under maximum exposure conditions. However, the maximum arsenic concentration of both surface water SW-35(04)and sediment (SS-9(04)) were substantially (1.6 to 1.9 times) higher than other concentrations, so the number of individuals actually exposed to concentrations close to these values is expected to be small. For this reason, little or no effect on shrew populations is expected. Effects on individual shrews living in the area of maximum concentrations are expected to be minor, based on the slight exceedance of the LOAEL-based HQ (1.1).

Based on this assessment, exposure of the short-tailed shrew to Wetland Soil COPCs is not expected to present a potential for risk.

4.6.4.4 Wetland Soil Risk Characterization for the Herbivores: The Cottontail Rabbit

The cottontail rabbit was modeled as a representative herbivore under average, 95% UCL, and maximum concentrations of arsenic and vanadium. No other exposure assumptions were modified for this species. Updated TRV values used to evaluate effects are listed in Table 4-8.

HQs based on this range of exposure concentrations are presented in Table 4-43. As shown, no estimated exposures exceeded either NOAEL- or LOAEL-based benchmarks, under maximum exposure conditions. Thus, no potential for risk is expected for the cottontail rabbit.

4.6.5 Conclusion: Potential Risk from Wetland Soils

Based on the results of this assessment, no significant potential for risk is indicated for plants, soil invertebrates, site carnivores (represented by the shrew), or site herbivores (represented by the rabbit) as the result of exposure to Wetland Soil COPCs. Calculated HQs were below representative LOAEL-based toxicity values. Vanadium plant LOAEL benchmarks are associated with a large uncertainty, and risk cannot therefore be assumed.

4.7 UPLAND SOILS

An evaluation of potential risks associated with upland soils around the former residence, garage and storage area is presented in this section. However, the area of study included in the Upland Soils Habitat Area has been modified since the SLERA, as described below.

In the SLERA, the Former Drum Disposal Area (FDDA) was considered to be part of the Upland Habitat Area. As discussed in the RI report, the sampling approach developed and implemented in the RI included the collection of several soil samples from this area. In accordance with the plan, soil samples were field screened and the sample depth that represented the highest response factors were submitted for laboratory analyses. As such, the majority (all but one sample – SB-03(04)) were submitted from depth intervals below 1 foot. The results from both the SLERA (using this one sample) and the preliminary human health risk assessment indicated that soil concentrations were driving risk in these limited sample locations. In addition, soil contamination was also detected near and below the water table surface, which was contributing to groundwater impacts.

Based on the results of the SLERA, the preliminary refinement performed as part of this assessment, and conversations with EPA during the development of this assessment with regard to the number and type of soil samples in relation to preliminary results and presumed remedial actions, a potential risk has been assumed and no further refinement or evaluation of the data in addition to the SLERA was performed in this area as part of this BERA. However, the remainder of the Upland Soils Habitat Area (without SB-03(04)) has been evaluated further in the sections below. Risks for the FDDA are presented at the end of this section, and are based on the evaluation conducted in the SLERA.

As the result of this change, both the number and concentrations of COPCs have changed somewhat from the SLERA, since some compounds were detected only in FDDA sample SB-03(04) and nowhere else. These changes are noted in the appropriate sections below.

4.7.1 Upland Soils Habitat Description

This area consists primarily of the upland soils around the former residence, garage, and storage area (Figure 4-7). These areas consist of open packed dirt and fields between the property boundary and the small northern tributary to Sutton Brook. An abandoned house, a large garage, various unused vehicles, and a variety of debris are present in this Habitat Area near the former entrance to the landfill. This area is overgrown in some areas with native and invasive weeds and grasses.

As described in Section 4.2.1, the New Jersey tea inchworm (*Apodrepanulatrix liberaria*, an Endangered moth) and frosted elfin (*Callophrys irus*, a Special Concern butterfly) are upland species that have been documented in the vicinity of the site. Both rely on critical host plants (New Jersey tea for the moth, and wild indigo and wild lupine for the butterfly) that have the potential to exist in this area, although none were documented in the floral surveys of either the Ecological Characterization or Wetland Delineation conducted for the Site.

4.7.2 Upland Soils Problem Formulation

The components of the Upland Soil Problem Formulation is presented below.

4.7.2.1 Upland Soil Exposure Pathways and Potential Receptors

The Upland Habitat Area is comprised of the generally disturbed and impacted areas around the former residence and garage, and associated work areas near the former entrance to the landfill. Contaminants in this area may be present as the result of direct deposition (spills and releases) from vehicles, or from

debris or miscellaneous waste material stored around the area. Vegetation consists of pioneer and invasive species characteristic of disturbed areas.

The primary exposure medium is site soils. Potential receptors may include small mammals, which through burrowing or consumption of contaminated invertebrate prey or plants may be exposed to site contaminants; also insectivorous birds, and other grazing or burrowing species that may incidentally ingest soils. However, because of the relatively poor quality of the habitat in this area, potential receptors are likely to be limited under current conditions.

A conceptual site model describing potential exposure pathways and receptors for the Upland Habitat Area is shown in Figure 4-9.

4.7.2.2 Upland Soil Contaminants of Potential Concern

Upland soils were evaluated in the SLERA by comparing maximum concentrations to appropriate NOAEL-based benchmarks. However, many of the maximum concentrations reported in the SLERA were obtained in the FDDA sample SB-03(04). Maximum concentrations of many compounds are much lower (below benchmarks) in the non-FDDA portion of the Upland Soils, and two compounds, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were not detected at all. For this reason, the COPCs evaluated in this BERA are different than those reported in the SLERA. Summary statistics for the SLERA COPCs detected in the Upland Soils Habitat Area, exclusive of SB-03(04), are shown in Table 4-44.

To determine Upland Soil COPCs for plants and invertebrates, maximum concentrations of the Upland Soil COPCs identified in the SLERA were compared to the SLERA NOAEL-based benchmarks. This comparison is shown in Table 4-45. As shown, maximum concentrations of eight compounds in the non-FDDA portion of the Upland Soils exceeded benchmarks, and so are evaluated further in this BERA. For wildlife, all COPCs with HQs greater than one in the SLERA (Table 4-45) were subject to additional evaluation in this BERA, with the exception of 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene, which were only detected in the FDDA. BERA COPCs resulting from this process for are listed in Table 4-46.

4.7.2.3 Upland Soils Assessment Endpoints and Measures of Effect

Assessment endpoints for the Upland Soils reflect both the habitat characteristics and the findings of the SLERA and are described in this section. In the SLERA, maximum estimated doses of Upland Soil COPCs to a representative herbivore, the meadow vole, all were below NOAEL-based TRVs. This feeding guild is thus not included as an assessment endpoint for this BERA. Other assessment endpoints remain similar to those in the SLERA, and are presented below:

Assessment Endpoints for the Upland Soils

1. abundance and diversity of plant species;
2. survival and growth of invertebrate species; and
3. survival, growth, and reproduction of site carnivores.

Measures of effect for these assessment endpoint were the same as in other Habitat Areas:

- comparison of all COPC concentrations to toxicological values reflecting levels of effect on survival, growth, and reproduction;
- comparison of the estimated body dose of receptors, as estimated from food chain modeling of

higher trophic level receptors using calculated values for COPCs in plant and prey items, to literature-based toxicity reference doses reflecting effects on survival, growth, or reproduction.

4.7.3 Upland Soils Analysis of Exposure and Effect

Components of exposure and effect are described below.

4.7.3.1 Analysis of Exposure

Exposure of site receptors to COPCs was evaluated by media samples of upland soil collected during the RI and previous sampling events. The Upland Soil habitat area is represented by 12 soil samples, excluding SB-3(04), illustrated on Figure 4-7 and listed on Table 4-1. Analyses performed on each sample are identified in Table 4-4.

Exposure of wildlife carnivores to Upland Soil COPCs was evaluated by food chain modeling, according to the methods described in Appendix J. Consistent with the SLERA, the American robin was chosen as the species representative of the carnivore. This species is typical of upland and mixed woodland areas, and has been observed at the site. Natural history descriptions of this species were presented in the SLERA, and quantitative aspects of life history are provided in Table 4-5.

For this assessment, exposures of the robin to Site COPCs in the Upland Soils Habitat Area were evaluated by using average, 95% UCL, and maximum soils data. Average and 95% UCL data accurately reflect exposure by a freely roaming receptor such as the robin. Concentration of COPCs in prey (invertebrates) and vegetation was estimated directly from soil data; no sampling of food items was conducted. In addition, the robin was assumed to feed 50% of the time in the Upland Soil Habitat area, and 50% of the time in off-site areas. This assumption reflects the fact that much of the Upland Soils habitat area lies near or adjacent to the site boundary, and that large areas of suitable habitat (mixed hardwood forests, residential lawns and shrubbery, and open areas) surround the site. Much of the Upland Soils areas consists of compacted soil with little vegetation or suitable habitat for soil invertebrates, which would further reduce the desirability of the area for feeding. Roosting areas are restricted to the woodlands along the northwest edge of the site, near the former residence, and breeding populations in this area would be expected to forage largely off-site. For these reasons, a 50% use factor was assumed to more accurately reflect actual site usage for this receptor.

In addition, the diet of the robin was adjusted to more accurately reflect the mixed composition of food items ingested by this species. According to Wheelwright, 1996, the proportion of fruit in robins' diets was influenced by several factors, especially time of year: fruit constituted more of the diet in the fall and winter (median values >90%) than in the spring (<10%); summer values were intermediate. Male and female robins did not differ in the proportion of fruit eaten in any month in any region. In addition, the stomachs of juvenile robins generally contained a higher proportion of fruit than did stomachs of adults. For these reasons, a mixed diet of fruits and invertebrates was used to more accurately reflect the average robin diet, rather than an exclusively invertebrate diet, as was assumed in the SLERA. Specific values are shown in Table 4-5.

4.7.3.2 Analysis of Effect

Potential effects of Upland Soil COPCs were evaluated by LOAEL-based benchmarks for plant and soil invertebrate receptors (Table 4-6) and LOAEL TRVs for robin (Table 4-7). As discussed in Section 4.4.3.2, the NOAEL and LOAEL for lead has been updated to reflect EPA usage in the Eco-SSLs.

4.7.4 Upland Soils Risk Characterization

Upland Soils were evaluated in regard to the three receptors identified above: plants, soil invertebrates, and avian carnivores (the robin). These are discussed separately below. As noted, the FDDA, represented by SB-03(04), is not included in this evaluation.

4.7.4.1 Upland Soils Plant Risk Characterization

As shown by the plant HQs listed in Table 4-45, maximum concentrations of six compounds in Upland Soil exceeded NOAEL-based benchmarks for plants in the SLERA. Much of the area contained in the Upland Soils habitat area was the location of debris and machinery storage, and the presence of low concentrations of the detected organics and metals is a likely consequence of this use. The soil throughout much of the area consists of compacted soil from truck traffic and material storage activities.

Maximum concentrations of two compounds (1,2,4-trichlorobenzenene and zinc) exceeded plant benchmarks in two or fewer of nine or more samples and produced NOAEL-based HQs of 2.0 or less. 1,2,4-trichlorobenzene only slightly exceeded (HQ of 1.2) the NOAEL benchmark in a single location, so is not likely to cause a significant ecological impact. Zinc (HQ of 2.0) was detected in two samples at concentrations exceeding the NOAEL. Sample SO-07(99) in the vicinity of the maintenance garage contained 379 mg/kg zinc. Zinc was also detected at SO-01(99) at a concentration of 199 mg/kg, slightly over the 190 mg/kg plant benchmark. The NOAEL-based benchmark for zinc (190 mg/kg) is a draft Eco-SSL developed by EPA, and represents a geometric mean of acceptable toxicity values (calculated variously by EPA) from 19 studies. However, six of these studies showed acceptable toxicity values of between 299 mg/kg and 361 mg/kg, suggesting that the 379 mg/kg of zinc detected in Site sample SO-07(99) is not likely to be in the range associated with significant effects. Because all other zinc concentrations were considerably lower than 379 mg/kg, effects, if any, are expected to be localized.

Lead exceeded NOAEL-based benchmarks in three locations, producing a maximum NOAEL HQ of 1.9, relative to the NOAEL-benchmark in the SLERA of 120 mg/kg (Appendix K). All three locations with lead concentrations exceeding the NOAEL-based benchmark were located in the area near the former residence and garage, and HQs for these samples – SO-09(99), SO-07(99), and SO-01(99) ranged from 1.1 to 1.9. Concentrations in these samples ranged from 136 mg/kg to 233 mg/kg (Appendix A), values typical of concentrations in urban soil, which has been found to average 389 mg/kg of lead in the urban Boston area (Bradley et al 1994). Because of the low number of relatively low HQ values, and the consistency with urban soil generally, lead is not considered to present a potential risk to plants.

The remaining three compounds, 2,4-dimethylphenol, mercury, and vanadium, produced NOAEL-based HQs greater than 3.0 in at least one location, so were evaluated further through additional toxicity data. NOAEL-based HQs for these compounds ranged from 8.7 to 9.0.

2,4-dimethylphenol was detected only in SO-07(99), collected from near the garage, and produced a NOAEL HQ of 8.9. The benchmark for 2,4-dimethylphenol (0.01 mg/kg) was cited by EPA Region 5 as a value based specifically on exposure to plants, with no further detail provided. No specific plant LOAEL toxicity data could be located; however, the NOAEL value cited is up to three orders of magnitude less than plant screening values for other phenols, which have benchmarks ranging from 3 mg/kg for pentachlorophenol to 70 mg/kg for phenol (Efroymson et al, 1997a), suggesting a high level of conservatism in the NOAEL value. For this reason, the 0.089 mg/kg of 2,4-dimethylphenol is not expected to signify a level of risk sufficient to initiate further assessment.

Mercury and vanadium both also produced HQs greater than 3.0 and so were compared to the LOAEL-based plant values presented and described in Table 4-6. As shown in Table 4-47, maximum

concentrations of mercury did not exceed LOAEL-based benchmarks. As noted on Table 4-6c, the value used as the mercury LOAEL (0.3 mg/kg) is recommended by Oak Ridge National Laboratory researchers as a screening level benchmark, so is normally used as a NOAEL-based value. It is used as a LOAEL here because it was the lowest effect level in the study cited by Oak Ridge. No adverse effect is expected from mercury.

Maximum concentrations of vanadium exceeded plant LOAEL-based benchmarks, producing a LOAEL-based HQ of 7.2. Vanadium exceeded the LOAEL-based plant benchmark of 2.5 mg/kg by at least six times in all 11 samples tested (see data in Appendix A), and in all but one of 14 reference samples. As described previously in Section 4.6.4.1, the 2.5 mg/kg plant benchmark may be overly conservative, since other data cited by Efroymson et al. suggested a LOAEL value of 50 mg/kg, which is well above the maximum of 18 mg/kg detected in Upland Soils. Thus, although concentrations exceed the lowest LOAEL value, significant uncertainty surrounds the this LOAEL value and suggests that effects may be less then suggested. Thus, a potential for risk to plants from exposure to vanadium cannot be assumed.

As an additional point of comparison, concentrations of vanadium were also compared to reference concentrations. The concentration of vanadium in Upland Soils ranged from 9.2 mg/kg to 18 mg/kg. Concentrations of vanadium in reference samples ranged from 2.2 mg/kg to 14 mg/kg. According to EPA, mean concentrations of vanadium in Massachusetts soil is 87 mg/kg (EPA 2003), and the maximum concentrations of vanadium in Upland Soil (18 mg/kg) is well below this value.

Based on these results, no significant risk to plants is indicated from Upland Soil COPCs, since HQ exceedances were generally low and infrequent.

This finding has particular relevance for the endangered New Jersey tea inchworm and the "special concern" frosted elfin butterfly (Section 4.2.1), both of which rely on one or two critical host plants for feeding and/or reproduction. While none of these critical host plants were identified at the site during the Ecological Characterization and other studies, the results of this evaluation suggests that host plant species, if present, would not be affected by detected concentrations of COPCs. Thus, the food base and larval host plant population required by the protected moth and butterfly are expected to be unaffected by detected concentrations of site contaminants.

4.7.4.2 Upland Soil Invertebrate Risk Characterization

HQs based on invertebrate benchmarks are also presented in Table 4-45. As shown, four compounds: 4,6-dinitro-o-cresol, copper, mercury, and zinc, exceeded NOAEL-based HQs in at least one sample. These exceedances were examined and evaluated further.

4,6-Dinitro-o-cresol was detected in one of 10 samples, producing a NOAEL-based HQ of 1.7. As discussed earlier (Section 4.2.3) this single occurrence and low NOAEL HQ is not considered to be reflective of potential risk, because of the relatively high level of conservatism associated with NOAEL-based benchmarks.

The remaining three 3 compounds (copper, mercury, and zinc) exceeded benchmarks in two or more samples or by a large margin, so were compared to LOAEL-based toxicity values. This comparison is shown in Table 4-48.

As shown by Table 4-48, maximum values of mercury were well below the LOAEL-based benchmark for mercury. The potential for risk from mercury is thus expected to be low.

Copper and zinc, which are naturally occurring inorganics, also exceeded LOAEL toxicity values. A review of site data shows that copper LOAEL HQs exceeded 1.0 in three samples, with HQs ranging from

1.1 to 1.4. All three samples, SO-09(99), SO-07(99), and SO-01(99), had copper concentrations ranging from 66.9 mg/kg to 88.3 mg/kg, and all were located around the former residence and associated work yards and material storage areas. However, the LOAEL used to evaluate these concentrations may not accurately represent a true effects level for these soils. Specifically, the LOAEL for copper (63 mg/kg) was the lowest measured LOAEL among 18 studies cited by Efroymson et al 1997b; LOAELs in other 17 studies ranged from 100 mg/kg to 2,000 mg/kg, depending on soil and compound type, suggesting that toxicity is highly site-specific and usually less than indicated by the 63 mg/kg LOAEL. The preponderance of LOAEL data substantially higher than the lowest LOAEL value cited in Table 4-48 suggests that a high degree of uncertainty is associated with the calculated LOAEL-based copper HQ, and that actual toxicity is likely to be substantially less than suggested. These data thus are not considered to indicate a significant potential for risk.

Zinc produced a LOAEL-HQ > 1.0 in one sample: SO-07(99) with 379 mg/kg of zinc (HQ of 2.0). This sample is located near the garage, and may reflect the presence of stored metal machinery or galvanized parts in these areas. However, the presence of zinc at a concentration of twice the LOAEL in SO-07(99) suggests a potential for risk from this compound at this location. Because LOAEL exceedances are not widespread, however, effects are likely to be localized around the area of SO-07(99).

Based on this assessment, the concentrations of zinc at SO-07(99) may present a localized potential risk to soil invertebrates.

4.7.4.3 Risk Characterization for Site Carnivores (American Robin)

In the SLERA, effects on wildlife from exposure to upland soil were evaluated through food chain modeling of the American robin (a carnivore) and the meadow vole (an herbivore). This effort estimates exposure doses to these receptors through bioaccumulation, as estimated from soil concentrations. As shown by Table 4-45, no COPCs produced HQs > 1.0 for the meadow vole, indicating no potential risk to this species.

Maximum concentrations of 10 compounds produced HQs > 1.0 for the robin, so were subject to evaluation under the more realistic exposure assumptions described in Section 4.7.3.1.

Tables 4-49 through 4-53 show food-based exposures for the robin, and Tables 4-54 through 4-56 show estimated exposure doses and NOAEL- and LOAEL-based HQs for the robin under an average, 95% UCL, and maximum exposure assumption. As shown by Table 4-54, both di-n-octylphthalate and lead produce LOAEL-based HQs greater than 1.0 under average exposure conditions. The LOAEL-based HQ for di-n-octylphthalate is 1.1, reflecting an average soil concentration of 0.24 mg/kg.

Average lead concentrations (100.5 mg/kg) from across the Upland Soils area produced a LOAEL-based HQ of 1.5. Lead concentrations between 100 and 233 mg/kg were present in samples SO-01(99), SO-04(99), SO-05(99), SO-07(99), SO-09(99), and SO-10(99), all of which were located next to the residence or in the former storage areas.

To determine concentrations of di-n-octylphthalate and lead that would result in a LOAEL-based HQ of 1.0 or less, the food chain models of Tables 4-49 through 4-54 were run backwards, using soil concentration as the variable. From this exercise, a concentration of 0.20 mg/kg of di-n-octylphthalate was determined to result in an LOAEL-based HQ of 1.0. Likewise, a lead concentration of 65 mg/kg was determined to reduce the lead LOAEL-based HQ to 1.0. These concentrations thus serve to identify the soil concentration associated with an upper bound of potential risk.

Based on this assessment, concentrations of di-n-octylphthalate and lead in the Upland Soils have the potential to present a risk to site carnivores, as represented by the American Robin.

4.7.5 Conclusion: Potential Risk from Upland Soils

Based on the results of this assessment, no significant potential for risk is indicated for plants from Upland Soils. However, the concentration of zinc at SO-07(99) may present a potential risk to soil invertebrates, although this risk is expected to be localized. In addition, concentrations of lead and di-n-octylphthalate in Upland Soils have the potential to present a risk to site carnivores, as represented by the American Robin.

4.8 UNCERTAINTY ANALYSIS

Ecological risk assessments are subject to a wide variety of uncertainties as the result of both the assumptions used to describe site conditions, receptor exposure, and the natural variability in receptor behavior and toxicological response. Ecological risk assessments must estimate or infer information about receptors, exposures, and effects to reach a conclusion about potential effects at both the individual and population level. While such assumptions do not negate the conclusions of the assessment, they influence how the conclusions are used when making risk management decisions.

This risk assessment was conducted in accordance with EPA guidance and standard practice regarding the use of benchmarks and food chain models. However, numerous assumptions underlie data collection, data evaluation, risk analysis, and risk characterization. These assumptions, and their tendency to lead to either an underestimation or overestimation of risk, are summarized in Table 4-57.

4.9 SUMMARY

This document presents the methods and results of a Baseline Ecological Risk Assessment (BERA) conducted as part of the Remedial Investigation of the Sutton Brook Disposal Area Superfund Site in Tewksbury, Massachusetts. The first component of this BERA was the completion of a Screening-Level Ecological Risk Assessment (SLERA). The SLERA evaluated five distinct habitat areas through the use of generic benchmarks and toxicity values. The SLERA was completed in accord with EPA, 1997 *Ecological Risk Assessment for Superfund*, and had as the primary objective the identification of exposure pathways and compounds that present a potential risk of adverse effects to ecological receptors. In accord with EPA guidance, the evaluation approach compared maximum concentrations of identified contaminants of potential concern (COPCs) to generic no-effect or threshold-effect benchmarks to identify compounds that have a potential for adverse effect. The results of the SLERA identified compounds exceeding benchmarks in each of the five habitat areas, indicating that further evaluation of these COPCs was warranted.

The BERA consists of the further evaluation of the pathways and COPCs identified in the SLERA. In the BERA, the conservative assumptions used in the SLERA are reviewed and, where appropriate, replaced by site-specific values to obtain a more accurate understanding of the ecological risks at the site. In addition, the results of additional sampling and site-specific toxicity tests are included to more accurately assess the potential for exposure and effect in selected portions of the Site. The goal of this assessment is to identify COPCs that present a potential risk to ecological receptors, and, for each of these COPCs, to describe the upper bounds of the threshold of effects.

In the BERA, concentrations of COPCs in surface water, sediment and soils were used to estimate the potential for effects on aquatic and semi-aquatic receptors, waterfowl, and terrestrial wildlife at the Site. Potential risks to aquatic and semi-aquatic receptors were evaluated by a comparison of media concentrations to ecological benchmarks, while risks to waterfowl and wildlife were evaluated by the estimation of an exposure dose and comparison to established Toxicity Reference Values (TRVs). Risks were evaluated separately for the following Habitat Areas and assessment endpoints at the Site:

- Upper Sutton Brook - consists of an Eastern Reach, extending from the access road to the bridge/crossing; the Southern Tributary, which enters Sutton Brook from the south; and the Site Channel, which extends from the bridge/crossing downstream to and including sample location SD/SW-34.
  - Assessment endpoints: benthic and pelagic macroinvertebrates and fish
- Aquatic Wetlands - consists primarily of emergent, shrub-scrub and forested wetlands that exist at various locations at the Site.
  - Assessment endpoints: benthic and pelagic macroinvertebrates, amphibian, wildlife herbivore (black duck), omnivores (mallard), and carnivores (heron)
- Pond - shallow man-made pond south of the Southern Lobe.
  - Assessment endpoints: benthic and pelagic macroinvertebrates, amphibian, and, in conjunction with the Aquatic Wetland, wildlife herbivore, omnivores, and carnivores
- Wetland Soils - consists of saturated, but not inundated, soils that exist adjacent to the Aquatic Wetland areas.
  - Assessment endpoints: terrestrial plants and soil invertebrates, wildlife herbivores (rabbit) and carnivores (shrew)
- Uplands - consists of open packed dirt and fields on the northern portion of the Site (e.g., former residence and garage).
  - Assessment endpoints: terrestrial plants and soil invertebrates, wildlife herbivores (meadow vole) and carnivores (robin)

A review of rare, threatened and endangered species databases and information sources indicated that the New Jersey Tea Inchworm (*Apodrepanulatrix liberaria*) (an Endangered moth) and frosted elfin (*Callophrys irus*) (a Special Concern butterfly) have been documented in the vicinity of the site. The search also indicated that the project area is located within a priority habitat, *Priority Habitat 380* (PH X380). Both of these species are upland species that are dependent on one or two specific host plants for reproduction and/or feeding, a characteristic that limits the suitability of many apparently appropriate habitats. Based on an assessment conducted as part of this BERA, neither of these species is considered likely to occur at the Site because of the lack of available populations of critical host plants; however, an evaluation of the potential effects of contaminants on these species was considered in the BERA.

Risks in the Upper Sutton Brook Site Channel and the Former Drum Disposal Area portion of the Upland Soils habitat were not evaluated in this BERA. The potential for risk in these areas was based on the conclusions of the SLERA only.

Risk calculations are represented by the use of Hazard Quotients (HQs), which quantifies the comparison between the exposure experienced by a receptor to the exposures associated with toxicological effects (published in the literature). For receptors other than wildlife, the exposure concentration is the concentration of COPC detected at each location in surface water or sediment. The waterfowl or wildlife receptors were evaluated based on average, 95% UCL, and maximum contaminant concentrations, to allow for three levels of conservatism in risk estimates. An exception is the shrew, which, because of a small home range, was evaluated by use of maximum values only.

Exposures are refined and compared to concentrations associated with the lowest or probable level of effect. These values, categorically referred to in this document as lowest observed adverse effect (LOAEL)-based benchmarks or TRVs, are used as a representative of an upper bound of the potential for

effect. These values typically consisted of generic probable effect level benchmarks or the lowest of the range of applicable effects values identified in the scientific literature.

Risk was evaluated by several methods. First, for each compound, the number, magnitude, and location of no-observed-adverse-effect level (NOAEL)-based HQs > 1.0 were evaluated. Because of the conservatism of NOAEL-based benchmarks, small and infrequent exceedences are typically not associated with a likelihood of adverse effect. Compounds exceeding NOAEL-based benchmarks by a large number or present in more than 3 samples were compared to LOAEL-based benchmarks. The resulting LOAEL-based HQs were evaluated in conjunction with the number and location of LOAEL exceedances, and the scientific representativeness of the LOAEL value itself. These considerations were combined to arrive at a final assessment of potential risk. A comparison of detected concentrations of inorganics to reference concentrations was conducted in some instances as an additional point of comparison.

Based on the results of the BERA, potential risks were identified in the following areas:

Upper Sutton Brook:

Reach:	Eastern Reach
Media:	Surface water
Assessment Endpoints:	Fish and pelagic invertebrates
COPCs:	Iron (exceedance of chronic WQC)

Reach:	Site Channel
Media:	Surface water
Assessment Endpoints:	Fish and pelagic invertebrates
COPCs:	DDT, ethylbenzene, toluene, xylenes, barium, and manganese (from NOAEL exceedances in SLERA)

Reach:	Site Channel
Media:	Sediment
Assessment Endpoints:	Benthic invertebrates
COPCs:	1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methyl-2-pentanone, acetone, carbon disulfide, chloroethane, ethylbenzene, xylenes, toluene, arsenic, and manganese (from NOAEL exceedances in SLERA)

Aquatic Wetland

Media:	Surface Water
Assessment Endpoint:	Aquatic life
COPCs:	Iron (exceedance of chronic WQC)

Media:	Surface Water
Assessment Endpoint:	Amphibians
COPCs:	Aluminum

Former Drum Disposal Area - Soils:

Assessment Endpoint: Plants
COPCs: Bis(2-Ethylhexyl)phthalate, ethylbenzene, naphthalene, xylenes

Assessment Endpoint: Soil Invertebrates
COPCs: 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, ethylbenzene, toluene, xylenes

Assessment Endpoint: Carnivores (robin)
COPCs: 1,2,4-Trimethylbenzene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, xylenes

Upland Soils (excluding Former Drum Disposal Area):

Assessment Endpoint: Soil invertebrates
COPCs: Zinc (localized)

Assessment Endpoint: Carnivores
COPCs: di-n-octylphthalate and lead

Additional detail is provided in Table 4-58.

4.10 REFERENCES

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TABLE 4-1
SUMMARY OF SAMPLES BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Habitat Type	Description	General Location	Site Samples		Reference Samples	
			Surface Water	Sediment or Soil	Surface Water	Sediment or Soil
Upper Sutton Brook	stream and tributary above wetland	Eastern Reach	SW-10(99) SW-31(04) SW-32 (04) SW-214(06) SW-215(06)	SD-20(99) SD-31(04) SD-32(04) SD-208(06) SD-209(06) SD-210(06) SD-211(06) SD-212(06) SD-213(06) SD-214(06) SD-215(06)	SW-11(99) SW-30 SW-222(06) Shawsheen River SW-01(99) SW-07(99)	SD-06(99) SD-07(99) SD-10(99) SD-11(99) SD-30(04) SD-18(99) SD-19(99) SD-30(99) SD-31(99) SD-33(99)
		Southern Tributary	SW-09(99) SW-43(04)	SD-14(99) SD-15(99) SD-43(04) SD-202(06) SD-203(06) SD-204(06) SD-205(06) SD-206(06) SD-207(06)		SD-200(06) SD-201(06)
		USB Site Channel	SW4-99 SW-05(99) SW-33 SW-34(04)	SD-22(99) SD-23(99) SD-21(99) SD-33(04) SD-34(04)		
Aquatic Wetland	Stagnant wetland areas that are underwater all or part of the year, with associated downstream areas and tributaries.	Lower Sutton Wetland: Shrub wetlands north and south of the Sutton Brook below SW/SD-34(04), including the channel of the lower Sutton; also Sutton Brook below the wetlands, and associated tributaries. Also includes small isolated wetland areas around the site.	SW1-99 SW2-99 SW3-99 SW-02(99) SW-03(99) SW-08(99) SW-36 SW-37 SW-38(04) SW-35(04) SW-106(05) SW-107(05) SW-108(05) SW-109(05) SW-110(05) SW-111(05)	SD-16(99) SD-17(99) SD-24(99) SD-25(99) SD-26(99) SD-28(99) SD-36(04) SD-37(04) SD-35(04) SS-12(04) WS-7(04) SD-38(04) WS-10(04) WS-11(04) WS-15(04) WS-16(04)	as above	as above
		Deep Marsh Wetland: Shrub wetland associated with the Deep Marsh adjacent to the Southern and eastern sides of the Southern Lobe	SW-102(05) SW-103(05) SW-104(05) SW-105(05) SW-101(05)	SD-02(99) SD-01(99) WS-102(05) WS-103(05) WS-104(05) WS-105(05) WS-101(05) SD-216(06) SD-217(06) SD-218(06) SD-219(06) SD-220(06) SD-221(06)		

TABLE 4-1
SUMMARY OF SAMPLES BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Habitat Type	Description	General Location	Site Samples		Reference Samples	
Wetland Soils	Moist or saturated soils adjacent to wetlands and stream	Border areas around Wetlands and stream channel	NA	SS-13(04) SD-12(99) SD-13(99) WS-6(04) SS-5(04) WS-107(05) WS-106(05) GP-8(04) GP-23(04) SS-14(04) GP-7(04) SS-9(04)	NA	SD-08(99) SD-09(99) WS-4(04) WS-111(05) WS-112(05) WS-113(05) WS-109(05)
Upland Soils	Upland soils	fields and clearings around former residence and drum storage area	NA	SO-01(99) SO-02(99) SO-04(99) SO-05(99) SO-06(99) SO-07(99) SO-08(99) SO-09(99) SO-10(99) SB-10(04): 1.5 - 2 ft. only SB-7(04): 0.5 - 1.0 SB-7(04): 1.5 - 2.0 SB-3(04): 0-2 only	NA	SS-1(04) SS-2(04) SS-3(04) SS-01(99) SS-02(99) PWM-4 PWM-5 SS-110 (05) SS-108(05)
Pond	Site Pond	pond south of Southern Lobe	SW-39(04) SW-40(04) SW-41(04) SW-42(04)	SD-39(04) SD-40(04) SD-41(04) SD-42(04)	Same as Upper Sutton	Same as Upper Sutton

TABLE 4-2
SURFACE WATER ANALYTICAL TESTING SUMMARY BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Sample Depth (ft)	Habitat Area	VOC	1,4-Dioxane	SVOC	Metals		Cyanide	PCBs	Pesticides	EPH	VPH	Hardness	Nitrate	Sulfate
							Total	Dissolved								
Pond Surface Water Samples																
SW-39 (04)	10/28/04	0 - 0.5	Pond	X	X	X	X	X		X	X			X	X	X
SW-40 (04)	10/22/04	0 - 0.5	Pond	X	X	X	X			X	X			X	X	X
SW-41 (04)	10/22/04	0 - 0.5	Pond	X	X	X	X			X	X			X	X	X
SW-42 (04)	10/28/04	0 - 0.5	Pond	X	X	X	X			X	X			X	X	X
Total Number of Pond Samples				**4**	**4**	**4**	**4**	**1**	**0**	**4**	**4**	**0**	**0**	**4**	**4**	**4**
Upper Sutton Brook Surface Water Samples																
Eastern Reach																
SW-10 (99)	08/10/99	surface	Upper Sutton Brook	X		X	X		X	X	X					
SW-31 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X	X	X		X	X			X	X	X
SW-32 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X	X	X		X	X			X	X	X
SW-214 (06)	11/09/06	0 - 0.5	Upper Sutton Brook	X	X	X		X						X		
SW-215 (06)	11/10/06	0 - 0.5	Upper Sutton Brook	X	X	X		X						X		
Southern Tributary																
SW-09 (99)	08/10/99	surface	Upper Sutton Brook	X		X	X		X	X	X					
SW-43 (04)	10/22/04	0 - 0.5	Reference	X	X	X	X			X	X			X	X	X
Site Channel																
SW4-99	06/03/99	surface	Upper Sutton Brook	X		X	X					X	X			
SW-05 (99)	08/10/99	surface	Upper Sutton Brook	X		X	X		X	X	X					
SW-33	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X	X			X	X			X	X	X
	09/02/05			X	X		X	X								
SW-34 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X	X			X	X			X	X	X
Total Number of Upper Sutton Brook Samples				**12**	**8**	**11**	**10**	**5**	**3**	**8**	**8**	**1**	**1**	**7**	**5**	5
Wetland Aquatic Surface Water Samples																
SW1-99	06/02/99	surface	Wetland Aquatic	X		X	X					X	X			
SW2-99	06/02/99	surface	Wetland Aquatic	X		X	X					X	X			
SW3-99	06/02/99	surface	Wetland Aquatic	X		X	X					X	X			
SW-02 (99)	08/09/99	surface	Wetland Aquatic	X		X	X		X	X	X					
SW-03 (99)	08/09/99	surface	Wetland Aquatic	X		X	X		X	X	X					
SW-08 (99)	08/09/99	surface	Wetland Aquatic	X		X	X		X	X	X					
SW-35 (04)	10/22/04	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
SW-36	10/21/04	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
	09/20/05			X	X		X	X								
SW-37	10/21/04	0 - 0.5	Wetland Aquatic	X	X	X	X			X	X			X	X	X
	09/20/05			X	X		X	X								
SW-38 (04)	10/21/04	0 - 0.5	Wetland Aquatic	X	X	X	X			X	X			X	X	X
SW-101 (05)	12/01/05	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
SW-102 (05)	12/05/05	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
SW-103 (05)	12/01/05	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
SW-104 (05)	12/01/05	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
SW-105 (05)	12/01/05	0 - 0.5	Wetland Aquatic	X	X	X	X	X		X	X			X	X	X
SW-106 (05)	12/02/05	0 - 0.5	Wetland Aquatic	X	X		X	X						X	X	X
SW-107 (05)	12/02/05	0 - 0.5	Wetland Aquatic	X	X		X	X						X	X	X
SW-108 (05)	12/01/05	0 - 0.5	Wetland Aquatic	X	X		X	X						X	X	X
SW-109 (05)	12/01/05	0 - 0.5	Wetland Aquatic	X	X		X	X						X	X	X
SW-110 (05)	12/02/05	0 - 0.5	Wetland Aquatic	X	X		X	X						X	X	X
SW-111 (05)	12/02/05	0 - 0.5	Wetland Aquatic	X	X		X	X						X	X	X
Total Number of Wetland Aquatic Samples				**23**	**17**	**15**	**23**	**15**	**3**	**12**	**12**	**3**	**3**	**15**	**15**	**15**
Reference Surface Water Samples																
SW-01 (99)	08/09/99	surface	Reference	X		X	X		X	X	X					
SW-07 (99)	08/09/99	surface	Reference	X		X	X		X	X	X					
SW-222 (06)	11/09/06	0 - 0.5	Reference					X						X		
SW-11 (99)	08/10/99	surface	Reference	X		X	X		X	X	X					
SW-30	11/23/04	0 - 0.5	Reference	X	X	X	X			X	X			X	X	X
	09/20/05			X	X		X	X								
	02/16/06			X	X		X	X								
	10/05/06			X	X		X	X								
Total Number of Reference Samples				**7**	**4**	**4**	**7**	**4**	**3**	**4**	**4**	**0**	**0**	**2**	**1**	**1**
Total Number of Samples				**46**	**33**	**34**	**44**	**25**	**9**	**28**	**28**	**4**	**4**	**28**	**25**	**25**

NOTE:
ft = feet below the surface of the water.
X = The sample was submitted for the analysis indicated.
A blank space indicates the sample was not analyzed for this constituent.
VOC = Volatile organic compounds by EPA Method 8260 (1995), 8260A (June 1999), 8260B (2004 and 2005).
1,4-Dioxane by EPA Method 8260B (2004 and 2005).
SVOC = Semi-volatile organic compounds by EPA Method 8270B (1995), 8270D (June 1999), and 8270C (2004 and 2005).
Total Metals = Total (unfiltered) metals by EPA 6000/7000 Series Methods (1995, 2004, and 2005), 200 Series Methods (June 1995).
Dissolved Metals = Metal concentrations after the water sample was passed through a 0.45 micron filter by EPA 6000/7000 Series Methods (2004 and 2005).
Cyanide by EPA Method 335.3 (1995).
PCB = Polychlorinated biphenyls by EPA Method 8082.
Pesticides by EPA Method 8081A (2004 and 2005).
EPH = Extractable petroleum hydrocarbons by MADEP EPH 98-1 (June 1999).
VPH = Volatile petroleum hydrocarbons by by MADEP VPH 98-1 (June 1999).
Hardness by Method 2340B.
Nitrate - Nitrogen by EPA Method 353.1.
Sulfate by EPA Method 375.4.

TABLE 4-3
SEDIMENT ANALYTICAL TESTING SUMMARY BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Sample Depth (ft)	Habitat Area	VOC	SVOC	Metals	Cyanide	PCBs	Pesticides	AVS/SEM	Grain Size	TOC	Toxicity Test	pH
Pond Sediment Samples														
SD-39 (04)	10/28/04	0 - 0.5	Pond	X	X	X		X	X		X	X		
SD-40 (04)	10/22/04	0 - 0.5	Pond	X	X	X		X	X		X	X		
SD-41 (04)	10/22/04	0 - 0.5	Pond	X	X	X		X	X		X	X		
SD-42 (04)	10/28/04	0 - 0.5	Pond	X	X	X		X	X		X	X		
Total Number of Pond Samples				**4**	**4**	**4**	**0**	**4**	**4**	**0**	**4**	**4**		**0**
Upper Sutton Brook Sediment Samples														
Eastern Reach:														
SD-20 (99)	08/10/99	0 - 0.5	Upper Sutton Brook	X	X	X	X	X	X					
SD-31 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X		X	X	X	X	X		
SD-32 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X		X	X	X	X	X		
SD-208 (06)	11/10/06	0 - 0.5	Upper Sutton Brook			X[1]								
SD-209 (06)	11/10/06	0 - 0.5	Upper Sutton Brook			X[1]								
SD-210 (06)	11/10/06	0 - 0.5	Upper Sutton Brook			X[1]								
SD-211 (06)	11/10/06	0 - 1	Upper Sutton Brook			X[1]								
SD-212 (06)	11/10/06	0 - 1	Upper Sutton Brook			X[1]								
SD-213 (06)	11/10/06	0 - 1	Upper Sutton Brook			X[1]								
SD-214 (06)	11/09/06	0 - 0.5	Upper Sutton Brook	X	X	X						X		
SD-215 (06)	11/09/06	0 - 0.5	Upper Sutton Brook	X	X	X						X		
Southern Tributary														
SD-43 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X		X	X		X	X		
SD-202 (06)	11/09/06	0 - 0.5	Upper Sutton Brook			X[2]								
SD-203 (06)	11/09/06	0 - 0.5	Upper Sutton Brook			X[2]								
SD-204 (06)	11/09/06	0 - 0.5	Upper Sutton Brook			X[2]					X		X	
SD-205 (06)	11/09/06	0 - 0.5	Upper Sutton Brook			X[2]								
SD-206 (06)	11/09/06	0 - 0.5	Upper Sutton Brook			X[2]					X		X	
SD-207 (06)	11/09/06	0 - 0.5	Upper Sutton Brook			X[2]					X		X	
SD-14 (99)	08/10/99	0 - 0.5	Upper Sutton Brook	X	X	X	X	X	X					
SD-15 (99)	08/10/99	0 - 0.5	Upper Sutton Brook			X								
Site Channel														
SD-21 (99)	08/10/99	0 - 0.5	Upper Sutton Brook	X	X	X	X	X	X					
SD-22 (99)	08/09/99	0 - 0.5	Upper Sutton Brook	X	X	X	X	X	X					
SD-23 (99)	08/09/99	0 - 0.5	Upper Sutton Brook	X	X	X	X	X	X					
SD-33 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X		X	X	X	X	X		
SD-34 (04)	10/22/04	0 - 0.5	Upper Sutton Brook	X	X	X		X	X	X	X	X		
Total Number of Upper Sutton Brook Samples				**12**	**12**	**13**	**5**	**10**	**10**	**4**	**8**	**7**	**3**	0
Aquatic Wetland Sediment Samples														
SD-01 (99)	08/10/99	0 - 0.5	Aquatic Wetland	X	X	X	X	X	X					
SD-16 (99)	08/09/99	0 - 0.5	Aquatic Wetland	X	X	X	X	X	X					
SD-17 (99)	08/09/99	0 - 0.5	Aquatic Wetland			X								
SD-24 (99)	08/09/99	0 - 0.5	Aquatic Wetland	X	X	X	X	X	X					
SD-25 (99)	08/09/99	0 - 0.5	Aquatic Wetland	X	X	X	X	X	X					
SD-26 (99)	08/09/99	0 - 0.5	Aquatic Wetland	X	X	X	X	X	X					
SD-28 (99)	08/09/99	0 - 0.5	Aquatic Wetland	X	X	X	X	X	X					
SD-35 (04)	10/22/04	0 - 0.5	Aquatic Wetland	X	X	X		X	X		X	X		
SD-36 (04)	10/21/04	0 - 0.5	Aquatic Wetland	X	X	X		X	X	X	X	X		
SD-37 (04)	10/21/04	0 - 0.5	Aquatic Wetland	X	X	X		X	X		X	X		
SD-38 (04)	11/18/04	0 - 2	Aquatic Wetland	X	X	X		X	X	X	X	X		
SS-12 (04)	11/09/04	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
WS-7 (04)	11/09/04	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
WS-10 (04)	11/18/04	0 - 2	Aquatic Wetland	X	X	X		X	X			X		X

TABLE 4-3
SEDIMENT ANALYTICAL TESTING SUMMARY BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Sample Depth (ft)	Habitat Area	VOC	SVOC	Metals	Cyanide	PCBs	Pesticides	AVS/SEM	Grain Size	TOC	Toxicity Test	pH
WS-11 (04)	11/18/04	0 - 2	Aquatic Wetland	X	X	X		X	X			X		X
WS-15 (04)	11/18/04	0 - 2	Aquatic Wetland	X	X	X		X	X			X		X
WS-16 (04)	11/18/04	0 - 2	Aquatic Wetland	X	X	X		X	X			X		X
WS-101 (05)	12/01/05	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
WS-102 (05)	12/01/05	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
WS-103 (05)	12/01/05	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
WS-104 (05)	12/01/05	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
WS-105 (05)	12/01/05	0 - 1	Aquatic Wetland	X	X	X		X	X			X		X
SD-216 (06)	11/09/06	0 - 0.5	Aquatic Wetland	X	X	X2					X	X		
SD-217 (06)	11/09/06	0 - 0.5	Aquatic Wetland	X	X	X2						X		
SD-218 (06)	11/09/06	0 - 1	Aquatic Wetland	X	X	X2						X		
SD-219 (06)	11/09/06	0 - 0.5	Aquatic Wetland	X	X	X2						X		
SD-220 (06)	11/09/06	0 - 1	Aquatic Wetland	X	X	X2						X		
SD-221 (06)	11/09/06	0 - 0.5	Aquatic Wetland	X	X	X2						X		
SD-02 (99)	08/10/99	0 - 0.5	Aquatic Wetland	X	X	X		X	X					
Total Number of Wetland Aquatic Samples				**28**	**28**	**23**	**6**	**22**	**22**	**2**	**5**	**21**		11
Reference Sediment Samples														
SD-18 (99)	08/09/99	0 - 0.5	Reference	X	X	X	X	X	X					
SD-19 (99)	08/09/99	0 - 0.5	Reference			X								
SD-30 (99)	08/09/99	0 - 0.5	Reference	X	X	X	X	X	X					
SD-31 (99)	08/09/99	0 - 0.5	Reference	X	X	X	X	X	X					
SD-33 (99)	08/09/99	0 - 0.5	Reference	X	X	X	X	X	X					
SD-200 (06)	11/10/06	0 - 0.5	Reference			X[1]					X		X	
SD-201 (06)	11/10/06	0 - 0.5	Reference			X[1]					X		X	
SD-06 (99)	08/09/99	0 - 0.5	Reference	X	X	X	X	X	X					
SD-07 (99)	08/09/99	0 - 0.5	Reference			X								
SD-10 (99)	08/10/99	0 - 0.5	Reference	X	X	X	X	X	X					
SD-11 (99)	08/10/99	0 - 0.5	Reference			X								
SD-30 (04)	11/23/04	0 - 0.5	Reference	X	X	X		X	X		X	X		
Total Number of Reference Samples				**7**	**7**	**10**	**6**	**7**	**7**		**3**	**1**	**2**	
Total Number of Samples				**51**	**51**	**50**	**17**	**43**	**43**	**6**	**20**	**33**	**5**	11

NOTE:
1. The sample was submitted for analysis of arsenic and iron only.
2 = The sample was submitted for analysis of mercury only.

ft = feet below top of sediment
X = The sample was submitted for the analysis indicated.
A blank space indicates the sample was not analyzed for this constituent.
VOC = Volatile organic compounds by CLP VOC Analysis (1989) or EPA Method 8260B.
SVOC = Semi-volatile organic compounds by CLP Extractable Organic Analysis (1989) or EPA Method 8270.
Metals by CLP Inorganic Analysis (1989) or EPA method 6000/7000 series.
Cyanide by Midi-Distillation Procedure.
PCB = Polychlorinated biphenyls by CLP Extractable Organic Analysis (1989) or EPA method 8082.
Pesticides by CLP Extractable Organic Analysis (1989) or EPA Method 8081 and 8081A.
AVS/SEM = Acid volatile sulfide/simultaneous extracted metals.
Grain Size by sieve ASTM C-117 and C-136.
TOC = Total organic carbon by Lloyd Kahn.
pH - by EPA Method 9045C.

TABLE 4-4
SOIL ANALYTICAL TESTING SUMMARY BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Habitat Area	VOC	PAHs	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	EPH w/PAH	VPH w/VOC	TOC	pH	Dioxins
Upland Soils Soil Samples																
SB-3 (04) (FDDA Only)	10/08/04	0 - 2	Upland Soils	X		X										
SO-01 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-02 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-04 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-05 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-06 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-07 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-08 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-09 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SO-10 (99)	08/04/99	0 - 0.5	Upland Soils	X		X	X	X	X	X		X	X			
SB-7 (04)	10/05/04	0.5 - 1.0	Upland Soils				X									
		1.5 - 2.0	Upland Soils	X												
SB-10 (04)	10/04/04	1.5 - 2.0	Upland Soils				X									
Total Number of Upland Soil Samples				**11**	**0**	**10**	**11**	**9**	**9**	**9**	**0**	**9**	**9**	**0**	**0**	**0**
Wetland Soils Soil Samples																
GP-23 (04)	11/09/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	
SS-13 (04)	11/08/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	
SS-14 (04)	11/09/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	
SD-12 (99)	08/10/99	0 - 0.5	Wetland Soils	X		X	X	X	X	X						
SD-13 (99)	08/10/99	0 - 0.5	Wetland Soils				X									
GP-7 (04)	11/09/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	
GP-8 (04)	11/08/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	
SS-5 (04)	11/18/04	0 - 2	Wetland Soils	X		X	X		X	X				X	X	X
WS-6 (04)	11/08/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	
SS-9 (04)	11/09/04	0 - 1	Wetland Soils	X		X	X		X	X				X	X	X
WS-106 (05)	11/29/05	0 - 1	Wetland Soils				X									
WS-107 (05)	11/29/05	0 - 1	Wetland Soils				X									
Total Number of Wetland Soil Samples				**9**	**0**	**9**	**12**	**1**	**9**	**9**	**0**	**0**	**0**	**8**	**8**	**2**
Reference Soil Samples																
SS-110 (05)	11/29/05	0 - 1	Reference	X		X	X		X	X				X	X	
WS-111 (05)	12/01/05	0 - 1	Reference	X		X	X		X	X				X	X	
SS-01 (99)	08/04/99	0 - 0.5	Reference - U	X		X	X	X	X	X						
SS-02 (99)	08/04/99	0 - 0.5	Reference - U				X									
PMW-4 (02)	05/28/02	0 - 2	Reference - U				X[1]									
PMW-5 (02)	05/28/02	0 - 2	Reference - U				X[1]									
SS-3 (04)	11/08/04	0 - 1	Reference - U	X		X	X		X	X				X	X	
SS-1 (04)	11/23/04	0 - 1	Reference - U	X		X	X		X	X				X	X	X
SS-2 (04)	11/23/04	0 - 1	Reference - U	X		X	X		X	X				X	X	
SS-108 (05)	12/01/05	0 - 1	Reference - U	X		X	X		X	X				X	X	
SD-08 (99)	08/10/99	0 - 0.5	Reference - W	X		X	X	X	X	X						
SD-09 (99)	08/10/99	0 - 0.5	Reference - W				X									
WS-4 (04)	11/08/04	0 - 1	Reference - W	X		X	X		X	X				X	X	
WS-109 (05)	12/01/05	0 - 1	Reference - W	X		X	X		X	X				X	X	
WS-112 (05)	11/29/05	0 - 1	Reference - W	X		X	X		X	X				X	X	
WS-113 (05)	11/29/05	0 - 1	Reference - W	X		X	X		X	X				X	X	
Total Number of Background Samples				**12**	**0**	**12**	**14**	**2**	**12**	**12**	**0**	**0**	**0**	**10**	**10**	1
Total Number of Samples				**32**	**0**	**31**	**37**	**12**	**30**	**30**	**0**	**9**	**9**	**18**	**18**	3

TABLE 4-4
SOIL ANALYTICAL TESTING SUMMARY BY HABITAT AREA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Habitat Area	VOC	PAHs	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	EPH w/PAH	VPH w/VOC	TOC	pH	Dioxins

NOTES:
X = The sample was submitted for the analysis indicated.
X [1] = The sample was submitted for arsenic and thallium analysis only.
A blank space indicates the sample was not analyzed for this constituent.
Shading indicates the sample was excluded from the Human Health and Ecological Risk Assessment (HERA).
ft = feet below ground surface
VOC = Volatile organic compounds by CLP Volatile Organic Analysis (1989), EPA Method 8260B (1999, 2000, 2002, 2004, and 2005).
PAH = Polynuclear aromatic hydrocarbons.
SVOC = Semi-volatile organic compounds by CLP Extractable Organic Analysis (1989), EPA Method 8270C (1999, 2000, 2002, 2004, and 2005).
Metals by CLP Inorganic Analysis (1989), EPA 6000/7000 Series Methods (1999, 2000, 2002, 2004, and 2005).
Cyanide by Midi-Distillation Procedure.
FDDA = Former Drum Disposal Area; this area is represented by sample SB-03(04) only.
PCB = Polychlorinated biphenyls by CLP Extractable Organic Analysis (1989), EPA Method 8082 (1999, 2000, 2002, 2004, and 2005).
Pesticides by CLP Extractable Organic Analysis (1989) EPA Method 8081/8081A (1999, 2000, 2002, 2004, and 2005).
TPH = Total petroleum hydrocarbons by a Modified EPA Method 8100 (2002).
EPH = Extractable petroleum hydrocarbons (MADEP Method 1998).
VPH = Volatile petroleum hydrocarbons (MADEP Method 1998).
TOC = Total organic carbon by Lloyd Kahn (2004 and 2005).
pH - by EPA Method 9045C.
Dioxins - by EPA Method 8280A (2004).
Reference U = Reference Upland
Reference W = Reference Wetland

TABLE 4-5
LIFE HISTORY PARAMETERS FOR SITE RECEPTORS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Black Duck		Mallard		American Robin		Northern Short-tailed Shrew		Eastern Cottontail	
Variable	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**
Migration Factor (MF)	0.67	Needs open water; assume present 8 mo./yr.	0.67	Needs open water; assume present 8 mo./yr.	0.67	Assumed present 8 mo./yr, based on USEPA 1993	1	does not hibernate	1	does not hibernate
Home Range, ha	518	DeGraff and Yamasaki, 2001	580	average of male and female in wetland, river environment; EPA 1993	0.48	average foraging home range; EPA 1993	0.39	EPA 1993	3.76	averag of male and female in mixed habitat; EPA 1993
Area Use Factor (AUF) = site size / home range	1	Site-specific. Presence of suitable habitat nearby will reduce site use.	1	Conservative assumption	**0.5**	**Professional judgement; Small Upland Soils area is interspersed with and surrounded by suitable or more desirable habitat, particularly in neighbor-hoods surrounding the site.**	1	home range is <1 ha. EPA 1993	1	home range is 3 ha. EPA 1993
Water Ingestion Rate ($IR_{water,}$) l/day	0.08	based on IR_{water} of mallard (USEPA 1993)	0.062	USEPA 1993	0.011	EPA 1993. No COPCs were included in water fraction	0.003	EPA 1993. Assumed to drink from the Aquatic Wetland.	0.116	Sample et al. 1996
Total Food Ingestion Rate (IR_{total}), kg/day	0.303	Nagy, 1987 as per USEPA 1993*	0.267	USEPA 1993	0.117	USEPA 1993, based on 77.3 g BW	**0.019**	**Based on 1.25 g. wet wt/ g bw/day used in EPA Eco-SSLs (EPA 2003) and 15 g body wt. (EPA 1993).**	0.237	Sample et al. 1996
Invertebrate Ingestion Rate (IR_{invert}), kg/day	0	no component of diet assumed to be invertebrates	0.134	estimated diet of site female (50% invertebrates, April - Dec))	**0.074**	**63% = average spring and summer composition of diet (USEPA 1993).**	**0.019**	**100% of diet assumed to consist of invertebrates**	0	no animal component in diet
Plant Ingestion Rate (IR_{plant}) kg/day	0.303	EPA 1993	0.134	estimated diet of site female (50% plants, April - Dec)	**0.043**	**37% = average spring and summer composition of diet (USEPA 1993).**	0	No plant component in diet	0.237	100% of diet consists of vegetable matter
Soil or Sediment Ingestion Rate ($IR_{soil/sediment}$) kg/day	0.003	USEPA 1993 indicates <2% of diet is sediment. 1% assumed here.	0.003	USEPA 1993 indicates <2% of diet is sediment. 1% assumed here.	0.007	= add'l 6.3% of diet. Soil assumed to result only from invertebrate ingestion. Ingestion rate is 63% of the soil ingestion rate of the American woodcock which consumes 100% invertebrates and 10% soil	**0.0006**	**based on 3% soil ingestion rate (EPA, 2005a)**	0.03	Ingestion assumed to be similar to EPA 1993 value for meadow vole (2.4%), which has similar feeding habits
Body weight, (BW) kg.	1.245	average of male and female; Illinois Natural History Survey webpage	1.134	average of male and female; USEPA 1993	0.077	USEPA 1993	0.015	EPA 1993	1.189	Average of male and female

Sources:
USEPA, 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187 This is the source unless noted otherwise.
Sample, B.E. et al. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory ES/ER/TM-86/R3

TABLE 4-6a
LOAEL-BASED TOXICITY VALUES FOR SURFACE WATER, SEDIMENT, AND SOILS
a. LOAEL-BASED TOXICITY VALUES FOR SURFACE WATER
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

AQUATIC LIFE VALUES:

Compound	Parameter	Concentration mg/l	Source
4,4'-DDT	LOAEL	0.000013	Suter & Tsao, 1996. This value is a secondary chronic value based on the protection of aquatic life, which is appropriate to the assessment endpoints for this area.
Ethylbenzene	LOAEL, aquatic	0.194	Lowest Ecotox value for a freshwater species, in this case the scud. Value shown is based on an ethylbenzene LC50 1.940, which was divided by 10 for LOAEL use.
Toluene	LOAEL, aquatic	0.58	Lowest Ecotox value for a freshwater species. Value shown is based on a toluene LC50 of 5.8 mg/l for a trout; UF of 10 applied for LOAEL use.
Xylenes (total)	LOAEL, aquatic	0.33	Lowest Ecotox value for a freshwater species, in this case rainbow trout. Value shown is based on a xylenes LC50 of 3.3 mg/l, which was divided by 10 for LOAEL use. Lower listed Ecotox xylene value was based on a chemical mixture.
Barium, Dissolved	LOAEL, aquatic	3.2	Lowest Ecotox value for barium sulfate, which is the dominant form in surface water (ATSDR). Mortality data lacking; lowest value listed was an EC50 of 32 mg/l for intoxication and imbalance in *Daphnia magna* ; uncertainty factor of 10 applied to convert EC50 to LOAEL.
Iron, Dissolved	LOAEL, aquatic	7.3	Lowest non-fish Ecotox value for effects on freshwater species, in this case the mayfly. Lowest value listed was an iron LC50 of 73.1 mg/l; uncertainty factor of 10 applied to convert LC50 to LOAEL. Value cited is the lowest estimated LOAEL higher than the WQC of 1.0 mg/l.
Manganese, Dissolved	LOAEL, aquatic	1.3	Lowest Ecotox value for manganese carbonate, a dominant form in surface water (ATSDR). Value based on effects on growth of a carp; reported value of 13.1 mg/l divided by 10 for LOAEL use. Lowest estimated invertebrate LOAEL value is 1.7 mg/l, based on effects of manganese chloride to a crayfish; reported LC50 is 17 mg/l.

See Appendix N-1 for Ecotox Database references

AMPHIBIAN VALUES:

Compound	Parameter	Concentration mg/l	Source
Aluminum, Dissolved	LOAEL, amphib.	0.088	Westerman et al 2003; value is based on average LC50 values for non-larvae life stages of the American toad (tolerant)and the northern leopard frog (very sensitive). Average LC50 values divided by 10 for LOAEL use.
Iron, Dissolved	LOAEL, amphib.	3	Westerman, et al. 2003. LC50 data limited; value shown obtained from the author's recommended sensitive-species NOAEL-based benchmark of 0.3 mg/l by applying a UF of 10.
Manganese, Dissolved	LOAEL, amphib.	2	Value is based on the geometric mean of three manganese LC50 values cited in Birge 2000. Mean divided by 10 for LOAEL use. Geometric mean used because of wide range of data (1.42 to 318 mg/l)
Nickel, Dissolved	LOAEL, amphib.	0.37	Value is based on the average of four nickel LC50 values cited in Birge 2000. Average divided by 10 for LOAEL use.
Zinc, Dissolved	LOAEL, amphib.	0.0853	Value is based on the average of eleven zinc LC50 values cited in Birge 2000. Average divided by 10 for LOAEL use.

TABLE 4-6b
LOAEL-BASED TOXICITY VALUES FOR SURFACE WATER, SEDIMENT, AND SOILS
b. LOAEL-BASED TOXICITY VALUES FOR SEDIMENT
Baseline Ecological Risk Assessment

Compound	Parameter	Concentration mg/kg	Source
1,2,4-trimethylbenzene	LOAEL, USB	7.273	Equilibrium partioning, based on lowest Ecotox value for a freshwater species, in this case the scud. Value shown is based on an LC50 of 4.35 mg/l, which was divided by 10 for LOAEL use.
1,3,5-Trimethylbenzene	LOAEL, USB	7.043	Equilibrium partioning, based on lowest Ecotox value. No mortality, reproduction, or growth data available for freshwater invertebrates, so data for marine dungeness crab used. Reported 1,3,5-TMB LC50 mortality value of 4.3 mg/l divided by 10 for LOAEL use.
2-methylphenol	LOAEL , USB	5.162	Equilibrium partioning, based on lowest Ecotox value for a freshwater species. Value shown is based on an LC50 of 5 mg/l for Daphnia magna, which was divided by 10 for LOAEL use.
3-methylphenol/ 4-methylphenol	LOAEL, USB	1.416	Equilibrium partioning, based on lowest Ecotox value for a freshwater species. Value shown is based on an 4-methylphenol LC50 of 1.4 mg/l for Daphnia magna, which was divided by 10 for LOAEL use. LC50s for 3-methylphenol were higher.
4-methyl-2-pentanone	LOAEL, USB	0.559	Equilibrium partioning, based on secondary acute value of 2.2 mg/l for 4-methyl-2-pentanone reported in Suter and Tsao, 1996. Toxicity values in Ecotox database were higher.
Acetone	LOAEL, USB	0.462	Generated by equilibrium partioning per SLERA. Acetone surface water value based on the lowest Ecotox value for a freshwater species, in this case a sowbug. Reported LC50 of 100 mg/l divided by 10 for LOAEL use. Same LC50 reported for Daphnia species and Zebra danio fish.
	LOAEL, AqW	5.032	Generated by equilibrium partioning per SLERA. Acetone surface water value based on the lowest Ecotox value for a freshwater species, in this case a sowbug. Reported LC50 of 100 mg/l divided by 10 for LOAEL use. Same LC50 reported for Daphnia species and Zebra danio fish.
	LOAEL, Pond	0.05	Generated by equilibrium partioning per SLERA. Acetone surface water value based on the lowest Ecotox value for a freshwater species, in this case a sowbug. Reported LC50 of 100 mg/l divided by 10 for LOAEL use. Same LC50 reported for Daphnia species and Zebra danio fish.
Benzoic Acid	LOAEL, AqW	14.538	Calculated by equilibrium partitioning based on LC50 of 39.47 mg/l for aquatic invertebrates reported in Saha. et al. 2006. Reported value divided by 10 for LOAEL use.
Benzo(a)pyrene	LOAEL, USB	4.4	Equilibrium partioning, based on secondary acute value for benzo(a)pyrene (0.00024 mg/l) reported in Suter and Tsao, 1996
Carbon Disulfide	LOAEL, USB	0.224	Generated by equilibrium partitioning as per SLERA. Carbon disulfide surface water value based on lowest Ecotox value for a freshwater species, in this case Daphnia magna. Reported LC50 of 2.1 mg/l divided by 10 for LOAEL use.
	LOAEL, Pond	0.024	Generated by equilibrium partitioning as per SLERA. Carbon disulfide surface water value based on lowest Ecotox value for a freshwater species, in this case Daphnia magna. Reported LC50 of 2.1 mg/l divided by 10 for LOAEL use.
Chloroethane	LOAEL, USB	0.459	Equilibrium partioning, based on secondary acute value of 0.830 mg/l for 1,1-dichloroethane reported in Suter and Tsao, 1996. No surface water value available in Ecotox for 1,1,-dichloroethane or chloroethane.
	LOAEL, AqW	5.005	Equilibrium partioning, based on secondary acute value of 0.830 mg/l for 1,1-dichloroethane reported in Suter and Tsao, 1996. No surface water value available for 1,1-dichloroethane or chloroethane in Ecotox.
Ethylbenzene	LOAEL, USB	2.341	Calculated by equilibrium partitioning using the lowest Ecotox value for a freshwater aquatic species, in this case the scud. Value shown is based on an LC50 1.940, which was divided by 10 for LOAEL use.
Mercury	LOAEL, AqW	1.06	MacDonald, et al. 2000, Probable Effects Concentration
Naphthalene	LOAEL, USB	8.132	Equilibrium partioning, based on secondary acute value for naphthalene of 0.19 mg/l reported in Suter and Tsao, 1996
Toluene	LOAEL, USB	3.62	Calculated by equilibrium partitioning using lowest Ecotox value for a freshwater aquatic species. Value shown is based on a toluene LC50 of 5.8 mg/l for a trout; UF of 10 applied for LOAEL use.
	LOAEL, AqW	39.48	Calculated by equilibrium partitioning using lowest Ecotox value for a freshwater aquatic species. Value shown is based on a toluene LC50 of 5.8 mg/l for a trout; UF of 10 applied for LOAEL use.
Xylenes	LOAEL, USB	3.41	Calculated by equilibrium partitioning based on lowest Ecotox value for a freshwater species, in this case an LC50 of 3.3 mg/l for a rainbow trout. Reported value divided by 10 for LOAEL use.
Arsenic	LOAEL	33	MacDonald, et al. 2000, Probable Effects Concentration
	LOAEL	33	MacDonald, et al. 2000, Probable Effects Concentration
Iron	LOAEL	40,000	Ontario Ministry of Environment Severe Effects Level, 1993
Manganese	LOAEL	1,100	Ontario Ministry of Environment Severe Effects Level, 1993
Selenium	LOAEL	4	Van Derveer and Canton, 1997. Value shown is an Effects Range-median value, calculated in accord with Long and Morgan, 1995.

Note: USB sediment benchmarks generated by equilbrium partitioning are based on TOC of 2.3%. Aquatic wetland values based on TOC of 25.4%. Pond values based on a TOC of 0.25%. TOC values consistent with the SLERA.
LOAEL = Lowest observed adverse effect level.

TABLE 4-6c
LOAEL-BASED TOXICITY VALUES FOR SURFACE WATER, SEDIMENT, AND SOILS
c. LOAEL-BASED TOXICITY VALUES FOR SOIL
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Compound	Parameter	Concentration mg/kg	Source
1,2,4-trimethylbenzene	LOAEL, invert	10.6	Neuhauser, R. et al. 1985. The toxicity of selected organic chemicals to the earthworm Eisenia fetida. J. Enviorn. Qual. 14(3): 383:388.. Value for benzene, alkylated benzenes and chlorinated aliphatics based on carbaryl; worm toxicities similar. Study LC50s divided by 10 for NOEL use.
1,3,5-trimethylbenzene	LOAEL, invert	10.6	Neuhauser, R. et al. 1985. The toxicity of selected organic chemicals to the earthworm Eisenia fetida. J. Enviorn. Qual. 14(3): 383:388.. Value for benzene, alkylated benzenes and chlorinated aliphatics based on carbaryl; worm toxicities similar. Study LC50s divided by 10 for NOEL use.
2,4-dimethylphenol	LOAEL, plant	0.1	EPA Region 5, 2003, Ecological Screening Levels . Reported screening value multiplied by 10 for LOAEL use.
bis(2-ethylhexyl)phthalate	LOAEL, plant	134	EC50 as cited by Efroymson et al. 1997. Screening benchmark based on this study was 100 mg/kg.
	LOAEL, robin	4.6	Based on back-calculations from the existing robin exposure model.
Benzoic Acid	LOAEL, invert	4.2354	No standard available; sediment benchmark used. Sediment calculated by equilibrium partitioning based on average wetland soil TOC of 7.4% and LC50 of 39.47 mg/l for freshwater oligochaetes reported in Saha. et al. 2006. Reported value divided by 10 for LOAEL use.
Ethylbenzene	LOAEL, invert	10.6	Neuhauser, R. et al. 1985. The toxicity of selected organic chemicals to the earthworm Eisenia fetida. J. Enviorn. Qual. 14(3): 383:388.. Value for alkylated benzenes based on carbaryl; worm toxicities similar. Study LC50s divided by 10 for LOAEL use.
	LOAEL, plant	32	Hulzebos, E.M. et al. 1993. Phytotoxicity studies witeh Lactuca sativa in soil and nutrient solution. Env. Tox . Chem. 12(6):1079-1094. No value listed for ethylbenzene; styrene used as a surrogate. Reported EC50 of 320 mg/kg divided by 10 for LOAEL use.
Naphthalene	LOAEL, plant	10	Hulzebos, E.M. et al. 1993. Phytotoxicity studies witeh Lactuca sativa in soil and nutrient solution. Env. Tox . Chem. 12(6):1079-1094. Reported EC50 of 100 mg/kg divided by 10 for LOAEL use.
Toluene	LOAEL, invert	10.6	Neuhauser, R. et al. 1985. The toxicity of selected organic chemicals to the earthworm Eisenia fetida. J. Enviorn. Qual. 14(3): 383:388.. Value for toluene based on carbaryl; worm toxicities similar. Study LC50s divided by 10 for NOEL use.
Xylenes	LOAEL, invert	10.6	Neuhauser, R. et al. 1985. The toxicity of selected organic chemicals to the earthworm Eisenia fetida. J. Enviorn. Qual. 14(3): 383:388.. Value for xylene based on carbaryl; worm toxicities similar. Study LC50s divided by 10 for NOEL use.
	LOAEL, plant	100	Hulzebos, E.M. et al. 1993. Phytotoxicity studies witeh Lactuca sativa in soil and nutrient solution. Env. Tox . Chem. 12(6):1079-1094. Reported xylene EC50 of 1000 mg/kg divided by 10 for LOAEL use.
Copper	LOAEL, invert	63	Efroymson, R.A., et al. 1997. *Toxicologial Benchmarks for Contaminats of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, TN. Value is lowest measured LOAELs in worm study data.
Manganese	LOAEL, plant	4153	Paschke, M.W. et al. 2005. Manganese toxicity thresholds for restoration grass species. Env. Poll. 135(2): 313-322. Reported PT50 (phytoxicity) divided by 10 for LOAEL use.
Mercury	LOAEL, plant	0.3	Efroymson, R.A., et al. 1997. *Toxicologial Benchmarks for Screening Contaminats of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, TN. Reported value is a LOAEL, but is recommened by the authors as a screening level benchmark.
	LOAEL, invert	0.5	Efroymson, R.A., et al. 1997. Toxicologial Benchmarks for Contaminats of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN.
Selenium	LOAEL, plant	1.7	Efroymson, R.A., et al. 1997. *Toxicologial Benchmarks for Screening Contaminats of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, TN. Value shown is the average of reported LOAEL values, to account for varying water-soluble chemical forms. However, in acid soils with high moisture content selenium is bound to colloids as a ferric hydroxide complex which is insoluble and generally not bioavailable to plants (ATSDR). LOAEL benchmark is thus likely highly conservative.
Vanadium	LOAEL, plant	2.5	Efroymson, R.A., et al. 1997. *Toxicologial Benchmarks for Screening Contaminats of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* Oak Ridge National Laboratory, Oak Ridge, TN. Reported value is a LOAEL.
Zinc	LOAEL, invert	190	Efroymson, R.A., et al. 1997. Toxicologial Benchmarks for Contaminats of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. Value shown is lowest listed value for growth.

TABLE 4-7
AVIAN TOXICITY REFERENCE VALUES
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical	Administered Form	Receptor	Duration	Endpoint	NOAEL, mg/kg-day	LOAEL mg/kg-day	Comments	Reference
VOCs								
1,2,4-trimethylbenzene		rat	acute LD50	organ and CNS damage	3.55	35.5	UF of 100 applied to study LD50 of 3550 mg/kg to account for LOAEL-NOAEL and cross-class use.	Litton Bionetics Inc, 2000 as cited by Toxnet
Xylenes (total)		mouse	LD50	mortality	1.5	15	Value reflects UF of 1000 applied to LD50 of 1590 in study to account for LD50 - NOEL and cross-class application	Hazardous Substance Data Base
4,6-dinito-o-cresol		mallard	LD50	mortality	0.227	2.27	UF of 100 applied to study LD50 of 22.7 mg/kg for LD50-NOEL use.	Hazardous Substance Database
bis(2-ethylhexyl)phthalate		ringed dove	chronic	reproduction	1.1	11	NOEL from study.	Peakall, 1974, cited and converted to dose by Sample et al 1996
di-n-butylphthalate	di-n-butyl phthalate	Ringed Dove	Chronic (4 wks during critical lifestage)	reproduction	0.11	1.1	UF of 10 applied by Sample 1996 to obtain NOAEL from LOAEL	Sample et al 1996, based on study by Peakall 1974
di-n-octylphthalate	di-n-butyl phthalate	Ringed Dove	Chronic (4 wks during critical lifestage)	reproduction	0.11	1.1	based on di-n-butylphthalate	Sample et al 1996, based on study by Peakall 1974
Total PAHs		Mallard	Chronic	enlarged testis	3.83	38.3	study LOAEL = 400 mg/kg in diet, =38.3 mg/kg/d[3]. UF of 10 applied for LOAEL-NOAEL application	Patton and Dieter, 1980
4,4'-DDT		brown pelican	5 yrs.	reproduction	0.0028	0.028	NOAEL obtained from study LOAEL by use of UF of 0.1	Anderson et al. cited and converted to NOAELs and LOAELs by Sample et al. 1996
Aluminum, Total	$Al_2(SO_4)_3$	Ringed Dove	Chronic	reproduction	109.7	1097		Carriere et al. 1986 as reported by Sample et al 1996
Chromium, Total		Black Duck	Chronic 10 mo.	reproduction	1	5	Trivalent chromium	Haseltine, et al unpublished, as reported by Sample et al 1996
Iron, Total	Total iron	Poultry	Chronic		500	5000	Recommended safe level of iron in food	National Research Council, 2005
Lead, Total	NR	Chicken	4 weeks	reproduction	1.63	3.26	1.63 mg/kg/da used by EPA to calculate avian wildlife Eco SSL	Edens and Garlich, 1983, as cited by EPA Eco SSL for Lead, 2005
Selenium, Total	sodium selenite	Mallard	chronic (78 da)	reproduction	0.5	1		Heinz et al. 1987 as reported by Sample et al 1996
Zinc, Total	Zinc sulfate	Leghorn hens	Chronic (44 weeks)	reproduction	14.5	131		Sample et al 1996, based on study by Stahl et al 1990

TABLE 4-8
MAMMALIAN TOXICITY DATA
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Masschusetts

Chemical (administered form)		Receptor	Duration	Endpoint	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Comments	Reference
Arsenic		**Dog**	**8 weeks**	**Growth**	**1.04**	**1.66**	**NOAEL value used by EPA in calculation of Eco-SSL.**	**Neiger and Osweiler, 1989, as cited by EPA Eco-SSL document, 2005**
Manganese, Total		Rat	Chronic	reproduction	88	284		Laskey et al 1982 as reported by Sample et al 1996
Vanadium		**Mouse**	**12 days**	**mortality**	**4.16**	**8.31**	**NOAEL value used by EPA in calculation of Eco-SSL.**	**Sanchez et al, 1991, as reported in EPA Eco-SSL document, 2005**

bold value shows revised value from SLERA. See text for details.
References:
Sample, B.E. et al. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory ES/ER/TM-86/R3

TABLE 4-9
SCALED TOXICITY REFERENCE VALUES FOR THE SHORT-TAILED SHREW
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

A. Allometric Scaling Factors for the Short-tailed Shrew

Test Spp.	Typical Test Spp. BW, kg	Source	Shrew BW, kg	Source	Scaling Factor
rat	0.35	1	0.015	2	2.2

B. Scaled Manganese Toxicity Value for the Short-tailed Shrew

Chemical	Test Species	Test Spp. NOAEL (mg/kg BW/day)	Test Spp. LOAEL (mg/kg BW/day)	Scaling Factor	Shrew NOAEL, mg/kg BW/da	Shrew LOAEL, mg/kg BW/da
Manganese, Total	Rat	88	284	2.2	193.60	624.8

Scaling Factor $(bw_{test} / bw_{wldlf})^{0.25}$
$NOAEL_{wildlife} = NOAEL_{test} * \text{Scaling Factor}$
1. Sample et al. 1996
2. EPA 1993

TABLE 4-10a
SLERA UPPER SUTTON BROOK HAZARD QUOTIENTS OVER 1.0
a. SURFACE WATER HQs > 1.0

Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Maximum Surface Water Concentration, mg/l	Surface Water Frequency of Detection	Location of Maximum		NOAEL-based Benchmark, mg/l	Maximum Upper Sutton Brook Surface Water NOAEL-based HQs	Number of Surface Water NOAEL-based HQs > 1.0
			Sample Number	USB Reach			
4,4'-DDT	0.000009	1 / 7	SW-05 (99)	Site Channel	0.000001	9.00	1
Ethylbenzene	0.012	4 / 8	SW-05 (99)	Site Channel	0.0073	1.6	2
Toluene	0.123	5 / 8	SW4-99	Site Channel	0.0098	12.6	4
Xylenes (total)	0.037	2 / 4	SW-05 (99)	Site Channel	0.013	2.8	4
Barium, Dissolved	0.08	3 / 3	SW-33	Site Channel	0.004	20	3
Iron, Dissolved	1.4	3 / 3	SW-32 (04)	Eastern Reach	1.0	1.4	1
Manganese, Dissolved	0.53	3 / 3	SW-33	Site Channel	0.12	4.4	3

Notes:

*Maximum HQ is the maximum detected concentration per exposure point divided by the applicable ecological benchmark.
NA = Constituent not a chemical of potential concern for this exposure point.

See Appendix C for benchmark sources.
mg/l = milligrams per liter.
mg/kg = milligrams per kilogram.
HQ = Hazard Quotient.

TABLE 4-10b
SLERA UPPER SUTTON BROOK HAZARD QUOTIENTS OVER 1.0
b. SEDIMENT HQs > 1.0

Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Maximum Sediment Concentration, mg/kg	Sediment Frequency of Detection	Location of Maximum		NOAEL-based Benchmark, mg/kg	Maximum Upper Sutton Brook Sediment NOAEL-based HQs	Number of Sediment NOAEL-based HQs > 1.0
			Sample No.	USB Reach			
1,2,4-Trimethylbenzene	3.00	4/8	SD-22 (99)	Site Channel	1.287	2.3	1
1,3,5-Trimethylbenzene	16.00	4/8	SD-23 (99)	Site Channel	1.163	13.8	1
2-Methylphenol	0.24	1/9	SD-21 (99)	Site Channel	0.134	1.8	1
3-Methylphenol/4-Methylphenol	1.20	1/4	SD-33 (04)	Site Channel	0.627	1.9	1
4-Methyl-2-pentanone	0.10	2/8	SD-21 (99)	Site Channel	0.043	2.3	1
Acetone	0.72	4/8	SD-14 (99)	Southern Trib	0.069	10.4	1
Benzo(a)pyrene	0.44	1/9	SD-14 (99)	Southern Trib	0.257	1.7	1
Carbon disulfide	0.015	2/8	SD-22 (99)	Site Channel	0.001	15.3	2
Chloroethane	0.09	3/8	SD-23 (99)	Site Channel	0.026	3.3	2
Ethylbenzene	3.30	5/8	SD-22 (99)	Site Channel	0.088	37.5	5
Naphthalene	1.50	5/9	SD-32 (04)	Eastern Reach	0.514	2.9	1
Toluene	4.80	5/9	SD-33 (04)	Site Channel	0.061	78.4	3
Xylenes (total)	10.57	6/8	SD-22(99)	Site Channel	0.134	76.0	6
Arsenic, Total	767	10/10	SD-15(99)	Southern Trib	8.2	93.5	8
Iron, Total	85300	10/10	SD-15(99)	Southern Trib	20000	4.3	2
Manganese, Total	550	10/10	SD-33 (04)	Site Channel	460	1.2	1

Notes:

*Maximum HQ is the maximum detected concentration per exposure point divided by the applicable ecological benchmark.

See Appendix L for NOAEL benchmark sources.
mg/l = milligrams per liter.
mg/kg = milligrams per kilogram.
HQ = Hazard Quotient.

TABLE 4-11
UPPER SUTTON BROOK CONTAMINANTS OF POTENTIAL CONCERN
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts

Surface Water	Sediment
4,4'-DDT	1,2,4-Trimethylbenzene
Ethylbenzene	1,3,5-Trimethylbenzene
Toluene	2-Methylphenol
Xylenes (total)	3-Methylphenol/4-Methylphenol
Barium, Dissolved	4-Methyl-2-pentanone
Iron, Dissolved	Acetone
Manganese, Dissolved	Benzo(a)pyrene
	Carbon disulfide
	Chloroethane
	Ethylbenzene
	Naphthalene
	Toluene
	Xylenes (total)
	Arsenic, Total
	Iron, Total
	Manganese, Total

TABLE 4-12
USB SOUTHERN TRIBUTARY SURFACE WATER POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Benchmark Summary		SW-09 (99)			SW-43 (04)			Min Concen-tration	Max Concen-tration	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits		Average Con-centration	95% UCL
			8/10/99			10/22/04										
			surface			0										
			surface			0.5										
Analytical Parameter	NOAEL-based Benchmark	No. NOAEL-based Benchmark Exceedances	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit								
Toluene	0.0098	0	ND		0.01	0.001		8E-04	0.001	0.001	SW-43 (04)	1 / 2	0.0008	0.01	0.001	N/A

All concentrations in mg/l
Detected compounds only shown.
LOAEL benchmark sources listed on Table 4-6. NOAEL benchmark sources listed in Appendix L.
Blank means compound not analyzed
ND means compound not detected.
HQs calculated only if compound detected or if detection limit exceeds benchmark
Shading indicates LOAEL-based HQ > 1.0
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-13
USB SOUTHERN TRIBUTARY SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location	Benchmark Summary Data						SD-202 (06)				SD-203 (06)				SD-204 (06)				SD-205 (06)				SD-206 (06)				SD-207 (06)			
Sampling Date							11/9/06				11/9/06				11/9/06				11/9/06				11/9/06				11/9/06			
Depth Top							0				0				0				0				0				0			
Depth Bottom							0.5				0.5				0.5				0.5				0.5				0.5			
Analytical Parameter	NOAEL-based Benchmark	Maximum NOAEL-based HQ	No. Exceedances of NOAEL-based Benchmarks	LOAEL-based Benchmark	Maximum LOAEL-based HQ	No. LOAEL-based HQs > 1.0	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**
Organics																														
Acetone	0.069	10.4	1	0.462	1.6	1																								
Toluene	0.061	6.1	1	3.62	0.1	0																								
Benzo(a)pyrene	0.257	1.7	1	4.4	0.1	0																								
Metals																														
Arsenic, Total	8.2	93.5	7	33	23.2	6	**9.4**	J	0.34	0.3	**42**	J	4.2	1.3	**130**	J	4.5	3.9	**58**	J	3	1.8	**58**	J	3.3	1.8	**94**	J	3.9	2.8
Iron, Total	20,000	4.3	1	40,000	2.1	2	9200	J	3.4	0.2	11000	J	42	0.3	**21000**	J	45	0.5	15000	J	30	0.4	8000	J	33	0.2	11000	J	39	0.3
Manganese, Total	460	0.3	0	NC	NC	NC																								

All concentrations in mg/kg
See Appendix C for NOAEL sources
See Table 2-6 for LOAEL sources
Blank means not analyzed
NA = Not available
NC = not calculated
Bold indicates exceedance of NOAEL-based benchmark
Shading indicates LOAEL-based HQ > 1.0
Itialics indicates HQ based on 1/2 detection limit.
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.
Detection limits for historical sample SD-14(99) not available.

TABLE 4-13
USB SOUTHERN TRIBUTARY SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location	SD-43 (04)				SD-14 (99)				SD-15(99)				Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Location of Maximum Concentration	Detection Frequency			Range of Detection Limits			Average Concentration	95% UCL
Sampling Date	10/22/04				8/10/99				8/10/99																
Depth Top	0				0				0																
Depth Bottom	0.5				0.5				0.5																
Analytical Parameter	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**													
Organics																									
Acetone	ND		0.6	*0.6*	**0.72**	J		1.6					0.72	J	0.72	J	SD-14 (99)	1	/	2	0.6	-	0.6	0.51	N/A
Toluene	ND		0.09	*0.01*	0.37	J		0.1					0.37	J	0.37	J	SD-14 (99)	1	/	2	0.09	-	0.09	0.21	N/A
Benzo(a)pyrene	ND		0.47	*0.05*	0.44	J		0.1					0.44	J	0.44	J	SD-14 (99)	1	/	2	0.47	-	0.47	0.34	N/A
Metals																									
Arsenic, Total	**88**		0.28	2.7	**406**	J		12.3	**767**	J		23.2	9.4	J	767	J	SD-15(99)	9	/	9	0.28	-	4.5	183.60	432
Iron, Total	9700		2.8	0.2	**43,900**	J		1.1	**85,300**	J		2.1	8000	J	85,300	J	SD-15(99)	9	/	9	2.8	-	45	23789	43784
Manganese, Total	41		0.56		57.8				118				41		118		SD-15(99)	3	/	3	0.56	-	0.56	72.27	

TABLE 4-14
USB SOUTHERN TRIBUTARY TOXICITY TEST RESULTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

A. Results of 10-day Toxicity Test with *Hyalella azteca*

Sample Name	Location	Mean Proportion Surviving	Mean Weight (mg)	Arsenic Concentration mg/kg	Iron Concentration, mg/kg	Arsenic /g Iron
SD-204	midreach	0.98	0.072	130	21,000	6.2
SD-200	reference	0.94	0.079	5.4	5,200	1.0
SD-201	reference	0.98	0.083	110	8,900	12.4
SD-207	near confluence	0.98	0.086	94	11,000	8.5
SD-206	up from confluence	0.99	0.087	58	8,000	7.3
Control		0.98	0.096			

B. Results of 10-day Toxicity Test with *Chironomus tentans*

Sample Name	Location	Mean Proportion Surviving	Mean Weight (mg)	Arsenic Concentration mg/kg	Iron Concentration, mg/kg	Arsenic/g Iron
SD-204	midreach	0.95	1.37	130	21,000	6.2
SD-207	near confluence	0.94	1.38	94	11,000	8.5
SD-201	Reference	0.93	1.5	110	8,900	12.4
SD-200	Reference	0.99	1.55	5.4	5,200	1.0
SD-206	up from confluence	0.91	1.69	58	8,000	7.3
Control		0.93	1.82			

TABLE 4-15
USB EASTERN REACH SURFACE WATER POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Summary of Benchmark Comparisons						SW-10 (99)				SW-214				SW-215				SW-31 (04)			
							8/10/99				11/9/06				11/10/06				10/22/04			
							surface				0				0				0			
							surface				0.5				0.5				0.5			
Analytical Parameter	NOAEL-based Benchmark	No. Exceedances of NOAEL-based Benchmark	Maximum NOAEL-based HQ	LOAEL-based Benchmark	Maximum LOAEL-based HQ	No. LOAEL-based HQs > 1.0	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**
Organics																						
Toluene	0.0098	0	0.03	NC		0	ND		0.01	NC	ND		8E-04	NC	ND		8E-04	NC	0.0003	J	8E-04	NC
Metals																						
Barium, Dissolved	0.004	4	3.8	3.2	0.01	0					**0.01**	J	0.01	0.003	**0.015**		0.01	0.005	**0.02**		0.01	0.006
Iron, Dissolved	1	1	1.4	NC		NC					0.21		0.05	NC	0.26		0.05	NC	0.64		0.05	NC
Manganese, Dissolved	0.12	2	2.3	1.3	0.2	0					0.03		0.01	0.02	0.063		0.01	0.05	**0.16**		0.01	0.1

All concentrations in mg/l
Detected compounds only shown.
NOAEL-based benchmarks listed in Appendix C.
LOAEL Benchmark sources listed on Table 2-6.
Blank means compound not analyzed
ND means compound not detected.
Total xylenes is the sum of isomers, where analyzed.
HQs calculated only if compound detected or if detection limit exceeds benchmark
Bold indicates NOAEL-based benchmark exceedance
Shading indicates LOAEL-based HQ > 1.0
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.
NC = Not calculated

TABLE 4-15
USB EASTERN REACH SURFACE WATER POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	SW-32 (04)				Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Location of Maximum Concentration	Detection Frequency			Range of Detection Limits			Average Concentration	95% UCL
	10/22/04																
	0																
	0.5																
Analytical Parameter	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**													
Organics																	
Toluene	ND		8E-04	NC	0.00032	J	0.00032	J	SW-31 (04)	1	/	5	0.0003	-	0.0003	0.003	0.0003
Metals																	
Barium, Dissolved	**0.02**		0.01	0.006	0.0097		0.02		SW-31 (04)	4	/	4	0.0097	-	0.02	0.016	0.02
Iron, Dissolved	**1.4**		0.05	NC	0.21		1.4		SW-32 (04)	4	/	4	0.21	-	1.4	0.628	0.909
Manganese, Dissolved	**0.27**		0.01	0.2	0.03		0.27		SW-32 (04)	4	/	4	0.03	-	0.27	0.131	0.186

Table 4-16
USB EASTERN REACH SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Benchmark Summary Data						SD-20 (99)				SD-208 (06)				SD-209 (06)				SD-210 (06)				SD-211 (06)				SD-212 (06)				SD-213 (06)			
Sampling Date							8/10/99				11/17/06				11/10/06				11/10/06				11/10/06				11/10/06				11/10/06			
Depth Top							0				0				0				0				0				0				0			
Depth Bottom							0.5				0.5				0.5				0.5				1				1				1			
Analytical Parameter	NOAEL-based Benchmark	Maximum NOAEL-based HQ	No. Samples Exceeding NOAEL-based Benchmark	LOAEL-based Benchmark	No. LOAEL-based HQs > 1.0	Maximum LOAEL-based HQ	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**
Organics																																		
Acetone	0.069	0.9	0	0.4629	0	0.1	ND	R																										
Carbon disulfide	0.001	6.7	1	0.224	0	0.03	ND	UJ	0.007	*0.02*																								
Naphthalene	0.514	2.9	1	8.132	0	0.2	ND		0.43	*0.03*																								
p/m-Xylene	0.134	1.3	1	3.41	0	0.05	ND		0.007	*0.001*																								
Toluene	0.061	0.02	0	NC	NC	NC	ND		0.007	NC																								
Metals																																		
Arsenic, Total	8.2	17.1	9	33	5	4.2	**62.1**	J		1.9	7.1	J	2.5	0.2	**9.5**	J	2.7	0.3	**140**	J	3.4	4.2	**29**	J	3.3	0.9	**74**	J	5.8	2.2	**92**	J	2.5	2.8
Iron, Total	20,000	1.4	1	NC	NC	NC	9060	J		NC	2200	J	25	NC	3700	J	27	NC	15000	J	34	NC	3800	J	33	NC	18000	J	58	NC	**27000**	J	25	NC
Manganese, Total	460	0.2	0	NC	NC	NC	103			NC				NC				NC				NC				NC				NC				NC

All concentrations in mg/kg
See Appendix C for NOAEL sources from SLERA.
See Table 2-6 for LOAEL sources
NC = not calculated
Blank means not analyzed
Bold means value exceeds NOAEL-based benchmark
Shading means LOAEL-based HQ > 1.0, for detected COPCs
Italics mean HQ is based on 1/2 detection limit.
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

Table 4-16
USB EASTERN REACH SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	SD-214 (06)				SD-215 (06)				SD-31 (04)				SD-32 (04)				Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Average Concentration	95% UCL
Sampling Date	11/9/06				11/9/06				10/22/04				10/22/04												
Depth Top	0				0				0				0												
Depth Bottom	0.5				1				0.5				0.5												
Analytical Parameter	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**	Concentration	Qualifier	Detection Limit	**LOAEL-based HQ**									
Organics																									
Acetone	0.058		0.009	0.1	0.063	J	0.01	0.1	ND		0.5	*0.5*	ND		1.1	*1.2*	0.058		0.063	J	SD-215 (06)	2 / 5	0.0089 - 1.1	0.061	N/A
Carbon disulfide	**0.007**	J	0.009	0.03	ND		0.01	*0.02*	ND		0.5	*1.1*	ND		1.1	*2.5*	0.0067	J	0.0067	J	SD-214 (06)	1 / 5	0.007 - 1.1	0.005	N/A
Naphthalene	ND		0.004	*0*	ND	UJ	0.005	*0.00*	ND		0.25	*0.02*	**1.5**		0.56	0.2	1.5		1.5		SD-32 (04)	1 / 5	0.0044 - 0.56	0.369	1.5
p/m-Xylene	ND		9E-04	####	ND		0.001	#####	ND		0.05	*0.01*	**0.17**		0.11	0.05	0.17		0.17		SD-32 (04)	1 / 5	0.0009 - 0.11	0.040	0.170
Toluene	0.0011	J	0.001	NC	ND		0.0015	NC	ND		0.075	NC	ND		0.17	*NC*	0.0011	J	0.0011	J	SD-214 (06)	1 / 5	0.0013 - 0.17	0.001	N/A
Metals																									
Arsenic, Total	**8.4**	J	0.27	0.3	**26**	J	0.29	0.8	7.2		0.26	0.2	**55**		0.34	1.7	7.1	J	140	J	SD-210 (06)	11 / 11	0.26 - 5.8	46.4	70
Iron, Total	3200		2.7	NC	2100		2.9	NC	2700		2.6	NC	4800		3.4	NC	2100		27000		SD-215 (06)	11 / 11	2.6 - 58	8324	14420
Manganese, Total	66		0.55	NC	45		0.58	NC	62		0.53	NC	41		0.68	NC	41		103		SD-208 (06)	5 / 5	0.53 - 0.68	63.4	87

TABLE 4-17
USB SITE CHANNEL SURFACE WATER POINT DATA AND NOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample No.	Benchmark Summary			SW-05 (99)			SW-33 (04)			SW-33 (05)			SW-34 (04)		
Date				8/10/99			10/22/04			9/20/05			10/22/04		
Sample Top Depth., ft.				surface			0			0			0		
Sample Bottom Depth, ft.				surface			0.5			0.5			0.5		
Analytical Parameter	NOAEL-based Benchmark	Maximum NOAEL-based HQ	No. NOAEL-based Benchmark Exceedances	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit
Organics															
4,4'-DDT	1.00E-06	9.0	1	**9.E-06**	J		ND		0.00004				ND		4E-05
Ethylbenzene	0.0073	1.6	3	**1.E-02**			0.001		0.0005	**0.0088**		0.0005	0.0035		0.0005
Toluene	0.0098	12.6	4	**8.E-02**			0.0082		0.001	**0.097**		0.0008	**0.047**		0.0008
Xylenes (total)	0.013	2.8	4	**4.E-02**			0.004			**0.0369**			**0.0149**		
Metals															
Barium, Dissolved	0.004	20.0	1							0.08		0.01			
Iron, Dissolved	1	0.1	0							0.12		0.05			
Manganese, Dissolved	0.12	4.4	1							0.53		0.01			

All concentrations in mg/l
See Appendix L for NOAEL-based benchmarks from the SLERA.
Benchmark sources listed on Table 2-6.
Blank means compound not analyzed
ND means compound not detected.
Total xylenes is the sum of isomers, where analyzed.
HQs calculated only if compound detected or if detection limit exceeds benchmark
Bold indicates exceedance of NOAEL-based benchmark
Shading indicates LOAEL-based HQ > 1.0
Italics indicate HQ based on 1/2 the detection limit
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-17
USB SITE CHANNEL SURFACE WATER POINT DATA AND NOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample No.	SW4-99			Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Location of Maximum Concentration	Detection Frequency			Range of Detection Limits			Average Concentration	95% UCL
Date	6/3/99															
Sample Top Depth., ft.	surface															
Sample Bottom Depth, ft.	surface															
Analytical Parameter	Concentration	Qualifier	Detection Limit													
Organics																
4,4'-DDT				0.000009	J	0.000009	J	SW-05 (99)	1	/	3	4E-05	-	4E-05	0.000009	N/A
Ethylbenzene	**0.012**		0.01	0.001		0.012		SW4-99	5	/	5	0.0005	-	0.01	0.007	0.0122
Toluene	**0.123**		0.01	0.0082		0.123		SW4-99	5	/	5	0.0008	-	0.01	0.071	0.1131
Xylenes (total)	**0.0334**		0.005	0.00413		0.037		SW-33 (05)	5	/	5	0.005	-	0.005	0.025	0.0394
Metals																
Barium, Dissolved				0.08		0.08		SW-33 (05)	1	/	1	0.01	-	0.01	0.08	N/A
Iron, Dissolved				0.12		0.12		SW-33 (05)	1	/	1	0.05	-	0.05	0.12	N/A
Manganese, Dissolved				0.53		0.53		SW-33 (05)	1	/	1	0.01	-	0.01	0.53	N/A

TABLE 4-18
USB SITE CHANNEL SEDIMENT POINT DATA AND NOAEL-BASED HQS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location	Benchmark Summary Data			SD-21 (99)			SD-22 (99)			SD-23 (99)			SD-33 (04)			SD-34 (04)		
Sampling Date				8/10/99			8/9/99			8/9/99			10/22/04			10/22/04		
Depth Top				0			0			0			0			0		
Depth Bottom				0.5			0.5			0.5			0.5			0.5		
Analytical Parameter	NOAEL-based Benchmark	Maximum NOAEL-based HQ	No. Exceedances of NOAEL-based Benchmarks	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit
Organics																		
1,2,4-Trimethylbenzene	1.287	2.3	2	0.64			**3**			0.094	J		**1.3**	J	0.18	ND		0.3
1,3,5-Trimethylbenzene	1.163	13.8	1	0.13	J		0.18	J		**16**			0.46	J	0.18	ND		0.3
2-Methylphenol	0.134	1.8	1	**0.24**	J		ND		0.57	ND		0.89	ND		0.51	ND		0.7
3-Methylphenol/4-Methylphenol	0.627	1.9	1										**1.2**		0.51	ND		0.7
4-Methyl-2-pentanone	0.043	2.3	1	**0.1**			0.034			ND		0.02	ND		0.36	ND		0.6
Acetone	0.069	3.9	1	0.056	J		0.038	J EB		**0.27**	J EB		ND		0.36	ND		0.6
Carbon disulfide	0.001	15.3	2	**0.006**	J		**0.015**			ND		0.02	ND		0.36	ND		0.6
Chloroethane	0.026	3.3	2	0.005	J		**0.035**			**0.085**			ND	UJ	0.072	ND		0.12
Ethylbenzene	0.088	37.5	5	**1.3**	J		**3.3**			**1**			**0.54**	J	0.036	**0.17**		0.06
Naphthalene	0.514	1.0	0	ND		0.35	0.38	J		0.37	J		0.29		0.18	0.5		0.3
o-Xylene	NA	NC	NC	0.12			0.2			0.19	J		0.57	J	0.036	0.088		0.06
p/m-Xylene	NA	NC	NC	1.9	J		10			3.5			1.7	J	0.036	2.9		0.06
Total Xylenes	0.134	76.0	5	**2.02**			**10.2**			**3.69**			**2.27**			**2.988**		
Toluene	0.061	78.4	2	**0.46**			0.035			0.022			**4.8**	J	0.054	ND		0.09
Metals																		
Arsenic, Total	8.2	19.5	5	**8.3**	J		**43.8**	J		**21.4**	J		**160**		0.25	**78**		0.35
Iron, Total	20000	0.8	0	15100	J		15800	J		5880	J		15000		2.5	7200		3.5
Manganese, Total	460	1.2	1	171			176			92.9			**550**		0.5	79		0.7

All concentrations in mg/kg
See Appendix L for NOAEL sources
Total xylenes reflects the sum of the isomers
Blank means not analyzed
NA = Not available
NC = not calculated
Bold indicates exceedance of NOAEL-based benchmark
Itialics indicates HQ based on 1/2 detection limit.
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-18
USB SITE CHANNEL SEDIMENT POINT DATA AND NOAEL-BASED HQS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location	Minimum Concentration (Qualifier)		Maximum Concentration (Qualifier)		Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Average Concentration	95% UCL
Sampling Date									
Depth Top									
Depth Bottom									
Analytical Parameter									
Organics									
1,2,4-Trimethylbenzene	0.094	J	3		SD-22 (99)	4 / 5	0.18 - 0.3	1.0368	2.1805
1,3,5-Trimethylbenzene	0.13	J	16		SD-23 (99)	4 / 5	0.18 - 0.3	3.3840	16
2-Methylphenol	0.24	J	0.24	J	SD-21 (99)	1 / 5	0.51 - 0.89	0.3150	0.24
3-Methylphenol/4-Methylphenol	1.2		1.2		SD-33 (04)	1 / 2	0.51 - 0.7	0.7750	N/A
4-Methyl-2-pentanone	0.034		0.1		SD-21 (99)	2 / 5	0.02 - 0.6	0.048	N/A
Acetone	0.038	J EB	0.27	J EB	SD-23 (99)	3 / 5	0.36 - 0.6	0.136	0.2263
Carbon disulfide	0.006	J	0.015		SD-22 (99)	2 / 5	0.02 - 0.6	0.010	N/A
Chloroethane	0.005	J	0.085		SD-23 (99)	3 / 5	0.072 - 0.12	0.044	0.0728
Ethylbenzene	0.17		3.3		SD-22 (99)	5 / 5	0.036 - 0.06	1.262	2.4235
Naphthalene	0.29		0.5		SD-34 (04)	4 / 5	0.18 - 0.35	0.343	0.4576
o-Xylene	0.088		0.57	J	SD-33 (04)	5 / 5	0.036 - 0.06	0.234	0.4184
p/m-Xylene	1.7	J	10		SD-22 (99)	5 / 5	0.04 - 0.06	4.000	9.7518
Total Xylenes	2.02		10.2		SD-22 (99)	5 / 5	0.04 - 0.06	4.234	10.2
Toluene	0.022		4.8	J	SD-33 (04)	4 / 5	0.054 - 0.09	1.072	4.8
Metals									
Arsenic, Total	8.3	J	160		SD-33 (04)	5 / 5	0.25 - 0.35	62.3	120
Iron, Total	5880	J	15800	J	SD-22 (99)	5 / 5	2.5 - 3.5	11796.0	15800
Manganese, Total	79		550		SD-33 (04)	5 / 5	0.5 - 0.7	213.8	550

TABLE 4-19a
SLERA AQUATIC WETLAND HAZARD QUOTIENTS OVER 1.0
a. SURFACE WATER NOAEL-BASED HAZARD QUOTIENTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts

	Surface Water Maximum Conc., mg/l	Surface Water Location of Maximum	Surface Water Frequency of Detection	NOAEL-based Aquatic Benchmark	NOAEL-based Amphibian Benchmark	Maximum Surface Water Aquatic NOAEL-based HQ	Number of Aquatic NOAEL-based HQs > 1.0	Maximum Amphibian Surface Water NOAEL-based HQ	Number of Amphibian NOAEL-based HQs > 1.0
ASSESSMEMT ENDPOINT:						**Aquatic Invertebrates**		**Amphibians**	
Ethylbenzene	0.00794	SW3-99	6 / 21	0.0073	NB	1.1	1	NB	
Toluene	0.072	SW-08 (99)	12 / 21	0.010	0.1	7.3	5	1.1	1
Xylenes (total)	0.033	SW-08 (99)	5 / 6	0.013	1.1	2.5	3	0.03	
Aluminum, Dissolved	0.220	SW-108 (05)	1 / 14	0.087	0.010	2.5	1	22.0	1
Arsenic, Dissolved	0.021	SW-35 (04)	8 / 14	0.150	0.010	0.1		2.1	2
Barium, Dissolved	0.140	SW-110 (05)	14 / 14	0.004	0.8	35.0	14	0.2	
Copper, Dissolved	0.004	SW-101 (05)	3 / 14	0.007	0.003	0.6		1.3	1
Iron, Dissolved	5.3	SW-101 (05)	14 / 14	1.000	0.3	5.3	10	17.7	13
Lead, Dissolved	0.005	SW-108 (05)	1 / 14	0.002	0.008	2.5	1	0.6	
Manganese, Dissolved	0.980	SW-110 (05)	14 / 14	0.120	0.0142	8.2	12	69.0	14
Nickel, Dissolved	0.009	SW-110 (05)	12 / 14	0.039	0.003	0.2		2.9	4
Zinc, Dissolved	0.038	SW-36	3 / 14	0.089	0.003	0.4		12.7	4

Notes:
*Maximum HQ is the maximum detected concentration per exposure point divided by the applicable benchmark
See Appendix C for benchmark sources
NA = Constituent not a chemical of potential concern for this exposure point.

Shading indicates NOAEL-based HQ > 1.0
mg/l = milligrams per liter.
mg/kg = milligrams per kilogram.
HQ = Hazard Quotient.

TABLE 4-19b
SLERA AQUATIC WETLAND HAZARD QUOTIENTS OVER 1.0
b. SEDIMENT NOAEL-BASED HAZARD QUOTIENTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusett

	Sediment Maximum Conc., mg/kg	Sediment Location of Maximum	Sediment Frequency of Detection	NOAEL-based Benchmark	Maximum Sediment NOAEL-based HQ	Number of Sediment NOAEL-based HQs > 1.0
ASSESSMEMT ENDPOINT:					**Benthic Invertebrates**	
Acetone	2.1	WS-102 (05)	18/21	0.755	2.8	6
Benzoic Acid	5.5	WS-104 (05)	4/12	0.155	35.6	4
Arsenic, Total	64	SD-38 (04)	22/22	8.200	7.8	11
Beryllium, Total	2.1	WS-11 (04)	11/22	1.100	1.9	2
Iron, Total	24800	SD-01 (99)	22/22	20000	1.2	1
Mercury, Total	0.22	WS-102 (05)	8/20	0.150	1.5	2
Selenium, Total	5.1	WS-11 (04)	11/15	0.720	7.1	8

Notes:
*Maximum HQ is the maximum detected concentration per exposure point divided by the applicable ecological benchmark.
See Appendix C for NOAEL benchmark sources
NA = Constituent not a chemical of potential concern for this exposure point.
Shading indicates NOAEL-based HQ > 1.0
mg/l = milligrams per liter.
mg/kg = milligrams per kilogram.
HQ = Hazard Quotient.

TABLE 4-20
SLERA AQUATIC WETLAND AND SITE POND WILDLIFE HAZARD QUOTIENTS OVER 1.0
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts

CONSTITUENT OF POTENTIAL CONCERN:	Aquatic Wetland and Site Pond NOAEL-based HQs		
	Carnivore (Heron)	Omnivore (Mallard)	Herbivore (Black Duck)
Aluminum, Total	0.16	1.4	0.4
Iron, Total	0.99	1.1	0.4
Lead, Total	0.29	1.0	1.7
Selenium, Total	0.22	0.9	1.4

Notes:
*Maximum HQ is the maximum detected concentration per exposure point divided by the applicable ecological benchmark.

Shading indicates NOAEL-based HQ > 1.0

TABLE 4-21
AQUATIC WETLAND CONTAMINANTS OF POTENTIAL CONCERN
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Media	**Surface Water**	**Surface Water**	**Sediment**	**Surface Water and Sediment**	
Receptor	**Aquatic Organisms**	**Amphibians**	**Benthic Organisms**	**Herbivore (Black Duck)**	**Ominvores (Mallard)**
	Ethylbenzene	Toluene	Acetone	Lead, Total	Aluminum, Total
	Toluene	Aluminum, Dissolved	Benzoic Acid	Selenium, Total	Iron, Total
	Xylenes (total)	Arsenic, Dissolved	Chloroethane		
	Aluminum, Dissolved	Copper, Dissolved	Toluene		
	Barium, Dissolved	Iron, Dissolved	Arsenic, Total		
	Iron, Dissolved	Manganese, Dissolved	Beryllium, Total		
	Lead, Dissolved	Nickel, Dissolved	Iron, Total		
	Manganese, Dissolved	Zinc, Dissolved	Mercury, Total		
			Selenium, Total		

TABLE 4-22
SUMMARY STATISTICS FOR AQUATIC WETLAND SURFACE WATER COPCs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Average Concentration	95% UCL
Aluminum, Dissolved	0.22	0.22	mg/l	SW-108 (05)	1 / 14	0.047 -- 0.19	0.059	0.081
Arsenic, Dissolved	0.0036 J	0.0206 J	mg/l	SW-35 (04)	8 / 14	0.005 -- 0.005	0.006	0.012
Barium, Dissolved	0.01	0.14	mg/l	SW-110 (05)	14 / 14	0.01 -- 0.01	0.031	0.068
Copper, Dissolved	0.003 J	0.004 J	mg/l	SW-101 (05)	3 / 14	0.01 -- 0.01	0.005	N/A
Iron, Dissolved	0.12	5.3	mg/l	SW-101 (05)	14 / 14	0.05 -- 0.05	1.730	2.543
Lead, Dissolved	0.005 J	0.005 J	mg/l	SW-108 (05)	1 / 14	0.01 -- 0.01	0.005	N/A
Manganese, Dissolved	0.06	0.98	mg/l	SW-110 (05)	14 / 14	0.01 -- 0.01	0.337	0.486
Nickel, Dissolved	0.0015 J	0.0088 J	mg/l	SW-110 (05)	12 / 14	0.0042 -- 0.025	0.004	0.005
Vanadium, Dissolved	0.001 J	0.001 J	mg/l	SW-101(05), SW-102(05), SW-104(05), SW-106(05), SW-107(05), SW-108(05), SW-110(05), SW-35(04)	8 / 14	0.001 -- 0.01	0.002	0.001
Zinc, Dissolved	0.014 J	0.0255 J	mg/l	SW-36	3 / 14	0.05 -- 0.12	0.035	0.026
Ethylbenzene	0.00038 J	0.00794 J	mg/l	SW3-99	6 / 21	0.0005 -- 0.01	0.002	0.007
Xylenes (total)	0.00595	0.033	mg/l	SW-08 (99)	5 / 6	0.005 -- 0.01	0.005	0.026
Toluene	0.0017	0.072	mg/l	SW-08 (99)	12 / 21	0.00075 -- 0.01	0.011	0.051

Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-23
AQUATIC WETLAND SEDIMENT DATA SUMMARY
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Analytical Parameter	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency			Range of Detection Limits			Average Concentration	95% UCL
Organics											
Acetone	0.011	4.4	SD-218 (06)	23	/	28	0.005	-	0.66	1.071	2.11
Benzoic Acid	0.2	5.5	WS-104 (05)	5	/	22	0.66	-	240	3.06	3.72
Chloroethane	0.017	0.35	SD-02 (99)	7	/	27	0.0015	-	0.13	0.029	0.065
Toluene	0.00086	8.4	SD-02 (99)	18	/	27	0.0011	-	0.1	0.329	3.42
Metals											
Aluminum, Total	1500	7300	WS-11 (04)	23	/	23	4.9	-	30	3159.1	3759.2
Arsenic, Total	2	64	SD-38 (04)	23	/	23	0.24	-	1.5	14.2	20.8
Beryllium, Total	0.26	2.1	WS-11 (04)	11	/	23	0.24	-	3.7	0.575	0.8
Iron, Total	1600	24800	SD-01 (99)	23	/	23	2.4	-	15	6462	8531.8
Lead, Total	1.9	75.6	SD-01 (99)	23	/	23	2.4	-	15	13.6	19.1
Manganese, Total	28.1	341	SD-02 (99)	23	/	23	0.49	-	3	129.6	170.0
Mercury, Total	0.032	0.3	SD-216 (06)	14	/	29	0.05	-	0.59	0.1	0.1
Selenium, Total	0.54	5.1	WS-11 (04)	11	/	16	0.49	-	3	1.3	1.9
Vanadium, Total	2.2	70	WS-7 (04)	23	/	23	0.49	-	3	10.5	23.3

Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-24
SURFACE WATER AQUATIC HAZARD QUOTIENTS IN THE AQUATIC WETLAND
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Maximum Conc. in Aquatic Wetland Surface Water, mg/l	Surface Water Aquatic Benchmarks and HQs			
		Surface Water NOAEL-Based Benchmarks, mg/l	Maximum NOAEL-Based HQ	Surface Water LOAELs, mg/l	Maximum LOAEL-Based HQ
Toluene	0.072	0.0098	7.3	0.58	0.1
Xylenes (total)	0.033	0.013	2.5	0.33	0.10
Barium, Dissolved	0.14	0.004	35.0	3.20	0.04
Manganese, Dissolved	0.98	0.12	8.2	1.30	0.8

NOAEL sources presented in Appendix L
LOAEL sources presented in Table 4-6.
mg/l = milligrams per liter.

TABLE 4-25
AQUATIC WETLAND SEDIMENT LOAEL-BASED HAZARD QUOTIENTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Analytical Parameter	Maximum Detected Concentration	LOAEL-based Benchmark	Maximum LOAEL based HQ	No. LOAEL Exceedances
Acetone	4.4	5.032	0.9	0
Benzoic Acid	5.5	14.538	0.4	0
Chloroethane	0.35	5.005	0.1	0
Toluene	8.4	39.48	0.2	0
Arsenic, Total	64	33	1.9	3
Mercury, Total	0.3	1.06	0.3	0
Selenium, Total	5.1	4	1.3	1

TABLE 4-26
AQUATIC WETLAND SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Area Superfund Site - Tewksbury, Massachusetts

Sample Location	SD-16 (99)			SD-17 (99)			SD-24 (99)			SD-25 (99)			SD-26 (99)			SD-28 (99)			SD-35 (04)			SD-36 (04)			SD-37 (04)		
Sampling Date	8/9/99			8/9/99			8/9/99			8/9/99			8/9/99			8/9/99			10/22/04			10/21/04			10/21/04		
Depth Top	0			0			0			0			0			0			0			0			0		
Depth Bottom	0.5			0.5			0.5			0.5			0.5			0.5			0.5			0.5			0.5		
Analytical Parameter	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit
Organics																											
Acetone	0.093	J EB					0.32	J EB		0.22	J EB		0.018	J EB		0.06	J EB		ND		0.45	ND	UJ	0.66	ND	UJ	0.49
Benzoic Acid																			ND		4.7	ND		4.6	ND		4.1
Chloroethane	ND		0.012							ND		0.01	ND		0.006	ND		0.008	ND		0.091	ND		0.13	ND		0.098
Toluene	ND		0.012							ND		0.01	ND		0.006	0.003	J		ND		0.068	ND		0.1	ND		0.073
Metals																											
Aluminum, Total	3560			2160			5160			1730			4030			3350			2700		5.6	1600		5.5	2100		4.9
Arsenic, Total	9.7	J		10.7	J		48.9			4.6	J		23.4	J		9.3	J		14		0.28	39		0.28	9.4		0.24
Beryllium, Total	ND		0.57	ND		0.41	ND		0.7	ND		0.36	ND		0.28	ND		0.92	ND		0.28	ND		0.28	ND		0.24
Iron, Total	4360	J		3200	J		5470	J		2690	J		18400	J		2910	J		3100		2.8	6100		2.8	6500		2.4
Lead, Total	6.5	J		3	J		21.6	J		2.7	J		15.2	J		5	J		3.6		2.8	5.2		2.8	9		2.4
Manganese, Total	31.4			28.1			260			145			134			148			46		0.56	38		0.55	81		0.49
Mercury, Total	ND	UJ	0.09	ND	UJ	0.09	0.11	J		ND	UJ	0.1	ND	UJ	0.05	ND	UJ	0.07	ND		0.08	ND		0.07	ND		0.08
Selenium, Total																			ND		0.56	ND		0.55	ND		0.49
Vanadium, Total	7.8			4.8			15.1			2.7			8.9			2.2			7.3		0.56	4.5		0.55	6.2		0.49

All concentrations in mg/kg
See Appendix L for NOAEL sources
See Table 4-6 for LOAEL sources
Blank means not analyzed
NA = Not available
NC = not calculated
Shading indicates LOAEL-based HQ > 1.0
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-26
AQUATIC WETLAND SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Area Superfund Site - Tewksbury, Massachusetts

Sample Location	SD-38 (04)			SS-12 (04)			WS-10 (04)			WS-11 (04)			WS-15 (04)			WS-16 (04)			WS-7 (04)			SD-01 (99)			SD-02 (99)		
Sampling Date	11/18/04			11/9/04			11/18/04			11/18/04			11/18/04			11/18/04			11/9/04			8/10/99			8/10/99		
Depth Top	0			0			0			0			0			0			0			0			0		
Depth Bottom	2			1			2			2			2			2			1			0.5			0.5		
Analytical Parameter	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit
Organics																											
Acetone	0.26	J	0.046	0.011		0.0075	0.072	J	0.013	0.84	J	0.074	0.097	J	0.012	0.15	J	0.016	0.095		0.018	0.58	J		1	J	0.005
Benzoic Acid	ND	R	16	ND		4.5	ND		6.8	ND	R	20	ND		6.1	ND		7.4	ND		6.7				ND		0.66
Chloroethane	ND	R	0.0092	ND		0.0015	0.024	J	0.0026	ND	R	0.015	ND		0.0024	ND		0.0033	ND		0.0036	0.029	J		0.35	J	0.005
Toluene	ND	R	0.0069	0.0012		0.0011	0.013	J	0.002	0.035	J	0.011	0.014	J	0.0018	0.0039	J	0.0024	0.0039		0.0027	0.029	J		8.4	J	0.005
Metals																											
Aluminum, Total	4100		19	3900		5.3	6000		8	7300	J	23	3700		7.2	4900		8.9	2000		8	2580			2590		
Arsenic, Total	64	J	0.94	6	J	0.27	7.7		0.4	14	J	1.2	7.3		0.36	2.1		0.44	2.4	J	0.4	27.9	J		11	J	
Beryllium, Total	0.69	J	0.94	ND		0.27	0.27	J	0.4	2.1	J	1.2	0.5		0.36	0.26	J	0.44	0.3	J	0.4	ND	UJ	1.1	ND	UJ	3.7
Iron, Total	7700	J	9.4	3600		2.7	4200		4	1600	J	12	5100		3.6	2600		4.4	2200		4	24800	J		14600	J	
Lead, Total	17	J	9.4	1.9	J	2.7	9.3		4	8.1	J	12	4.4		3.6	10		4.4	17		4	75.6			22.9		
Manganese, Total	180	J	1.9	43		0.53	97		0.8	54	J	2.3	190		0.72	40		0.89	70		0.8	118			341		
Mercury, Total	ND	R	0.36	ND		0.1	ND	J	0.15	ND	R	0.46	ND		0.14	ND		0.18	0.032	J	0.17	0.2	J		0.13	J	
Selenium, Total	1.7	J	1.9	ND		0.53	0.54	J	0.8	5.1	J	2.3	0.8		0.72	0.73	J	0.89	0.59	J	0.8				ND	UJ	2.4
Vanadium, Total	9.5	J	1.9	6.3		0.53	8.4		0.8	28	J	2.3	5.4		0.72	6.6		0.89	70		0.8	8.8			13.6		

TABLE 4-26
AQUATIC WETLAND SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Area Superfund Site - Tewksbury, Massachusetts

Sample Location	SD-216 (06)			SD-217 (06)			SD-218 (06)			SD-219 (06)			SD-220 (06)			SD-221 (06)			WS-101 (05)			WS-102 (05)			WS-103 (05)		
Sampling Date	11/9/06			11/9/06			11/9/06			11/9/06			11/9/06			11/9/06			12/1/05			12/1/05			12/1/05		
Depth Top	0			0			0			0			0			0			0			0			0		
Depth Bottom	0.5			0.5			1			0.5			1			1			1			1			1		
Analytical Parameter	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit
Organics																											
Acetone	4.2	J	0.061	4	J	0.085	4.4	J	0.065	4.2	J	0.081	0.082	J	0.012	1.6	J	0.11	1.3	J EB	0.081	2.1	J EB	0.11	1.3	J EB	0.065
Benzoic Acid	ND	R	150	ND	R	180	ND	R	230	ND	R	220	0.2	J	2	ND	R	240	2.9	J	22	3.8	J	26	4.9	J	21
Chloroethane	ND	R	0.012	0.022		0.017	ND	R	0.013	ND	R	0.016	ND		0.0024	ND	R	0.021	ND	R	0.016	ND	R	0.021	0.053	J	0.013
Toluene	0.1	J	0.0092	0.016	J	0.013	0.042	J	0.0098	0.0075	J	0.012	0.0009	J	0.0018	0.0079	J	0.016	0.016	J	0.012	ND	R	0.016	0.04	J	0.0098
Metals																											
Aluminum, Total																			2600	J	26	1500	J	30	1700	J	24
Arsenic, Total																			2.3	J	1.3	3.1	J	1.5	4.8	J	1.2
Beryllium, Total																			0.73	J	1.3	0.7	J	1.5	1.5	J	1.2
Iron, Total																			9200	J	13	4000	J	15	5400	J	12
Lead, Total																			12	J	13	33	J	15	6.5	J	12
Manganese, Total																			210	J	2.6	180	J	3	330	J	2.4
Mercury, Total	0.3		0.1	0.14		0.11	0.2		0.1	0.19		0.11	ND		0.05	0.083	J	0.1	0.12	J	0.55	0.22	J	0.59	0.084	J	0.48
Selenium, Total																			1.8	J	2.6	1.8	J	3	1.8	J	2.4
Vanadium, Total																			4	J	2.6	6.4	J	3	4.7	J	2.4

TABLE 4-26
AQUATIC WETLAND SEDIMENT POINT DATA AND SUMMARY STATISTICS
Baseline Ecological Risk Assessment
Sutton Brook Area Superfund Site - Tewksbury, Massachusetts

Sample Location	WS-104 (05)			WS-105 (05)			Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Location of Maximum Concentration	Detection Frequency			Range of Detection Limits			Average Concentration	95% UCL
Sampling Date	12/1/05			12/1/05													
Depth Top	0			0													
Depth Bottom	1			1													
Analytical Parameter	Concentration	Qualifier	Detection Limit	Concentration	Qualifier	Detection Limit											
Organics																	
Acetone	ND	J EB	0.061	ND	J EB	0.053	0.011	4.4	SD-218 (06)	23	/	28	0.005	-	0.66	1.071	2.113
Benzoic Acid	5.5	J	20	ND	R	17	0.2	5.5	WS-104 (05)	5	/	22	0.66	-	240	3.06	3.719
Chloroethane	0.038	J	0.012	0.017	J	0.011	0.017	0.35	SD-02 (99)	7	/	27	0.0015	-	0.13	0.029	0.065
Toluene	0.0085	J	0.0092	ND	R	0.008	0.00086	8.4	SD-02 (99)	18	/	27	0.0011	-	0.1	0.329	3.418
Metals																	
Aluminum, Total	1700	J	23	1700	J	20	1500	7300	WS-11 (04)	23	/	23	4.9	-	30	3159.130	3759.2
Arsenic, Total	2	J	1.2	3.7	J	1	2	64	SD-38 (04)	23	/	23	0.24	-	1.5	14.230	20.8
Beryllium, Total	0.88	J	1.2	0.74	J	1	0.26	2.1	WS-11 (04)	11	/	23	0.24	-	3.7	0.575	0.8
Iron, Total	1900	J	12	9000	J	10	1600	24800	SD-01 (99)	23	/	23	2.4	-	15	6462.174	8531.8
Lead, Total	4.2	J	12	18	J	10	1.9	75.6	SD-01 (99)	23	/	23	2.4	-	15	13.552	19.1
Manganese, Total	76	J	2.3	140	J	2	28.1	341	SD-02 (99)	23	/	23	0.49	-	3	129.587	170.0
Mercury, Total	0.08	J	0.47	0.084	J	0.37	0.032	0.3	SD-216 (06)	14	/	29	0.05	-	0.59	0.096	0.131
Selenium, Total	1.6	J	2.3	1.6	J	2	0.54	5.1	WS-11 (04)	11	/	16	0.49	-	3	1.270	1.904
Vanadium, Total	3.9	J	2.3	7.1	J	2	2.2	70	WS-7 (04)	23	/	23	0.49	-	3	10.530	23.280

TABLE 4-27
SURFACE WATER AMPHIBIAN HAZARD QUOTIENTS IN THE AQUATIC WETLAND
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

	Average Conc. in Aquatic Wetland Surface Water, mg/l	95% UCL Conc. in Aquatic Wetland Surface Water, mg/l	Maximum Conc. in Aquatic Wetland Surface Water, mg/l	**Surface Water Amphibian Benchmarks and LOAEL-based HQs**					
				Surface Water NOAEL-based Benchmark, mg/l	**Maximum NOAEL-based HQ**	**LOAEL-based Benchmark, mg/l**	**Average LOAEL-based HQ**	**95% UCL LOAEL-based HQ**	**Maximum LOAEL-based HQ**
Aluminum, Dissolved	0.059	0.081	0.22	0.01	22.0	0.088	0.7	0.9	2.5
Iron, Dissolved	1.730	2.543	5.3	0.3	17.7	3.0	0.6	0.8	1.8
Manganese, Dissolved	0.337	0.486	0.98	0.0142	69.0	2.0	0.2	0.2	0.5
Nickel, Dissolved	0.004	0.005	0.0088	0.003	2.9	0.370	0.01	0.01	0.02
Zinc, Dissolved	0.035	0.033	0.038	0.003	12.7	0.085	0.4	0.4	0.4

Shading indicates LOAEL-based HQ > 1.0.
NOAEL sources listed in Appendix L
LOAEL value sources listed in Table 4-6
mg/l = milligrams per liter.

TABLE 4-28
AQUATIC WETLAND AMPHIBIAN POINT DATA AND LOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Name	Units	Amphibian Ecological Benchmark	SW-02 (99)				SW-03 (99)				SW-08 (99)				SW-101 (05)			
			8/9/99				8/9/99				8/9/99				12/1/05			
			Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ
Aluminum, Dissolved	mg/l	0.088	NA	-	-	-	NA	-	-	-	NA	-	-	-	ND	-	0.096	*0.5455*
Iron, Dissolved	mg/l	3	NA	-	-	-	NA	-	-	-	NA	-	-	-	5.3	-	0.05	**2**
Manganese, Dissolved	mg/l	2	NA	-	-	-	NA	-	-	-	NA	-	-	-	0.36	-	0.01	0.2
Nickel, Dissolved	mg/l	0.37	NA	-	-	-	NA	-	-	-	NA	-	-	-	0.007	J	0.025	0.02
Zinc, Dissolved	mg/l	0.085	NA	-	-	-	NA	-	-	-	NA	-	-	-	ND	-	0.07	*0.4*

Notes:
HQ = Hazard Quotient

Shading indicates HQ>1 in at least one sample
J = estimated
UJ = compound not detected
ND - not detected
EB = equipment blank contamination
NA = not analyzed
* = no amphibian-specific benchmark available for compound
See Table 4-6 for benchmark sources
Total xylene values for samples collected after 1999 obtained by summing isomers
HQs for non-detected compounds are based on 1/2 the reporting limit. These are indicated in italics.

TABLE 4-28
AQUATIC WETLAND AMPHIBIAN POINT DATA AND LOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Name	Units	Amphibian Ecological Benchmark	SW-102 (05) 12/1/05				SW-103 (05) 12/1/05				SW-104 (05) 12/1/05				SW-105 (05) 12/1/05			
			Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ
Aluminum, Dissolved	mg/l	0.088	ND	-	0.056	*0.3182*	ND	-	0.063	*0.4*	ND	-	0.088	*0.5*	ND	-	0.06	*0.3*
Iron, Dissolved	mg/l	3	0.66	-	0.05	0.2	1.3	-	0.05	0.4	0.98	-	0.05	0.3	3.3	-	0.05	1.1
Manganese, Dissolved	mg/l	2	0.16	-	0.01	0.08	0.16	-	0.01	0.1	0.06	-	0.01	0.03	0.23	-	0.01	0.1
Nickel, Dissolved	mg/l	0.37	0.0018	J	0.025	0.005	0.0021	J	0.025	0.01	0.0025	J	0.025	0.01	0.0015	J	0.025	0.004
Zinc, Dissolved	mg/l	0.085	ND	-	0.06	*0.35*	ND	-	0.09	*0.5*	ND	-	0.06	*0.35*	ND	-	0.07	*0.4*

Notes:
HQ = Hazard Quotient

Shading indicates HQ>1 in at least one sample
J = estimated
UJ = compound not detected
ND - not detected
EB = equipment blank contamination
NA = not analyzed
* = no amphibian-specific benchmark available for compound
See Table 4-6 for benchmark sources
Total xylene values for samples collected after 1999 obtained by summing isomers
HQs for non-detected compounds are based on 1/2 the reporting limit. These are indicated in italics.

TABLE 4-28
AQUATIC WETLAND AMPHIBIAN POINT DATA AND LOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Name	Units	Amphibian Ecological Benchmark	SW-106 (05)				SW-107 (05)				SW-108 (05)				SW-109 (05)			
			12/2/05				12/2/05				12/1/05				12/1/05			
			Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ
Aluminum, Dissolved	mg/l	0.088	ND	-	0.14	*0.8*	ND	-	0.13	*0.7*	0.22	-	0.1	**2.5**	ND	-	0.081	*0.5*
Iron, Dissolved	mg/l	3	1.7	-	0.05	0.6	1.1	-	0.05	0.4	0.6	-	0.05	0.2	1.1	-	0.05	0.4
Manganese, Dissolved	mg/l	2	0.38	-	0.01	0.2	0.15	-	0.01	0.1	0.16	-	0.01	0.1	0.11	-	0.01	0.1
Nickel, Dissolved	mg/l	0.37	0.0027	J	0.025	0.01	0.0023	J	0.025	0.01	0.0027	J	0.025	0.01	0.0016	J	0.025	0.004
Zinc, Dissolved	mg/l	0.085	ND	-	0.07	*0.4*	ND	-	0.07	*0.4*	ND	-	0.1	*0.6*	ND	-	0.12	*0.7*

Notes:
HQ = Hazard Quotient

Shading indicates HQ>1 in at least one sample
J = estimated
UJ = compound not detected
ND - not detected
EB = equipment blank contamination
NA = not analyzed
* = no amphibian-specific benchmark available for compound
See Table 4-6 for benchmark sources
Total xylene values for samples collected after 1999 obtained by summing isomers
HQs for non-detected compounds are based on 1/2 the reporting limit. These are indicated in italics.

TABLE 4-28
AQUATIC WETLAND AMPHIBIAN POINT DATA AND LOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Name	Units	Amphibian Ecological Benchmark	SW-110 (05)				SW-111 (05)				SW1-99				SW2-99			
			12/2/05				12/2/05				6/2/99				6/2/99			
			Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ
Aluminum, Dissolved	mg/l	0.088	ND	U	0.047	*0.3*	ND	U	0.062	*0.4*	NA	-	-	-	NA	-	-	-
Iron, Dissolved	mg/l	3	0.12	-	0.05	0.04	1.1	-	0.05	0.4	NA	-	-	-	NA	-	-	-
Manganese, Dissolved	mg/l	2	0.98	-	0.01	0.49	0.45	-	0.01	0.2	NA	-	-	-	NA	-	-	-
Nickel, Dissolved	mg/l	0.37	0.0088	J	0.025	0.02	ND	-	0.025	*0.03*	NA	-	-	-	NA	-	-	-
Zinc, Dissolved	mg/l	0.085	ND	U	0.06	*0.35*	ND	U	0.06	*0.4*	NA	-	-	-	NA	-	-	-

Notes:
HQ = Hazard Quotient

Shading indicates HQ>1 in at least one sample
J = estimated
UJ = compound not detected
ND - not detected
EB = equipment blank contamination
NA = not analyzed
* = no amphibian-specific benchmark available for compound
See Table 4-6 for benchmark sources
Total xylene values for samples collected after 1999 obtained by summing isomers
HQs for non-detected compounds are based on 1/2 the reporting limit. These are indicated in italics.

TABLE 4-28
AQUATIC WETLAND AMPHIBIAN POINT DATA AND LOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Name	Units	Amphibian Ecological Benchmark	SW-35 (04)				SW-36							
			10/22/04				10/21/04				9/20/05			
			Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ
Aluminum, Dissolved	mg/l	0.088	ND	-	0.19	*1.1*	ND	-	0.16	*0.9*	ND	-	0.056	*0.3*
Iron, Dissolved	mg/l	3	3.6	-	0.05	1.2	2.6	-	0.05	0.9	0.51	-	0.05	0.2
Manganese, Dissolved	mg/l	2	0.37	-	0.01	0.2	0.27	-	0.01	0.1	0.39	-	0.01	0.2
Nickel, Dissolved	mg/l	0.37	0.0034	J	0.025	0.01	0.0071	J	0.025	0.02	ND	-	0.0044	*0.01*
Zinc, Dissolved	mg/l	0.085	0.014	J	0.05	0.2	0.013	J	0.05	0.2	0.038	J	0.05	0.4

Notes:
HQ = Hazard Quotient

Shading indicates HQ>1 in at least one sample
J = estimated
UJ = compound not detected
ND - not detected
EB = equipment blank contamination
NA = not analyzed
* = no amphibian-specific benchmark available for compound
See Table 4-6 for benchmark sources
Total xylene values for samples collected after 1999 obtained by summing isomers
HQs for non-detected compounds are based on 1/2 the reporting limit. These are indicated in italics.

TABLE 4-28
AQUATIC WETLAND AMPHIBIAN POINT DATA AND LOAEL-BASED HQs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Name	Units	Amphibian Ecological Benchmark	SW-37								SW-38 (04)				SW3-99			
			10/21/04				9/20/05				10/21/04				6/2/99			
			Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ	Result	Qualifier	DL	HQ
Aluminum, Dissolved	mg/l	0.088	NA	-	-	-	ND	-	0.049	*0.3*	NA	-	-	-	NA	-	-	-
Iron, Dissolved	mg/l	3	NA	-	-	-	0.76	-	0.05	0.3	NA	-	-	-	NA	-	-	-
Manganese, Dissolved	mg/l	2	NA	-	-	-	0.76	-	0.01	0.4	NA	-	-	-	NA	-	-	-
Nickel, Dissolved	mg/l	0.37	NA	-	-	-	ND	-	0.0042	*0.006*	NA	-	-	-	NA	-	-	-
Zinc, Dissolved	mg/l	0.085	NA	-	-	-	0.024	J	0.05	0.3	NA	-	-	-	NA	-	-	-

Notes:
HQ = Hazard Quotient

Shading indicates HQ>1 in at least one sample
J = estimated
UJ = compound not detected
ND - not detected
EB = equipment blank contamination
NA = not analyzed
* = no amphibian-specific benchmark available for compound
See Table 4-6 for benchmark sources
Total xylene values for samples collected after 1999 obtained by summing isomers
HQs for non-detected compounds are based on 1/2 the reporting limit. These are indicated in italics.

TABLE 4-29
AREA-WEIGHTED EXPOSURE CONCENTRATIONS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

A. Average Area-Weighted Exposure Concentrations

COPC	Sediment Concentration, mg/kg			Surface Water Concentration, mg/l		
	Aquatic Wetlands	Pond	Area-weighted Average	Aquatic Wetlands	Pond	Area-weighted Average
Aluminum, Total	3159	2575	**3083**	0.059	*0.021*	**0.054**
Iron, Total	6462	3750	**6109**	1.730	0.220	**1.534**
Lead, Total	13.600	15	**13.8**	0.0050	*0.005*	**0.005**
Selenium, Total	1.270	*0.258*	**1.1**	*0.003*	*0.003*	**0.003**

B. 95% UCL Area-Weighted Exposure Concentrations

COPC	Sediment Concentration, mg/kg			Surface Water Concentration, mg/l		
	Aquatic Wetlands	Pond	Area-weighted UCL	Aquatic Wetlands	Pond	Area-weighted UCL
Aluminum, Total	3759.2	3162	**3681.6**	0.081	*0.021*	**0.073**
Iron, Total	8531.8	4956	**8066.9**	2.543	0.220	**2.241**
Lead, Total	19.8	32	**21.4**	0.0050	*0.005*	**0.005**
Selenium, Total	1.9	*0.258*	**1.7**	*0.003*	*0.003*	**0.003**

C. Maximum Exposure Concentrations

COPC	Sediment Concentration, mg/kg			Surface Water Concentration, mg/l		
	Aquatic Wetlands	Pond	Maximum Concentration	Aquatic Wetlands	Pond	Maximum Concentration
Aluminum, Total	7300	3100	**6754.0**	0.220	*0.021*	**0.194**
Iron, Total	24800	4800	**22200.0**	5.300	0.220	**4.640**
Lead, Total	75.6	31	**69.8**	0.0050	*0.005*	**0.005**
Selenium, Total	5.1	*0.258*	**4.5**	*0.003*	*0.003*	**0.003**

Areas based on 0.87% for Aquatic Wetlands, and 13% for the Site Pond.
Surface water concentrations are dissolved concentrations

TABLE 4-30
BLACK DUCK EXPOSURE: CALCULATIONS OF AQUATIC PLANT TISSUE CONCENTRATIONS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Bioaccumulation-Based Plant Concentrations:

	95% UCL C_{sed}, mg/kg	Average C_{sed}, mg/kg	Max C_{sed}, mg/kg	BAF, dry wt. sed: dry wt.plant	95% UCL C_{plant}, mg/kg wet wt.	Average C_{plant}, mg/kg wet wt.	Max C_{plant}, mg/kg wet wt.
Lead, Total	21.35	13.8	69.8	0.65	3.05	1.97	10
Selenium, Total	1.7	1.1	4.5	3.8	1.41	0.95	3.74

Source for BAFs: Martin, D.B., 1997. Concentration of Selected Elements in the Kiamichi River above Hugo Reservoir. US Fish and Wildlife Service, Study 2F28, Tulsa, OK. BAF is for concentration in shoots of the water willow, which were measured on a dry wt. basis. To convert to wet weight, calculated dry wt. concentration was multiplied by 0.22, reflecting an average plant concentration of 78% water (EPA 1993).

TABLE 4-31
AQUATIC WETLANDS AND SITE POND: ESTIMATED EXPOSURE DOSES AND HAZARD QUOTIENTS FOR THE BLACK DUCK
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site

A. Average Calculated Exposure Doses of COPCs to the Black Duck

Contaminant of Potential Concern	Average Sediment Conc. mg/kg	Average Conc. in Plants, mg/kg	Average Conc. in Water, mg/l	Exposure, mg/kg bw/day	NOAEL-based TRVs, mg/kg bw/day	LOAEL-based TRVs, mg/kg bwday	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Lead, Total	13.785	1.971	0.005	0.3439	1.63	3.26	0.2	0.1
Selenium, Total	1.138	0.952	0.003	0.1571	0.5	1	0.3	0.2

B. . 95% UCL Calculated Exposure Doses of COPCs to the Black Duck

Contaminant of Potential Concern	95% UCL Sediment Conc. mg/kg	95% UCL Conc. in Plants, mg/kg	95% UCL Conc. in Water, mg/l	Exposure, mg/kg bw/day	NOAEL-based TRVs, mg/kg bw/day	LOAEL-based TRVs, mg/kg bwday	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Lead, Total	21.35	3.05	0.005	0.53258	1.63	3.26	0.3	0.2
Selenium, Total	1.69	1.41	0.003	0.23323	0.5	1	0.5	0.2

C. Maximum Calculated Exposure Doses of COPCs to the Black Duck

Contaminant of Potential Concern	Maximum Sediment Conc. mg/kg	Maximum Conc. in Plants, mg/kg	Maximum Conc. in Water, mg/l	Exposure, mg/kg bw/day	NOAEL-based TRVs, mg/kg bw/day	LOAEL-based TRVs, mg/kg bwday	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Lead, Total	69.80	9.98	0.005	1.74052	1.63	3.26	1.1	0.5
Selenium, Total	4.47	3.74	0.003	0.61675	0.5	1	1.2	0.6

Notes
Bold indicates an HQ >1.0 NA = not available.
bw/day = body weight per day

COPC = contaminant of potential concern
HQ = hazard quotient

TABLE 4-32
MALLARD EXPOSURE: CALCULATIONS OF AQUATIC PLANT TISSUE CONCENTRATIONS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Bioaccumulation-Based Plant Concentrations:

	95% UCL C_{soil}, mg/kg	Average C_{soil}, mg/kg	Max C_{soil}, mg/kg	BAF, dry wt. sed: dry wt.plant	95% UCL C_{plant}, mg/kg wet wt.	Average C_{plant}, mg/kg wet wt.	Max C_{plant}, mg/kg wet wt.
Aluminum, Total	3681.64	3083	6754	0.14	113.39	95	208
Iron, Total	8066.91	6109	22200	0.16	283.96	215	781

Source for BAFs: Martin, D.B., 1997. Concentration of Selected Elements in the Kiamichi River above Hugo Reservoir. US Fish and Wildlife Service, Study 2F28, Tulsa, OK. BAF is for concentration in shoots of the water willow, which were measured on a dry wt. basis. To convert to wet weight, calculated dry wt. concentration was multiplied by 0.22, reflecting an average plant concentration of 78% water (EPA 1993).

TABLE 4-33
MALLARD EXPOSURE: ESTIMATED SEDIMENT-DERIVED INVERTEBRATE CONCENTRATIONS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Calculation of Sediment-derived Inorganic Concentrations in Invertebrates

COPC	C_{sed} Average mg/kg	C_{sed} 95%UCL, mg/kg	C_{sed} Max mg/kg	BAF dry wt.: dry wt.	Average Invertebrate Conc. mg/kg dry wt.	95% UCL Invertebrate Conc. mg/kg dry wt.	Maximum Invertebrate Conc. mg/kg dry wt.	Average Invertebrate Conc. mg/kg wet wt.	95% UCL Invertebrate Conc. mg/kg wet wt.	Maximum Invertebrate Conc. mg/kg wet wt.
Aluminum, Total	3083	3681.637	6754	1	3083.1	3681.64	6754	678.278	809.96	1486
Iron, Total	6109	8066.912	22200	1	6109.4	8066.91	22200	1344	1774.72	4884

Notes:

BAF = sediment-organism bioaccumulation factor. BAFs for metals were obtained from Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation, August 1998, U.S. Department of Energy. Values are median values based on all organisms. In the absence of a published value, we assumed a BAF of 1.

Invertebrates were assumed to consist of 78% water, based on the average of invertebrate values in EPA, 1993. Wet weight concentrations obtained from dry weight by multiplying dry weight concentation by 0.22

TABLE 4-34
AQUATIC WETLAND AND SITE POND: ESTIMATED EXPOSURE DOSES AND HAZARD QUOTIENTS FOR THE MALLARD
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site

A. Average Calculated Exposure Doses of COPCs to the Mallard

Contaminant of Potential Concern	Average Sediment Conc. mg/kg	Average Conc. in Plants, mg/kg	Average Conc. in Water, mg/l	Average Conc. in Inverts, mg/kg	Exposure, mg/kg bw/day	NOAEL-based TRVs, mg/kg bw/day	LOAEL-based TRVs, mg/kg bwday	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Aluminum, Total	3083	95.0	0.05	678.3	66.68	109.7	1097	0.6	0.06
Iron, Total	6109	215.1	1.53	1344.1	134.32	500	5000	0.3	0.03

B. 95% UCL of Mean Calculated Exposure Doses of COPCs to the Mallard

Contaminant of Potential Concern	95% UCL Sediment Conc. mg/kg	95% UCL Conc. in Plants, mg/kg	95% UCL Conc. in Water, mg/l	95% UCL Conc. in Inverts, mg/kg	Exposure, mg/kg bw/day	NOAEL-based TRVs, mg/kg bw/day	LOAEL-based TRVs, mg/kg bwday	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Aluminum, Total	3682	113.4	0.07	810.0	79.63	109.70	1097	0.7	0.07
Iron, Total	8067	284.0	2.24	1774.7	177.37	500	5000	0.4	0.04

C. Maximum Calculated Exposure Doses of COPCs to the Mallard

Contaminant of Potential Concern	Maximum Sediment Conc. mg/kg	Maximum Conc. in Plants, mg/kg	Maximum Conc. in Water, mg/l	Maximum Conc. in Inverts, mg/kg	Exposure, mg/kg bw/day	NOAEL-based TRVs, mg/kg bw/day	LOAEL-based TRVs, mg/kg bwday	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Aluminum, Total	6754	208.0	0.19	1485.9	146.09	109.70	1097	**1.3**	0.13
Iron, Total	22200	781.4	4.64	4884.0	488.06	500	5000	1.0	0.10

Notes
Bold indicates an HQ >1.0
bw/day = body weight per day
COPC = contaminant of potential concern
HQ = hazard quotient
LOAEL = lowest observed adverse effects level
NOAEL = no observed adverse effects level
TRV = toxicity reference value

TABLE 4-35
SLERA SITE POND HAZARD QUOTIENTS OVER 1.0
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts

	Maximum Surface Water Conc. mg/l	Location of Maximum	Surface Water Frequency of Detection	Maximum Pond Surface Water NOAEL-based HQs				Maximum Sediment Conc. mg/kg	Location of Maximum	Sediment Frequency of Detection	Maximum Pond Sediment NOAEL-based HQ	Number of Sediment HQs > 1.0
ASSESSMENT ENDPOINT:				**Aquatic Invertebrates**	**Number of Aquatic HQs > 1.0**	**Amphibians**	**Number of Amphibian HQs > 1.0**				**Benthic Invertebrates**	
Acetone	NA	NA	NA	NA		NA		0.024	SD-42(04)	2/4	3.2	2
Carbon disulfide	NA	NA	NA	NA		NA		0.0016	SD-39(04)	2/4	16	2
Arsenic, Total	NA	NA	NA	NA		NA		15	SD-39(04)	4/4	1.8	1
Barium, Dissolved	0.006	SW-39(04)	1 / 1	1.5	1	0.008		NA	NA	NA	NA	
Manganese, Dissolved	0.02	SW-39(04)	1 / 1	0.2		1.4	1	NA	NA	NA	NA	
Zinc, Dissolved	0.007	SW-39(04)	1 / 1	0.5		2.3	1	NA	NA	NA	NA	

Notes:
Maximum HQ is the maximum detected concentration per exposure point divided by the applicable ecological benchmark.
See Appendix M for NOAEL benchmark sources.
NA = Constituent not a chemical of potential concern for this exposure point.

Shading indicates NOAEL-based HQ > 1.0
mg/l = milligrams per liter.
HQ = Hazard Quotient.

TABLE 4-36
SLERA WETLAND SOILS HAZARD QUOTIENTS OVER 1.0
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts

BERA Contaminant of Potential Concern	Maximum Wetland Soil Conc. mg/kg	Location of Maximum	Frequency of Detection	Plant NOAEL-based Benchmark	Invertebrate NOAEL-based Benchmark	SLERA Wetland Soil Maximum NOAEL-based HQs					
						Maximum Plant HQ	Number of Plant HQs > 1.0	Maximum Invertebrate HQ	Number of Invert HQs > 1.0	Carnivore (Shrew)	Herbivore (Rabbit)
Aldrin	0.005	SD-12 (99)	1/9	0.0032	0.620	1.6	1	0.01		0.004	0.001
Benzo(b)fluoranthene	1.70	SD-12 (99)	1/9	1.200	25	1.4	1	0.1		0.028	0.01
Benzoic Acid	0.780	SS-9 (04)	2/8	NS	0.035	NB		22.3	2	0.2	0.01
Chrysene	1.40	SD-12 (99)	1/9	1.2	25	1.2	1	0.1		0.1	0.05
Fluoranthene	2.60	SD-12 (99)	1/9	1.2	25	2.2	1	0.1		0.01	0.005
Phenanthrene	1.50	SD-12 (99)	1/9	1.2	25	1.3	1	0.1		0.02	0.01
Pyrene	2.30	SD-12 (99)	1/9	1.2	25	1.9	1	0.1		0.3	0.2
Arsenic, Total	30.0	SS-9 (04)	12/12	18.0	60	1.7	1	0.5		28.2	15.3
Manganese, Total	1000	WS-107 (05)	12/12	415.0	NS	2.4	3	NB		1.3	0.5
Mercury, Total	0.300	WS-106 (05)	10/12	0.030	0.010	10.0	9	3.0	3	0.004	0.002
Selenium, Total	2.40	WS-106 (05)	9/12	1.0	70	2.4	4	0.03		0.9	0.7
Vanadium, Total	16.1	SD-13 (99)	12/12	2.0	140	8.1	12	0.1		8.7	2.6

Shading indicates NOAEL-based HQ > 1.0
mg/kg = milligrams per kilogram.
See Appendix C for NOAEL-based benchmark sources

HQ = Hazard Quotient.

TABLE 4-37
WETLAND SOILS CONTAMINANTS OF POTENTIAL CONCERN
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Plants	Invertebrates	Carnivore (Shrew)	Herbivore (Rabbit)
Aldrin	Benzoic Acid	Arsenic, Total	Arsenic, Total
Benzo(b)fluoranthene	Mercury, Total	Manganese, Total	Vanadium, Total
Chrysene		Vanadium, Total	
Fluoranthene			
Phenanthrene			
Pyrene			
Arsenic, Total			
Manganese, Total			
Mercury, Total			
Selenium, Total			
Vanadium, Total			

TABLE 4-38
SUMMARY STATISTICS FOR WETLAND SOIL COPCs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Habitat Area	Chemical	Minimum Concentration (Qualifier) (1)		Maximum Concentration (Qualifier) (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Average Concentration	95% UCL
Wetland Soil	Solids, Total	22		84		%	SS-14 (04)	10/10	0.1-0.1	54.30	NC
	pH	4.5		6.9		SU	GP-7 (04)	8/8	-	5.96	NC
	Total Organic Carbon	0.412		20.2		%	GP-7 (04)	8/8	0.012-0.032	7.43	NC
	Aldrin	0.0051	J	0.0051	J	mg/kg	SD-12 (99)	1/9	0.00159-0.0215	0.004	0.005
	Benzo(b)fluoranthene	1.7		1.7		mg/kg	SD-12 (99)	1/9	0.4-1.1	0.47	1.700
	Benzoic Acid	0.48	J	0.78	J	mg/kg	SS-9 (04)	2/8	4-11	0.63	0.780
	Chrysene	1.4		1.4		mg/kg	SD-12 (99)	1/9	0.4-1.1	0.44	0.701
	Fluoranthene	2.6		2.6		mg/kg	SD-12 (99)	1/9	0.4-1.1	0.57	1.689
	Phenanthrene	1.5		1.5		mg/kg	SD-12 (99)	1/9	0.4-1.1	0.33	0.733
	Pyrene	2.3		2.3		mg/kg	SD-12 (99)	1/9	0.4-1.1	0.54	1.513
	Arsenic, Total	2.3	J	30	J	mg/kg	SS-9 (04)	12/12	0.24-0.89	9.67	14.999
	Manganese, Total	12		1000		mg/kg	WS-107 (05)	12/12	0.47-1.8	259.46	578.116
	Mercury, Total	0.027	J	0.3	J	mg/kg	WS-106 (05)	10/12	0.09-0.36	0.10	0.222
	Selenium, Total	0.24	J	2.4	J	mg/kg	WS-106 (05)	9/12	0.47-1.8	0.85	1.288
	Vanadium, Total	2.6		16.1		mg/kg	SD-13 (99)	12/12	0.47-1.8	9.22	11.906

Footnotes:
(1) Summary statisitics were calculated from analytical results for the following wetland soil samples: GP-7(04), GP-8(04), GP-23(04), SD-12(99), SD-13(99),SS-9(04), SS-13(04), SS-14(04), WS-6(04), WS-106, WS-107
J = estimated value. EB = equipment blank contamination.
NA = not applicable. NC = not calculated.
Averages calculated using 1/2 the DL for non-detects. Value is not included if 1/2 DL is greater than the detected maximum.

TABLE 4-39
WETLAND SOIL PLANT LOAEL-BASED HAZARD QUOTIENTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Detected Compound	Maximum Conc., mg/kg	Plant NOAEL-based Benchmark, mg/kg	Maximum NOAEL-based HQ	Plant LOAEL-based Benchmark, mg/kg	Maximum LOAEL-based HQ	Number of Exceedances
Manganese, Total	1,000	415	2.4	4153	0.2	0/12
Mercury, Total	0.3	0.03	10.0	0.3	1.0	0/12
Selenium, Total	2.4	1	2.4	1.7	1.4	2/12
Vanadium, Total	16.1	2	8.1	2.5	6.4	12/12

Shading indicates LOAEL-based HQ > 1.0
NOAEL-based benchmarks presented in Appendix L
LOAEL-based benchmark sources presented in Table 4-6

TABLE 4-40
SHREW EXPOSURE: CALCULATIONS OF EARTHWORM TISSUE CONCENTRATIONS OF INORGANICS
Baseline Ecologcal Risk Assessment
Sutton Brook Disposal Area Superfund Site

Soil concentrations based on all site soils 0-2' deep.

Regression-Based Concentrations:

Regression-based concentrations calculated according to equations provided by Sample et. al 1998, Development and Validation of Bioaccumulation Models for Earthworms, Oak Ridge National Laboratory, ES/ER/TM-220
Equations as specified in Table 18 of that document
Simple regression of Table 12 : ln(earthworm) = B0 + B1(ln[soil])
Results in dry wt; converted to wet wt. by multiplying by 0.16, based on 84% water content of worms (USEPA, 1993, Wildlife Factors Handbook).

Upland Worm Concentrations based on Average Soil Concentrations

			Average						
Analyte	**Estimation method**	**Source**	**Csoil, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(earthworm)**	**$C_{earthworm}$, mg/kg dry wt.**	**$C_{earthworm}$, mg/kg wet wt.**
Arsenic, Total	simple regression	Table 12	9.667	2.269	-1.421	0.706	0.181	1.20	0.19

Upland Worm Concentrations Based on 95% Soil Concentrations

			95% UCL						
Analyte	**Estimation method**	**Source**	**Csoil, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(earthworm)**	**$C_{earthworm}$, mg/kg dry wt.**	**$C_{earthworm}$, mg/kg wet wt.**
Arsenic, Total	simple regression	Table 12	14.999	2.708	-1.421	0.706	0.491	1.63	0.26

Upland Worm Concentrations Based on Maximum Soil Concentrations

			Maximum						
Analyte	**Estimation method**	**Source**	**Csoil, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(earthworm)**	**$C_{earthworm}$, mg/kg dry wt.**	**$C_{earthworm}$, mg/kg wet wt.**
Arsenic, Total	simple regression	Table 12	30.000	3.401	-1.421	0.706	0.980	2.67	0.43

Bioaccumulation-factor-Based Worm Concentrations:

Bioaccumulation of analytes with no recommended regression equation was evaluated using bioconcentration factors recommeded by USEPA 1999.
These BCFs calculated wet wt. concentrations in worms from dry weight concentrations in soil.

	Average Csoil, mg/kg	**95% UCL Csoil, mg/kg**	**Maximum Csoil, mg/kg**	**BCF, dry wt. soil: wet. wt. worm**	**Average $C_{earthworm}$, mg/kg wet wt.**	**95% UCL $C_{earthworm}$, mg/kg wet wt.**	**Maximum $C_{earthworm}$, mg/kg wet wt.**
Manganese, Total	259.5	578.1	1000.0	0.22	57.08	127.19	220.00
Vanadium, Total	9.2	11.9	16.1	0.22	2.03	2.62	3.54

BCF Source for metals: default value used by USEPA, 1999. Screening Level Ecological Risk Assessment Protocol for Waste Combustion Facilities. DRAFT. Vol. 1-3 Appendix H-5- 30.

TABLE 4-41
WETLAND SOILS: ESTIMATED EXPOSURES AND HAZARD QUOTIENTS FOR THE SHORT-TAILED SHREW
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

A. Wetland Soils: Calculated Exposure Doses and HQs for the Shrew, based on Average Site Concentrations

Contaminant of Potential Concern	Average Soil Conc. mg/kg	Average Conc. in Worms, mg/kg	Average Conc. in Water, mg/kg	Exposure, mg/kg bw/day	NOAEL Toxicity Reference Values, mg/kg bw/day	LOAEL Toxicity Reference Values, mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Arsenic, Total	9.667	0.19	0.0060	0.63	1.04	1.66	0.6	0.4
Manganese, Total	259.458	57.08	0.337	82.75	193.6	624.8	0.4	0.1
Vanadium, Total	9.217	2.03	0.002	2.94	4.16	8.31	0.7	0.4

B. Wetland Soils: Calculated Exposure Doses and HQs for the Shrew, based on 95% UCL Media Concentrations

Contaminant of Potential Concern	95% UCL Soil Conc. mg/kg	95% UCL Conc. in Worms, mg/kg	95% UCL Conc. in Water, mg/kg	Exposure, mg/kg bw/day	NOAEL Toxicity Reference Values[3], mg/kg bw/day	LOAEL Toxicity Reference Values[3], mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Arsenic, Total	14.999	0.26	0.012	0.93	1.04	1.66	0.9	0.6
Manganese, Total	578.116	127.19	0.486	184.32	193.6	624.8	1.0	0.3
Vanadium, Total	11.906	2.62	0.001	3.79	4.16	8.31	0.9	0.5

C. Wetland Soils: Calculated Exposure Doses and HQs for the Shrew, based on Maximum Concentrations

Contaminant of Potential Concern	Max. Soil Conc. mg/kg	Max. Conc. in Worms, mg/kg	Max. Conc. in Water, mg/kg	Exposure, mg/kg bw/day	NOAEL Toxicity Reference Values, mg/kg bw/day	LOAEL Toxicity Reference Values, mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Arsenic, Total	30.000	0.43	0.0206	1.74	1.04	1.66	**1.7**	**1.1**
Manganese, Total	1000.000	220.00	0.98	318.86	193.6	624.8	**1.6**	0.5
Vanadium, Total	16.100	3.54	0.001	5.13	4.16	8.31	**1.2**	0.6

Notes:

Shading indicates compound and LOAEL-based Hazard Quotient >1.0

Receptors assumed to consume water from the Aquatic Wetland

bw/day = body weight per day

COPC = contaminant of potential concern

LOAEL = lowest observed adverse effects level

mg/kg = milligrams per kilogram

Italics indicate compound not detected in surface water; value is 1/2 the reporting limit.

NOAEL = no observed adverse effects level

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

Soils concentrations based on currently exposed soil 0-2' deep.

UCL = Upper Confidence Limit

TABLE 4-42
RABBIT EXPOSURE: CALCULATION OF INORGANIC CONCENTRATIONS IN PLANT TISSUE
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Inorganics

Regression-Based Concentrations:

Regression according to Efroymson et al. 2001.: ln(conc. in leaves) = B0 + B1(ln[conc. in soil]).
All concentrations in dry weight; converted to wet wt. by multiplying by 0.15, based on 85% water content of dicot plants (USEPA, 1993, Wildlife Exposure Factors Handbook).

Efroymson, R. A. et al. 2001. Uptake of inorganic chemicals from soil by plant leaves: regressions of field data. Env. Tox. and Chem. 20(11): 2561-2571.
Equations as specified in Table 2 of that of that ariticle (based on original and validation datasets)

Plant Concentrations Based on Average Soil Concentrations

			Average						
Analyte	**Estimation method**	**Source**	**C_{soil}, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(plant)**	**C_{plant}, mg/kg dry wt.**	**C_{plant}, mg/kg wet wt.**
Arsenic, Total	simple regression	Table 2	9.67	2.269	-1.990	0.56	-0.720	0.49	0.073

Plant Concentrations Based on 95% UCL Soil Concentrations

			95% UCL						
Analyte	**Estimation method**	**Source**	**C_{soil}, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(plant)**	**C_{plant}, mg/kg dry wt.**	**C_{plant}, mg/kg wet wt.**
Arsenic, Total	simple regression	Table 2	15.00	2.708	-1.990	0.56	-0.474	0.62	0.09

Plant Concentrations Based on Maximum Soil Concentrations

			Maximum						
Analyte	**Estimation method**	**Source**	**C_{soil}, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(plant)**	**C_{plant}, mg/kg dry wt.**	**C_{plant}, mg/kg wet wt.**
Arsenic, Total	simple regression	Table 2	30.00	3.401	-1.990	0.56	-0.085	0.92	0.14

Bioaccumulation-Based Plant Concentrations:

Uptake of inorganic analytes with no recommended regression equation was evaluated using uptake factors recommeded by Baes et al. 1984.

	Average C_{soil}, mg/kg	**95% UCL C_{soil}, mg/kg**	**Max C_{soil}, mg/kg**	**Uptake Factor, dry wt. soil: dry wt.plant**	**Average C_{plant}, mg/kg wet wt.**	**95% UCL C_{plant}, mg/kg wet wt.**	**Max C_{plant}, mg/kg wet wt.**
Vanadium, Total	9.22	11.91	16.10	0.0055	0.01	0.01	0.01

Source for uptake factors: Baes, C. F. et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. US DOE, Oak Ridge National Laboratory.

To convert dry wt. values to wet weight, calculated dry wt. concentration was multiplied by 0.15, reflecting an average dicot plant concentration of 85% water (EPA 1993).

TABLE 4-43
WETLAND SOILS: ESTIMATED EXPOSURES AND HAZARD QUOTIENTS FOR THE COTTONTAIL RABBIT
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

A. Calculated Exposure Doses of COPCs to the Rabbit, based on Average Concentrations

Contaminant of Potential Concern	Average Soil Concentration mg/kg	Water Ingestion Rate kg/ day[2]	Average Conc. in Water, mg/kg	Average Concentration in Plants mg/kg	Rabbit Body Weight (wet) kg	Exposure mg/kg bw/day	NOAEL Toxicity Reference Values mg/kg bw/day	LOAEL Toxicity Reference Values mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Arsenic, Total	9.667	0.116	0.006	0.073	1.189	0.259	1.04	1.66	0.2	0.2
Vanadium, Total	9.217	0.116	0.002	0.008	1.189	0.234	4.16	8.31	0.1	0.03

B. Calculated Exposure Doses of COPCs to the Rabbit, based on 95%UCL Concentrations

Contaminant of Potential Concern	95% UCL Soil Concentration mg/kg	Water Ingestion Rate kg/ day[2]	95% UCL Water Concentration, mg/kg	95% UCL Concentration in Plants mg/kg	Rabbit Body Weight (wet) kg	Exposure mg/kg bw/day	NOAEL Toxicity Reference Values mg/kg bw/day	LOAEL Toxicity Reference Values mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Arsenic, Total	14.999	0.116	0.012	0.09	1.189	3.98E-01	1.04	1.66	0.4	0.2
Vanadium, Total	11.906	0.116	0.001	0.01	1.189	3.02E-01	4.16	8.31	0.1	0.04

C. Calculated Exposure Doses of COPCs to the Rabbit, based on Maximum Concentrations

Contaminant of Potential Concern	Maximum Soil Concentration mg/kg	Water Ingestion Rate kg/ day2	Maximum Conc. in Water, mg/kg	Maximum Concentration in Plants mg/kg	Rabbit Body Weight (wet) kg	Exposure mg/kg bw/day	NOAEL Toxicity Reference Values mg/kg bw/day	LOAEL Toxicity Reference Values mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
Arsenic, Total	30.000	0.116	0.0206	0.138	1.189	7.86E-01	1.04	1.66	0.8	0.5
Vanadium, Total	16.100	0.116	0.001	0.013	1.189	4.09E-01	4.16	8.31	0.1	0.05

Table 4-44

SUMMARY STATISTICS FOR UPLAND SOIL COPCs
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Exposure Point	Chemical	Minimum Concentration (Qualifier) (1)		Maximum Concentration (Qualifier) (1)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Average Concentration (2)	95% UCL (2)
Soil, Upland	*Metals*										
	Chromium	3.7		28.3	J	mg/kg	SO-05 (99)	11/11	0.45 - 0.59	17.4	20.7
	Copper	1.6		88.3	J	mg/kg	SO-01 (99)	11/11	0.45 - 0.59	49.3	62.4
	Lead	8	J	233	J	mg/kg	SO-01 (99)	11/11	2.2 - 2.9	100.5	134.6
	Mercury	0.019	J	0.26		mg/kg	SB-7 (04)	2/11	0.05 - 0.13	0.07	0.11
	Vanadium	8.1		18	J	mg/kg	SO-07 (99)	11/11	0.45 - 0.59	14.2	15.8
	Zinc	8.2		379	J	mg/kg	SO-07 (99)	11/11	2.2 - 6.4	136.5	190.6
	Pesticides										
	4,4'-DDT	0.00094	J	0.014	J	mg/kg	SO-07 (99)	1/1	0.00321 - 0.0796	0.01	N/A
	2,4-Dimethylphenol	0.089	J	0.089	J	mg/kg	SO-07 (99)	1/9	0.34 - 1	0.09	N/A
	4,6-Dinitro-o-cresol	0.25	J	0.25	J	mg/kg	SO-07 (99)	1/9	0.85-1.6	0.25	N/A
	Semivolatile Organics										
	Bis(2-Ethylhexyl)phthalate	0.066	J EB	1.3	EB	mg/kg	SO-09 (99)	9/9	0.34 - 1	0.50	0.787
	Di-n-butylphthalate	0.024	J	0.430		mg/kg	SO-07 (99)	4/9	0.34 - 0.5	0.17	0.26
	Di-n-octylphthalate	0.099	J	0.560		mg/kg	SO-09 (99)	3/9	0.34 - 0.5	0.24	0.46
	Naphthalene	0.039	J	0.220	J	mg/kg	SO-09 (99)	3/10	0.0063 - 0.76	0.08	0.19
	Volatile Organics										
	1,2,4-Trichlorobenzene	0.054	J	0.560		mg/kg	SO-07 (99)	3/10	0.0063 - 0.5	0.17	0.56
	Ethylbenzene	0.0008	J	0.0008	J	mg/kg	SO-09 (99)	1/10	0.00094 - 0.38	0.001	N/A
	Toluene	0.0006	J	0.0210		mg/kg	SO-09 (99)	3/10	0.0014 - 1.1	0.01	0.020
	Xylene (total)	0.88		0.880		mg/kg	SO-09 (99)	1/8	0.00094 - 0.01	0.09	0.880

Footnotes:
(1) SB-03(04) is part of the FDDA and is not included in this data set.
J = estimated value. EB = equipment blank contamination.
(2) Average concentrations and 95% UCLs were calculated using one half the detection limit for values reported as non-detect. N/A = not applicable; 95% UCLs were not calculated if < 3 acceptable analyses were available. Maximum value listed if calculated 95%UCL > maximum.
NC = not calculated.

TABLE 4-45
UPLAND SOILS NOAEL HAZARD QUOTIENTS OVER 1.0
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site, Tewksbury, Massachusetts

ASSESSMENT ENDPOINT:	Maximum Soil Conc., mg/kg	Location of Maximum	Frequency of Detection	Plant NOAEL-based Benchmark	Invertebrate NOAEL-based Benchmark	Upland Soil Maximum NOAEL HQs, Excluding FDDA				SLERA Upland Soil Maximum HQs	
						Maximum Plant HQ	Number of Plant HQs > 1.0	Maximum Invertebrate HQ	Number of Invertebrate HQs > 1.0	Carnivore (Robin)	Herbivore (Vole)
1,2,4-Trichlorobenzene	0.56	SO-07 (99)	3/10	0.48	20	1.2	1	0.03		0.9	0.0001
2,4-Dimethylphenol	0.089	SO-07 (99)	1/9	0.01	10	8.9	1	0.01		0.01	0.0001
4,4'-DDT	0.014	SO-07 (99)	1/1	4	4	0.004		0.004		6.7	0.0000062
4,6-Dinitro-o-cresol	0.25	SO-07 (99)	1/9	NS	0.15	NC		1.7	1	2.2	0.0018
Bis(2-Ethylhexyl)phthalate	1.3	SO-09 (99)	9/9	100	200	0.01		0.01		746.6	0.2080
Di-n-butylphthalate	0.43	SO-07 (99)	4/9	200	200	0.002		0.002		6.3	0.000001
Di-n-octylphthalate	0.56	SO-09 (99)	3/9	100	200	0.01		0.003		5548	0.0002
Xylene (total)	0.88	SO-09 (99)	1/8	10	1.06	0.1		0.83		6.2	0.0455
Chromium	28.3	SO-05 (99)	11/11	NS	NS	NS		NS		2.0	0.000005
Copper	88.3	SO-01 (99)	11/11	100	50	0.9		1.8	6	0.2	0.0045
Lead	233	SO-01 (99)	11/11	120	1700	1.9	3	0.14		21.4	0.0144
Mercury	0.26	SB-7 (04)	2/11	0.03	0.01	8.7	2	26	2	0.1	0.0001
Vanadium	8.1	SO-07(99)	11/11	2	140	4.1	11	0.06		0.4	0.0378
Zinc	379	SO-07 (99)	11/11	190	120	2.0	2	3.2	7	7.9	0.0033

Notes:
NB = Hazard Quotient not calculated as no benchmark available.
NC = not calculated

Shading indicates NOAEL-based HQ > 1.0
See Appendix L for NOAEL benchmark sources
PAH = Polycyclic aromatic hydrocarbons.

mg/kg = milligrams per kilogram.
HQ = Hazard Quotient.
SLERA HQs for the robin include SB-03(04). All compounds reevaluated in BERA.

TABLE 4-46
UPLAND SOIL CONTAMINANTS OF POTENTIAL CONCERN
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Plant COPCs	Soil Invertebrate COPCs	Carnivore COPCs (Robin)
1,2,4-Trichlorobenzene	4,6-Dinitro-o-cresol	4,4'-DDT
2,4-Dimethylphenol	Copper, Total	4,6-Dinitro-o-cresol
Lead, Total	Mercury, Total	di-n-butylphthalate
Mercury, Total	Zinc, Total	di-n-octylphthalate
Vanadium, Total		Bis(2-ethylhexyl)phthalate
Zinc, Total		Xylenes (total)
		Chromium, Total
		Lead, Total
		Zinc, Total

TABLE 4-47
UPLAND SOIL PLANT LOAEL-BASED HAZARD QUOTIENTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Detected Compound	Maximum Conc., mg/kg	Plant NOAEL-based Benchmark, mg/kg	Maximum NOAEL-based HQ	Plant LOAEL-based Benchmark, mg/kg	Maximum LOAEL-based HQ
Mercury, Total	0.26	0.03	8.7	0.3	0.9
Vanadium, Total	18	2	9.0	2.5	7.2

See Appendix L for NOAEL sources.
Shading indicates LOAEL-based HQ > 1.0
See Table 4-6 for LOAEL sources.

TABLE 4-48
UPLAND SOIL INVERTEBRATE LOAEL-BASED HAZARD QUOTIENTS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Detected Compound	Maximum Conc., mg/kg	Invertebrate NOAEL benchmark, mg/kg	Maximum NOAEL-based HQ	Invertebrate LOAEL benchmark, mg/kg	Maximum LOAEL-based HQ	No. LOAEL Exceedances
Copper	88.3	50	1.8	63	1.4	3
Mercury	0.26	0.01	26.0	0.5	0.5	0
Zinc	379	120	3.2	190	2.0	2

See Appendix L for NOAEL sources.
See Table 4-6 for LOAEL sources.
Shading indicates LOAEL-based HQ > 1.0
mg/kg = milligrams per kilogram.
HQ = Hazard Quotient.

TABLE 4-49
ROBIN EXPOSURE: COPC CONCENTRATIONS IN PLANT TISSUE
Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Inorganics

Regression-Based Concentrations:

Regression according to Efroymson et al. 2001.: ln(conc. in leaves) = B0 + B1(ln[conc. in soil]).
All concentrations in dry weight; converted to wet wt. by multiplying by 0.15, based on 85% water content of dicot plants (USEPA, 1993, Wildlife Exposure Factors Handbook).

Efroymson, R. A. et al. 2001. Uptake of inorganic chemicals from soil by plant leaves: regressions of field data. Env. Tox. and Chem. 20(11): 2561-2571.
Equations as specified in Table 2 of that of that ariticle (based on original and validation datasets)

Plant Concentrations Based on Average Soil Concentrations

Analyte	Estimation method	Source	Average C_{soil}, mg/kg	ln(Csoil)	B0	B1	ln(plant)	C_{plant}, mg/kg dry wt.	C_{plant}, mg/kg wet wt.
Lead	simple regression	Table 2	100.45	4.610	-1.330	0.56	1.251	3.50	0.52
Zinc	simple regression	Table 2	136.46	4.92	1.580	0.56	4.333	76.17	11.43

Plant Concentrations Based on 95% UCL Soil Concentrations

Analyte	Estimation method	Source	95% UCL C_{soil}, mg/kg	ln(Csoil)	B0	B1	ln(plant)	C_{plant}, mg/kg dry wt.	C_{plant}, mg/kg wet wt.
Lead	simple regression	Table 2	134.60	4.902	-1.330	0.56	1.415	4.12	0.62
Zinc	simple regression	Table 2	190.60	5.25	1.580	0.56	4.520	91.84	13.78

Plant Concentrations Based on Maximum Soil Concentrations

Analyte	Estimation method	Source	Maximum C_{soil}, mg/kg	ln(Csoil)	B0	B1	ln(plant)	C_{plant}, mg/kg dry wt.	C_{plant}, mg/kg wet wt.
Lead	simple regression	Table 2	233.00	5.451	-1.330	0.56	1.723	5.60	0.84
Zinc	simple regression	Table 2	379.00	5.94	1.580	0.56	4.905	134.97	20.24

Bioaccumulation-Based Plant Concentrations:

Uptake of inorganic analytes with no recommended regression equation was evaluated using uptake factors recommended by Baes et al. 1984.

	Average UCL C_{soil}, mg/kg	95% UCL C_{soil}, mg/kg	Max C_{soil}, mg/kg	Uptake Factor, dry wt. soil: dry wt.plant	Average C_{plant}, mg/kg wet wt.	95% UCL C_{plant}, mg/kg wet wt.	Max C_{plant}, mg/kg wet wt.
Chromium	17.39	20.70	28.30	0.0075	0.020	0.023	0.032

Source for uptake factors: Baes, C. F. et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. US DOE, Oak Ridge National Laboratory.

Organics

	95% UCL C_{soil}, mg/kg	Average C_{soil}, mg/kg	Max C_{soil}, mg/kg	Uptake Factor, dry wt. soil: dry wt.plant	95% UCL C_{plant}, mg/kg wet wt.	Average C_{plant}, mg/kg wet wt.	Max C_{plant}, mg/kg wet wt.
4,4'-DDT	N/A	0.008	0.014	0.004	NC	0.000005	0.00001
4,6-Dinitro-o-cresol	N/A	0.250	0.25	0.15	NC	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.79	0.501	1.30	0.002	0.0002	0.000	0.00
Di-n-butylphthalate	0.26	0.166	0.43	0.1	0.004	0.002	0.01
Di-n-octylphthalate	0.46	0.237	0.56	0.001	0.000	0.000	0.00
Xylene (total)	0.88	0.090	0.88	0.61	0.081	0.008	0.081

Uptake Factor sources for organics:
Organics calculated by Travis and Arms 1988: log BCF = 1.588 -(0.578 * log K_{ow}). Kow values as per Table 4-5 in the SLERA.
To convert dry wt. values to wet weight, calculated dry wt. concentration was multiplied by 0.15, reflecting an average dicot plant concentration of 85% water (EPA 1993).

TABLE 4-50
ROBIN EXPOSURE: INORGANICS EARTHWORM TISSUE CONCENTRATIONS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site

Soil concentrations based on all site soils 0-2' deep.

Regression-Based Concentrations:

Regression-based concentrations calculated according to equations provided by Sample et. al 1998, Development and Validation of Bioaccumulation Models for Earthworms, Oak Ridge National Laboratory, ES/ER/TM-220
Equations as specified in Table 18 of that document
Simple regression of Table 12 : ln(earthworm) = B0 + B1(ln[soil])
Results in dry wt; converted to wet wt. by multiplying by 0.16, based on 84% water content of worms (USEPA, 1993, Wildlife Factors Handbook).

Upland Worm Concentrations based on Average Soil Concentrations

			Average						
Analyte	**Estimation method**	**Source**	**Csoil, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(earthworm)**	**$C_{earthworm}$, mg/kg dry wt.**	**$C_{earthworm}$, mg/kg wet wt.**
Lead	simple regression	Table 12	100.45	4.610	-0.218	0.807	3.502	33.18	5.31
Zinc	simple regression	Table 12	136.46	4.916	4.449	0.328	6.061	429.00	68.64

Upland Worm Concentrations Based on 95% Soil Concentrations

			95% UCL						
Analyte	**Estimation method**	**Source**	**Csoil, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(earthworm)**	**$C_{earthworm}$, mg/kg dry wt.**	**$C_{earthworm}$, mg/kg wet wt.**
Lead	simple regression	Table 12	134.60	4.902	-0.218	0.807	3.738	42.02	6.72
Zinc	simple regression	Table 12	190.60	5.250	4.449	0.328	6.171	478.69	76.59

Upland Worm Concentrations Based on Maximum Soil Concentrations

			Maximum						
Analyte	**Estimation method**	**Source**	**Csoil, mg/kg**	**ln(Csoil)**	**B0**	**B1**	**ln(earthworm)**	**$C_{earthworm}$, mg/kg dry wt.**	**$C_{earthworm}$, mg/kg wet wt.**
Lead	simple regression	Table 12	233.00	5.451	-0.218	0.807	4.181	65.43	10.47
Zinc	simple regression	Table 12	379.00	5.938	4.449	0.328	6.397	599.75	95.96

Bioaccumulation-factor-Based Worm Concentrations:

Bioaccumulation of analytes with no recommended regression equation was evaluated using bioconcentration factors recommeded by USEPA 1999.
These BCFs calculated wet wt. concentrations in worms from dry weight concentrations in soil.

	Average Csoil, mg/kg	**95% UCL Csoil, mg/kg**	**Maximum Csoil, mg/kg**	**BCF, dry wt. soil: wet. wt. worm**	**Average $C_{earthworm}$, mg/kg wet wt.**	**95% UCL $C_{earthworm}$, mg/kg wet wt.**	**Maximum $C_{earthworm}$, mg/kg wet wt.**
Chromium	17.39	20.70	28.30	0.01	0.17	0.21	0.28

BCF Source: USEPA, 1999. Screening Level Ecological Risk Assessment Protocol for Waste Combustion Facilities. DRAFT. Vol. 1-3 Appendix H-5- 30.

TABLE 4-51
ROBIN EXPOSURE: AVERAGE ORGANIC COPC CONCENTRATIONS IN EARTHWORM TISSUE
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

A. Calculation of Average Earthwork Tissue Concentrations for Organics

Soils concentrations based on all site soil samples 0-2' deep.
Earthworm tissue concentrations calculated from porewater, as follows:

C_{worm}, mg/kg wet wt. = $K_{ww} * C_{porewater}$	Suter 2000, pg. 134. Calculated values are in wet weight.
K_{ww} : $\log K_{ww} = 0.87 * \log K_{ow} - 2.0$	Jaeger, 1998 as cited by EPA, 2005
$C_{porewater}$, mg/l = $C_{soil} / (K_{oc} * f_{oc})$	Suter 2000, pg. 84

K_{ww} = biota-soil partitioning coefficient, L soil porewater/kg wet weight tissue
C_{worm} = concentration in worm, wet weight
$C_{porewater}$ = concentration in porewater, mg/l
K_{oc} = organic carbon partition coefficient
Log K_{ow} = octanol-water partition coefficient
f_{oc} = fraction organic carbon in soil =3.5% in Upland Soils

Chemical Data

Soil fraction organic carbon (f_{oc}): 0.035

Compound	C_{soil} avg. mg/kg	K_{oc}	Log K_{ow}	f_{oc}	$C_{porewater}$, avg.	Log K_{ww}	K_{ww}	C_{worm}, avg.
4,4'-DDT	0.008	220000	6.91	0.035	0.00000102	4.0117	10273.06	0.0105
4,6-Dinitro-o-cresol	0.250	601.5	4.18	0.035	0.0119	1.6366	43.31	0.5143
Bis(2-ethylhexyl)phthalate	0.501	165000	7.6	0.035	0.0001	4.612	40926.07	3.5473
Di-n-butylphthalate	0.166	1460	4.5	0.035	0.0032	1.915	82.22	0.2671
Di-n-octylphthalate	0.237	195500	8.1	0.035	0.0000	5.047	111429.45	3.8523
Xylene (total)	0.090	443.1	3.12	0.035	0.0058	0.7144	5.18	0.0302

Xylenes (total) values are the sum of the isomers o-Xylene and p/m-Xylene.
f_{oc} is the average soil TOC concentration
K_{oc}, Log K_{ow} are as cited and referenced in Table 4.5 of the SLERA.

TABLE 4-52
ROBIN EXPOSURE: 95% UCL ORGANIC COPC CONCENTRATIONS IN EARTHWORM TISSUE
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Concentrations over 0.020 mg/kg produce a LOAEL-based HQ >1.0.

Soils concentrations based on all site soil samples 0-2' deep.
Earthworm tissue concentrations calculated from porewater, as follows:

C_{worm}, mg/kg wet wt. = K_{ww} * $C_{porewater}$	Suter 2000, pg. 134. Calculated values are in wet weight.
K_{ww} : log K_{ww} = 0.87 * log K_{ow} - 2.0	Jaeger, 1998 as cited by EPA, 2005
$C_{porewater}$, mg/l = C_{soil} / (K_{oc} * f_{oc})	Suter 2000, pg. 84

K_{ww} = biota-soil partitioning coefficient, L soil porewater/kg wet weight tissue
C_{worm} = concentration in worm, wet weight
$C_{porewater}$ = concentration in porewater, mg/l
K_{oc} = organic carbon partition coefficient
Log K_{ow} = octanol-water partition coefficient
f_{oc} = fraction organic carbon in soil

Chemical Data

Soil fraction organic carbon (f_{oc}): 0.035

Compound	C_{soil} 95% UCL mg/kg	K_{oc}	Log K_{ow}	f_{oc}	$C_{porewater}$, avg.	Log K_{ww}	K_{ww}	C_{worm}, avg.
4,4'-DDT	N/A	220000	6.91	0.035	NC	4.0117	10273.06	NC
1,2,4-Trichlorobenzene	0.560	717.6	4.02	0.035	0.022	1.4974	31.43	0.70
4,6-Dinitro-o-cresol	N/A	601.5	4.18	0.035	NC	1.6366	43.31	NC
Bis(2-ethylhexyl)phthalate	0.787	165000	7.6	0.035	0.000	4.612	40926.07	5.58
Di-n-butylphthalate	0.262	1460	4.5	0.035	0.005	1.915	82.22	0.42
Di-n-octylphthalate	0.457	195500	8.1	0.035	0.000	5.047	111429.45	7.4
Xylene (total)	0.880	443.1	3.12	0.035	0.057	0.7144	5.18	0.294

Notes:
N/A - Too few observations to calculate UCLs
Xylenes (total) values are the sum of the isomers o-Xylene and p/m-Xylene.
f_{oc} is the average soil TOC concentration
K_{oc}, Log K_{ow} are as cited and referenced in Table 4.5 of the SLERA.

TABLE 4-53
ROBIN EXPOSURE: MAXIMUM ORGANIC COPC CONCENTRATIONS IN EARTHWORM TISSUE
Baseline Ecological Assessment
Sutton Brook DIsposal Area Superfund Site - Tewksbury, Massachusetts

A. Calculation of Maximum Earthworm Tissue Concentrations for Organics

Soils concentrations based on all site soil samples 0-2' deep.
Earthworm tissue concentrations calculated from porewater, as follows:

$C_{worm,}$ mg/kg wet wt. = K_{ww} * $C_{porewater}$ — Suter 2000, pg. 134. Calculated values are in wet weight.
K_{ww} : log K_{ww} = 0.87 * log K_{ow} - 2.0 — Jaeger, 1998 as cited by EPA, 2005
$C_{porewater,}$ mg/l = C_{soil} / (K_{oc} * f_{oc}) — Suter 2000, pg. 84

K_{ww} = biota-soil partitioning coefficient, L soil porewater/kg wet weight tissue
C_{worm} = concentration in worm, wet weight
$C_{porewater}$ = concentration in porewater, mg/l
K_{oc} = organic carbon partition coefficient
Log K_{ow} = octanol-water partition coefficient
f_{oc} = fraction organic carbon in soil

Chemical Data

Soil fraction organic carbon (f_{oc}): 0.035

Compound	C_{soil} max. mg/kg	K_{oc}	Log K_{ow}	f_{oc}	$C_{porewater,}$ max.	Log K_{ww}	K_{ww}	$C_{worm,}$ max.
4,4'-DDT	0.014	220000	6.91	0.035	0.0000018	4.0117	10273.06	0.0187
1,2,4-Trichlorobenzene	0.560	717.6	4.02	0.035	0.0223	1.4974	31.43	0.7009
4,6-Dinitro-o-cresol	0.250	601.5	4.18	0.035	0.0119	1.6366	43.31	0.5143
Bis(2-ethylhexyl)phthalate	1.300	165000	7.6	0.035	0.0002	4.612	40926.07	9.2128
Di-n-butylphthalate	0.430	1460	4.5	0.035	0.0084	1.915	82.22	0.6919
Di-n-octylphthalate	0.560	195500	8.1	0.035	0.0001	5.047	111429.45	9.1195
Xylene (total)	0.880	443.1	3.12	0.035	0.0567	0.7144	5.18	0.2940

Xylenes (total) values are the sum of the isomers o-Xylene and p/m-Xylene.
f_{oc} is the average soil TOC concentration
K_{oc}, Log K_{ow} are as cited and referenced in Table 4.5 of the SLERA.

TABLE 4-54
UPLAND SOILS: ESTIMATED AVERAGE EXPOSURES AND HAZARD QUOTIENTS FOR THE AMERICAN ROBIN
Baseline Ecological Risk
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Contaminant of Potential Concern	Average Soil Conc. mg/kg	Average Conc. in Worms, mg/kg	Average Conc. in Plants, mg/kg	Exposure, mg/kg bw/day	NOAEL Toxicity Reference Values, mg/kg bw/day	LOAEL Toxicity Reference Values, mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
4,4'-DDT	0.008	0.011	0.000005	0.004	0.0028	0.028	1.3	0.1
4,6-Dinitro-o-cresol	0.250	0.514	0.006	0.174	0.227	22.7	0.8	0.01
Bis(2-Ethylhexyl)phthalate	0.501	3.547	0.000	1.157	1.1	11	1.1	0.11
Di-n-butylphthalate	0.166	0.267	0.002	0.092	0.11	1.1	0.8	0.1
Di-n-octylphthalate	0.237	3.852	0.00004	1.25	0.11	1.1	**11.3**	**1.1**
Xylene (Total)	0.090	0.030	0.008	0.014	1.5	15	0.009	0.001
Chromium	17.4	0.174	0.020	0.59	1	5	0.6	0.1
Lead	100	5.309	0.52	4.87	1.63	3.26	**3.0**	**1.5**
Zinc	136	68.641	11.43	28.39	14.5	131	**2.0**	0.2

Notes:

Shading indicates compound and LOAEL-based Hazard Quotient >1.0

bw/day = body weight per day

NOAEL = no observed adverse effects level

LOAEL = lowest observed adverse effects level

mg/kg = milligrams per kilogram

Soils concentrations based on currently exposed soil 0-2' deep.

TABLE 4-55
UPLAND SOILS: ESTIMATED 95% UCL EXPOSURES AND HAZARD QUOTIENTS FOR THE AMERICAN ROBIN
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Contaminant of Potential Concern	95% UCL Soil Conc. mg/kg	95% UCL Conc. in Worms, mg/kg	95% UCL Conc. in Plants, mg/kg	Exposure, mg/kg bw/day	NOAEL Toxicity Reference Values, mg/kg bw/day	LOAEL Toxicity Reference Values, mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
4,4'-DDT	N/A	NC	NC	NC	0.0028	0.028	NC	NC
4,6-Dinitro-o-cresol	N/A	NC	NC	NC	0.227	22.7	NC	NC
Bis(2-Ethylhexyl)phthalate	0.787	5.577	0.0002	1.820	1.1	11	**1.7**	0.17
Di-n-butylphthalate	0.262	0.422	0.004	0.144	0.11	1.1	**1.3**	0.13
Di-n-octylphthalate	0.457	7.442	0.00007	2.41	0.11	1.1	**21.9**	**2.2**
Xylene (total)	0.880	0.294	0.0805	0.137	1.5	15	0.091	0.0091
Chromium	20.70	0.21	0.023	0.70	1	5	0.7	0.1
Lead	134.6	6.723	0.62	6.38	1.63	3.26	**3.9**	**2.0**
Zinc	190.6	76.591	13.78	33.04	14.5	131	**2.3**	0.3

Notes:

Shading indicates compound and LOAEL-based Hazard Quotient >1.0

N/A = no 95% UCL available; data insufficient to calculate.

NC = not calculated

bw/day = body weight per day

NOAEL = no observed adverse effects level

LOAEL = lowest observed adverse effects level

mg/kg = milligrams per kilogram

Soils concentrations based on currently exposed soil 0-2' deep.

TABLE 4-56
UPLAND SOILS: ESTIMATED MAXIMUM EXPOSURES AND HAZARD QUOTIENTS FOR THE AMERICAN ROBIN
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Contaminant of Potential Concern	Maximum Soil Conc. mg/kg	Maximum Conc. in Worms, mg/kg	Maximum Conc. in Plants, mg/kg	Exposure, mg/kg bw/day	NOAEL Toxicity Reference Values, mg/kg bw/day	LOAEL Toxicity Reference Values, mg/kg bw/day	NOAEL-based Hazard Quotient	LOAEL-based Hazard Quotient
4,4'-DDT	0.014	0.019	0.00001	0.006	0.0028	0.028	**2.3**	0.2
4,6-Dinitro-o-cresol	0.250	0.514	0.006	0.174	0.227	22.7	0.8	0.01
Bis(2-Ethylhexyl)phthalate	1.300	9.213	0.0004	3.006	1.1	11	**2.7**	0.27
Di-n-butylphthalate	0.430	0.692	0.006	0.237	0.11	1.1	2.2	0.2
Di-n-octylphthalate	0.560	9.12	0.0001	2.95	0.11	1.1	**26.8**	**2.7**
Xylene (total)	0.880	0.294	0.08	0.137	1.5	15	0.1	0.01
Chromium	28.300	0.28	0.032	0.96	1	5	1.0	0.2
Lead	233	10.47	0.84	10.62	1.63	3.26	**6.5**	**3.3**
Zinc	379	95.96	20.24	46.22	14.5	131	**3.2**	0.4

Notes:

Shading indicates compound and LOAEL-based Hazard Quotient >1.0

bw/day = body weight per day

NOAEL = no observed adverse effects level

LOAEL = lowest observed adverse effects level

mg/kg = milligrams per kilogram

Soils concentrations based on currently exposed soil 0-2' deep.

TABLE 4-57
SUMMARY OF POTENTIAL UNCERTAINTY
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

		Potential Bias in Risk Estimate	
Assessment Stage	**Description of Uncertainty**	**Under-estimate**	**Over-estimate**
Problem Formulation	Some VOC non-detect data were rejected for the Deep Marsh due to high moisture content of samples. These detection limits were used as estimated values in the risk assessment. Because of the uncertainty surrounding rejected non-detects, use of this data may over- or underestimate risks.	X	X
	Sampling locations may not have identified maximum concentrations.	X	
	Some sampling locations were not included in the study because they were sampled more than 10 years ago, are located on the slopes of the landfill, or are in areas, such as the residential area, not included in the risk assessment.	X	
	Because of sample spacing, some areas exist with few or no samples. The potential exists that some areas of elevated concentrations may not have been detected.	X	
	The processing of samples with low percent solids may result in VOC and SVOC concentrations which are not entirely representative of field conditions. Actual concentrations may be higher or lower than estimated.	X	X
	Organic compounds were eliminated or retained as COPCs based on bioaccumulation potential, as indicated by K_{ow} values. K_{ow} alone may not accurately reflect bioaccumulation potential in all circumstances. Actual bioaccumulation may be greater or less than assumed.	X	X
	Intensive sampling in contaminated areas over-represents level of contamination when data is aggregated.		X
	Dissolved metals data set is smaller than the total metals data set, so not as representative of site conditions.	X	X
	Average and 95% concentrations of site COPCs were calculated using ½ the detection limit for samples with no detected concentration. Since the presence of the COPC is unknown, this approach likely over-estimates actual values.		X
	Piscivorous birds not evaluated in the Upper Sutton Brook. Although VOCs, the primary COPCs in this area, do not bioaccumulate appreciably, some metals do.	X	
	Species used in food chain models may not accurately represent all members of the feeding guild.	X	X
	J-value data from below the method reporting limit were used in the risk assessment. These data are estimated values with a high level of quantitative uncertainty.	X	X
	Dermal contact with water and sediment or soil by mammals was not evaluated. This is typically a negligible exposure route.	X	

TABLE 4-57
SUMMARY OF POTENTIAL UNCERTAINTY
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

		Potential Bias in Risk Estimate	
Assessment Stage	**Description of Uncertainty**	**Under-estimate**	**Over-estimate**
	Fish were assumed to be absent from the Aquatic Wetland, based on DO measurements and upstream seining efforts. However, the potential exists that a reproducing population may exist. Although fish would be assessed by the same benchmarks as aquatic invertebrates, they were not an explicit assessment endpoint and so adverse effects to these receptors may potentially be overlooked.	X	
	Benchmarks used for COPC selection and evaluation are based on physical and chemical media parameters, such as percent organic carbon, which may vary from the concentrations at the site. These benchmarks may thus over- or under-represent actual effects at the site.	X	X
	The risk evaluation excluded areas of the landfill lobes, on the assumption that these areas will be addressed by remediation. Risks in these areas will remain unknown and will continue until the landfill cover is installed. If the landfill is not remediated as planned, addition evaluations will be necessary.	X	
	A small number of analytes that had reporting limits greater than benchmarks were screened out from the COPC list. The potential exists that concentrations of these non-detected compounds may exceed the applicable benchmarks.	X	
	Sample extraction techniques may overestimate bioavailable fraction		X
Analysis Program	The entire area of Aquatic Wetland was assumed to be available and equally used by receptors during their time at the site. In reality, the size of these wetlands decreases significantly during the course of the year, reducing the size of the exposure area for certain semi-aquatic receptors.		X
	AVS/SEM: TOC analyses are assumed to fully represent bioavailability. AVS chemistry, in particular, is dictated by various chemical and physical factors and may be highly variable throughout the year. Furthermore, availability of metals through ingestion and absorption in the gut is not reflected by this analysis.	X	
	Single values used for ingestion and body weight. Actual populations consist of individuals of various sizes.	X	X
	Exposure effects calculated only for adult receptors using generic feeding and body weight characteristics. Young of the species or breeding females may have different feeding regimes and body weights. Toxicological data is typically not available for these specific groups.	X	X

TABLE 4-57
SUMMARY OF POTENTIAL UNCERTAINTY
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

		Potential Bias in Risk Estimate	
Assessment Stage	**Description of Uncertainty**	**Under-estimate**	**Over-estimate**
	Concentrations of COPCs in prey and food items were estimated through modeling. This approach may over- or under-estimate actual concentrations, which vary widely by species, COPC, and soil type.	X	X
	The diet and life history characteristics (ingestion rate, body weight, etc.) of receptors were based on studies in various locations in North America. Actual life history characteristics of site populations may differ from those studied.	X	X
	Amphibian bioaccumulation may differ from bioaccumulation in fish.	X	X
	Sediment toxicity testing was evaluated with two species, who may respond differently than species actually present at the site.	X	X
	Sediment variability may affect toxicity test results. Toxicity tests use a small volume of sediment in each test vessel, and the arsenic concentrations in individual test beakers may vary from the values obtained by chemical analysis of the sample.	X	X
	Effects of toxicity testing in the Southern Tributary were used to estimate arsenic effects elsewhere on the site. Variations in sediment matrix, chemistry, and other factors may alter the effects of arsenic at other locations.	X	X
	Use of maximum concentrations as exposure point concentrations likely misrepresents actual exposures, since it assumes that species feed in contaminant "hot spots" or in areas with the most elevated concentrations of COPCs, which are not necessarily co-located at the site.		X
	The black duck was assumed to migrate. Resident individuals, if present, may incur higher exposures.	X	
	Benchmark values are typically derived from a number of studies with widely varying results. The extent to which these values accurately reflect site conditions or responses is unknown.	X	X
Risk Characterization	Benchmarks are in part based on adverse effects to test organisms that may not necessarily be present on-site. Results may thus vary from the actual toxicity experienced by site receptors.	X	X
	Benchmarks based solely on chemical concentration may not reflect actual adverse effects in the field. Site-specific characteristics may render COPC concentrations greater or less than the benchmark suggests	X	
	The benchmark values reflect potential effects to a single organism, and may not be a good estimator of potential community or system-wide effects. Acute or chronic effects on organisms may not necessarily have an effect at the community or population level.	X	X

TABLE 4-57
SUMMARY OF POTENTIAL UNCERTAINTY
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

		Potential Bias in Risk Estimate	
Assessment Stage	**Description of Uncertainty**	**Under-estimate**	**Over-estimate**
	NOAELs obtained from study data by the use of generic uncertainty factors that have no real toxicological basis, but rather are generally accepted safety factors. Calculated NOAELs may thus be higher or lower than actual values.	X	X
	Benchmarks for chemically- or toxicologically-similar surrogate compounds were used for COPCs with no published benchmark. These surrogates may not actually be present at the Site and may potentially over- or underestimate toxicity. Actual effect of target compounds may differ from the resulting estimate based on the surrogate.	X	X
	Uptake of COPCs to aquatic plants considered uptake from roots only. While roots are considered to be the dominant pathway, uptake from water to leaf may also be important in some species.	X	
	Uptake factors for aquatic plants are based on aquatic species not native to New England.	X	X
	For some analytes, particularly metals, quantitation limits were higher than benchmarks. If no "J"-qualified data were present, these samples were not considered to reflect potential risk, even if the HQ based on ½ the detection limit exceeded 1.0. Some low exceedances of samples may be missed by this approach.	X	
	Receptor-specific mammal and bird toxicity data were unavailable; therefore, interspecies extrapolations were required for the COPCs. Test species may be more, or less, sensitive than site receptors.	X	X
	TRVs are based on laboratory species exposed under controlled conditions. The magnitude of effects may differ from laboratory results.	X	X
	Amphibian benchmarks are based on comparatively few studies that utilize species that may not be present at the site. Values may thus over or underestimate toxic levels for actual amphibian species at the site.	X	X
	Background/reference analyses for inorganics do not take into account differences in TOC between Site and background and reference samples. While the inorganic concentration does not necessarily correlate directly with TOC, TOC may influence of inorganic constituents. TOC is also a factor in determining organic concentration in environmental media.	X	X

TABLE 4-58
SUMMARY OF FINDINGS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

Location	Receptor and Assessment Endpoint	Potential for Risk?	Basis	Comment
Upper Sutton Brook: Southern Tributary	Pelagic Invertebrates and Fish (surface water)	No	Toluene, the only COPC detected in surface water, was below NOAEL-based benchmarks.	See Table 4-12.
	Benthic Invertebrates (sediment)	No	COPCs present at concentrations below LOAELs, or show no toxic effects.	Sediment toxicity testing with two species of invertebrates showed no effects on survival and no effects on growth that could be correlated with arsenic concentrations. Sediment with arsenic up to 130 mg/kg was tested. See Table 4-14.
Upper Sutton Brook: Eastern Reach	Pelagic Invertebrates and Fish (surface water)	Yes	Iron exceeded chronic WQC (Site TBC)	See Table 4-15.
	Benthic Invertebrates (sediment)	No	No exceedance of LOAEL-based values for COPCs other than arsenic. Arsenic concentrations are similar to those in the Southern tributary, which were found through toxicity testing to have no adverse effect on survival and no correlation with reductions in growth	Arsenic concentrations increase downstream of the confluence with the Southern Tributary. See Table 4-16.
Upper Sutton Brook: Site Channel	Pelagic Invertebrates and Fish (surface water)	Yes	DDT, ethylbenzene, toluene, xylenes, barium, and manganese exceeded NOAEL-based benchmarks in the SLERA. No further evaluation in the BERA.	Table 4-17
Upper Sutton Brook: Site Channel (con't)	Benthic Invertebrates (sediment)	Yes	1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methyl-2-pentanone, acetone, carbon disulfide, chloroethane, ethylbenzene, xylenes, toluene, arsenic, and manganese exceeded NOAEL-based benchmarks in the SLERA. No further evaluation in the BERA.	Table 4-18

TABLE 4-58
SUMMARY OF FINDINGS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

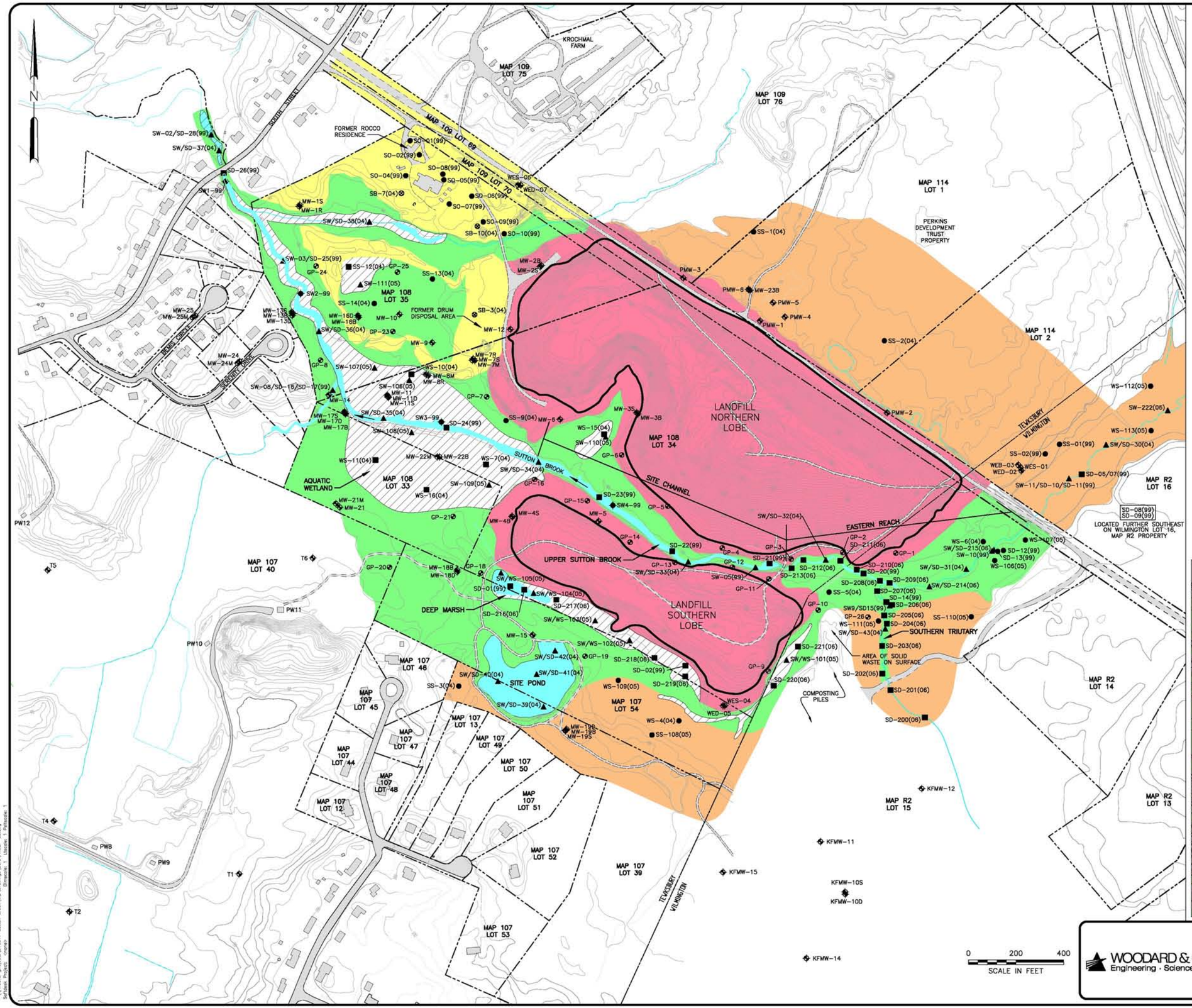
Location	Receptor and Assessment Endpoint	Potential for Risk?	Basis	Comment
Aquatic Wetland	Pelegic Invertebrates (surface water)	Yes	Iron exceeds chronic WQC (Site TBC)	Table 4-24
	Benthic Invertebrates (sediment)	No	Maximum concentrations below LOAEL-based values, or present in a single isolated locations at level only slightly above the LOAEL. Arsenic concentrations are similar (and lower) to those in Southern Tributary (see above)	Tables 4-25, 4-26
	Amphibians (surface water)	Yes	Aluminum LOAEL-based HQ of 2.5	Exceedance occurs in one location only. Tables 4-27, 4-28
Aquatic Wetland and Site Pond	Carnivores: Heron	No	No exposures exceeded NOAEL-based TRVs.	Table 4-20
	Herbivore: Black Duck	No	No exposures exceeded LOAEL-based TRVs; NOAEL-based TRV exceeded slightly only under maximum exposures.	Table 4-31
	Omnivores : Mallard	No	No exposures exceeded LOAEL-based TRVs.	Table 4-34
Site Pond	Benthic Invertebrates (sediment)	No	All COPCs are below LOAEL-based values.	Section 4.5.4
	Pelagic invertebrates (surface water)	No	Low NOAEL HQ (1.5). Concentration of COPC (barium) is lower than in off-site reference samples	Section 4.5.4
	Amphibians (surface water)	No	Low NOAEL exceedance (1.4, 2.3). Concentrations of COPCs (manganese, and zinc) are lower than in off-site reference samples	Section 4.5.4
Wetland Soils	Terrestrial Plants	No	Low and infrequent NOAEL exceedances reflect off-site effects (PAHs, Aldrin near access road) or natural conditions (Mn, As) . Mercury is < LOAEL-based benchmark. Selenium and vanadium exceed LOAEL benchmarks but are consistent with ranges in reference samples.	Section 4.6.4.1.; Table 4-39

TABLE 4-58
SUMMARY OF FINDINGS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

Location	Receptor and Assessment Endpoint	Potential for Risk?	Basis	Comment
	Terrestrial Invertebrates	No	COPCs (mercury and benzoic acid) are below LOAEL-based values.	Section 4.6.4.2.
	Wetland Carnivores: Shrew	No	Only slight arsenic exceedance of LOAEL-based TRV (HQ of 1.1) under maximum exposure scenario.	Table 4-41., Section 4.6.4.3.
	Wetland Herbivores: Rabbit	No	All exposure doses are well below NOAEL- and LOAEL-based TRVs	Table 4-43.
Former Drum Disposal Area	Plants	Yes	Bis(2-Ethylhexyl)phthalate, ethylbenzene, naphthalene, xylenes exceed NOAEL-based benchmarks in the SLERA, based on concentrations in SB-03(04). No further evaluation in the BERA.	SLERA
	Soil Invertebrates	Yes	1,2,4-Trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, toluene, and xylenes exceed NOAEL-based benchmarks in the SLERA, based on concentrations in SB-03(04). No further evaluation in the BERA.	SLERA
	Upland Carnivores: Robin	Yes	1,2,4-Trimethylbenzene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and xylenes exceed NOAEL-based TRVs in the SLERA, based on concentrations in SB-03(04). No further evaluation in the BERA.	SLERA
Upland Soils (Excluding Former Drum Disposal Area)	Plants	No	Most COPCs show low and infrequent exceedances of NOAEL benchmarks, or were present at concentrations below LOAEL-based values or toxicity values for similar compounds.	Section 4.7.4.1., Tables 4-45, 4-47
	Invertebrates	Yes	Zinc LOAEL-based HQ is 2.0 at SO-07(99). Effects likely localized.	Section 4.7.4.2.; Tables 4-45, 4-48

TABLE 4-58
SUMMARY OF FINDINGS
Baseline Ecological Risk Assessment
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

Location	Receptor and Assessment Endpoint	Potential for Risk?	Basis	Comment
			Other COPCs show either low and infrequent NOAEL exceedances or were present below representative LOAEL toxicity values.	
	Herbivores: Meadow Vole	No	All estimated exposures below NOAEL-based TRVs	Table 4-45
	Carnivores : Robin	Yes	Average concentrations of lead and di-n-octylphthalate produce a LOAEL-based HQ of 1.5 and 1.1, respectively	Table 4-54



LEGEND

MW-6	MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)
GP-1	TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)
SS-1	SOIL SAMPLING LOCATION (START – 1999) (W&C 2004, 2005)
SW/SD-33	SURFACE WATER OR SURFACE WATER AND SEDIMENT SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)
SB-1	SOIL BORING LOCATION (W&C 2004)
SD-23	SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)
SW1	SURFACE WATER SAMPLE COLLECTED AT STREAM PIEZOMETER LOCATION (1999)

(99) – INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

INTERPRETIVE LIMITS OF SOLID WASTE
APPROXIMATE LOCATION OF PROPERTY LINES
PAVED ROAD
UNPAVED ROAD
WATER
DRIVEWAY
FENCE
BUILDING

HABITAT AREAS

- LANDFILL AREA
- WETLAND SOILS HABITAT AREA
- UPLAND SOILS HABITAT AREA (FORMER DRUM DISPOSAL AREA AND RESIDENCE, GARAGE, AND STORAGE AREA
- REFERENCE LOCATIONS
- OPEN WATER AREAS
- AQUATIC WETLAND HABITAT AREA

ADDITIONAL REFERENCE LOCATIONS

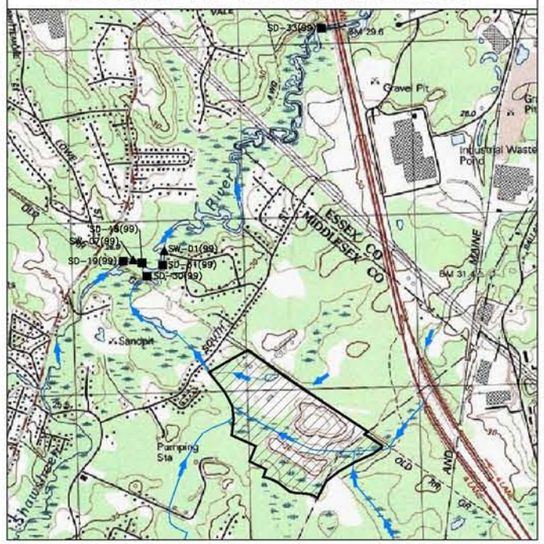


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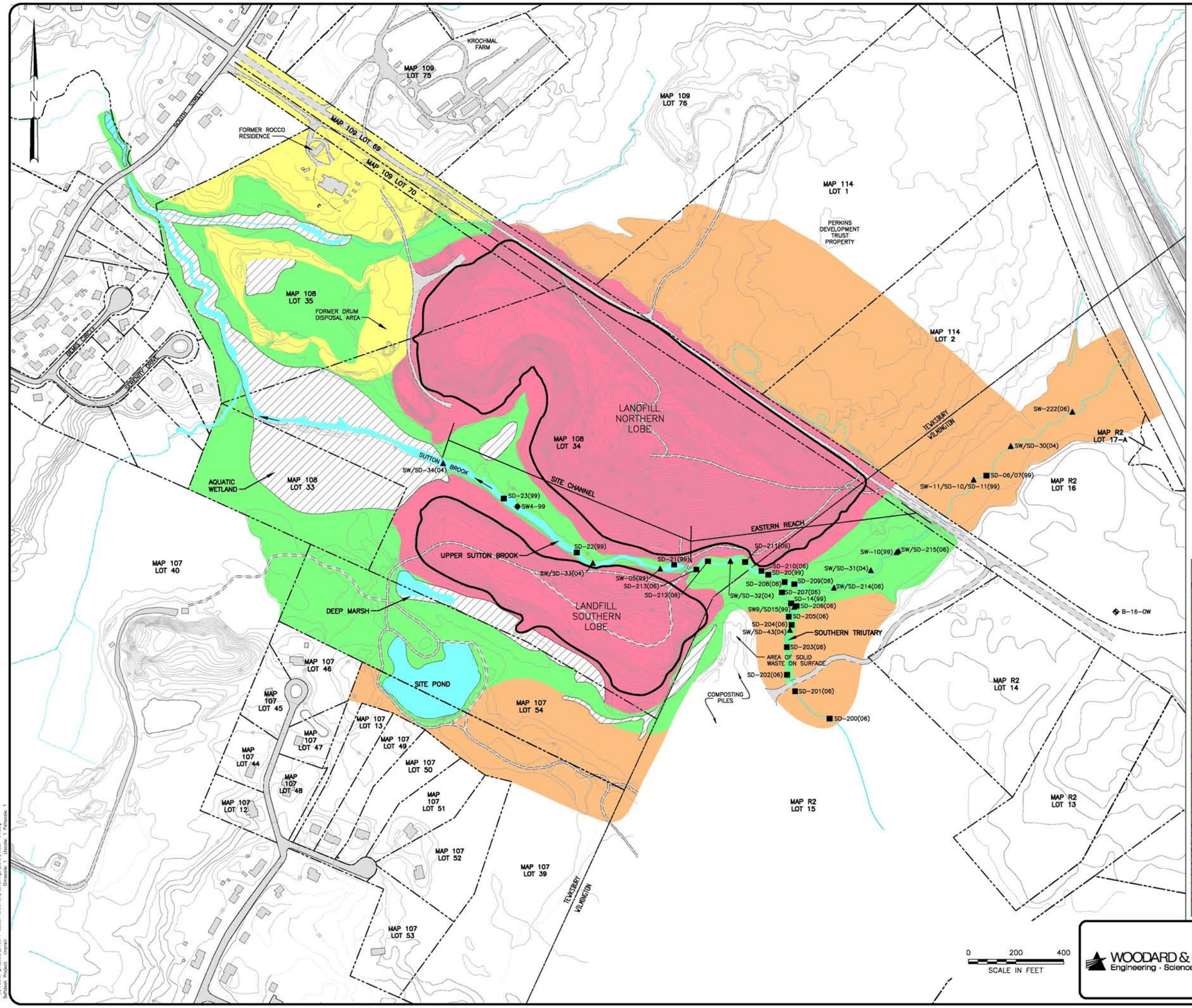
FIGURE 4–1

HABITAT AREAS AND SAMPLE LOCATIONS

SUTTON BROOK DISPOSAL AREA



LEGEND

SW/SD-33 ▲ SURFACE WATER OR SURFACE WATER AND SEDIMENT SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)

SD-23 ■ SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)

SW4 ◆ SURFACE WATER SAMPLE COLLECTED AT STREAM PIEZOMETER LOCATION (1999)

(99) – INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

INTERPRETIVE LIMITS OF SOLID WASTE

APPROXIMATE LOCATION OF PROPERTY LINES

PAVED ROAD

UNPAVED ROAD

WATER

DRIVEWAY

FENCE

BUILDING

HABITAT AREAS

LANDFILL AREA

WETLAND SOILS HABITAT AREA

UPLAND SOILS HABITAT AREA (FORMER DRUM DISPOSAL AREA AND RESIDENCE, GARAGE, AND STORAGE AREA

REFERENCE LOCATIONS

OPEN WATER AREAS

AQUATIC WETLAND HABITAT AREA

ADDITIONAL REFERENCE LOCATIONS

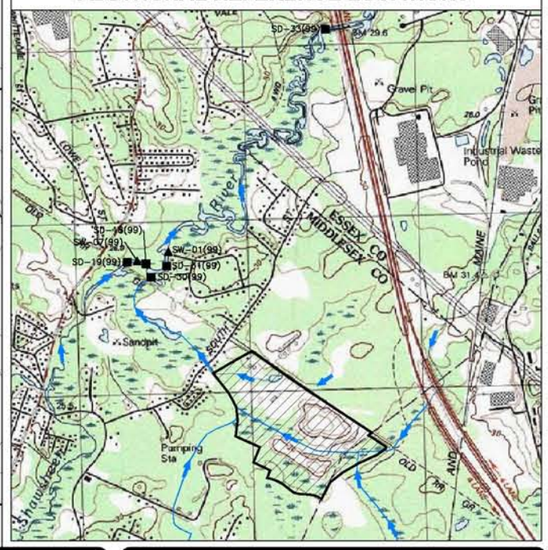


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FIGURE 4–2

UPPER SUTTON BROOK
HABITAT AREA AND SAMPLE LOCATIONS

SUTTON BROOK DISPOSAL AREA

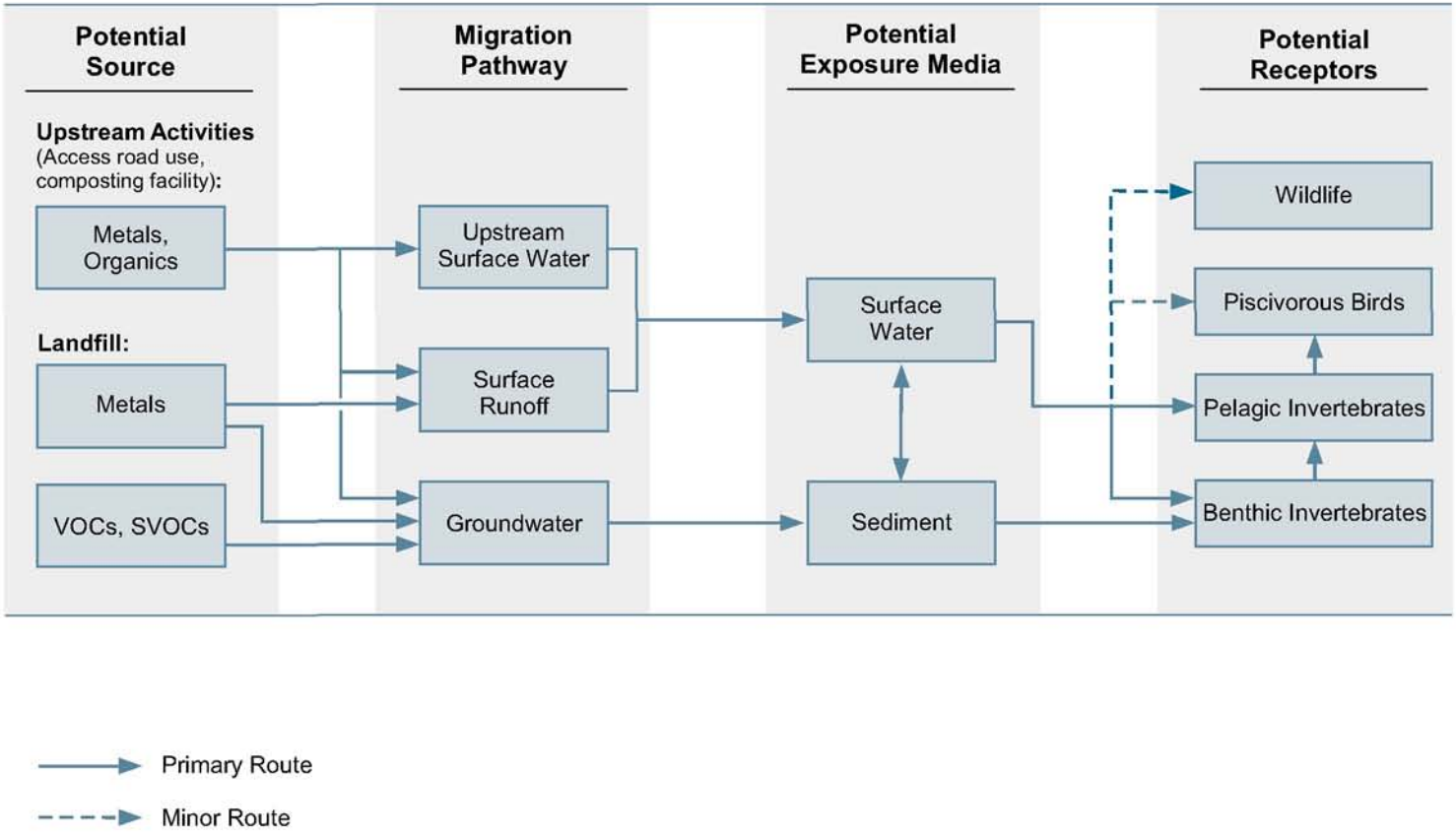

Figure 4-3
Upper Sutton Brook
Ecological Conceptual Site Model
Sutton Brook Disposal Area

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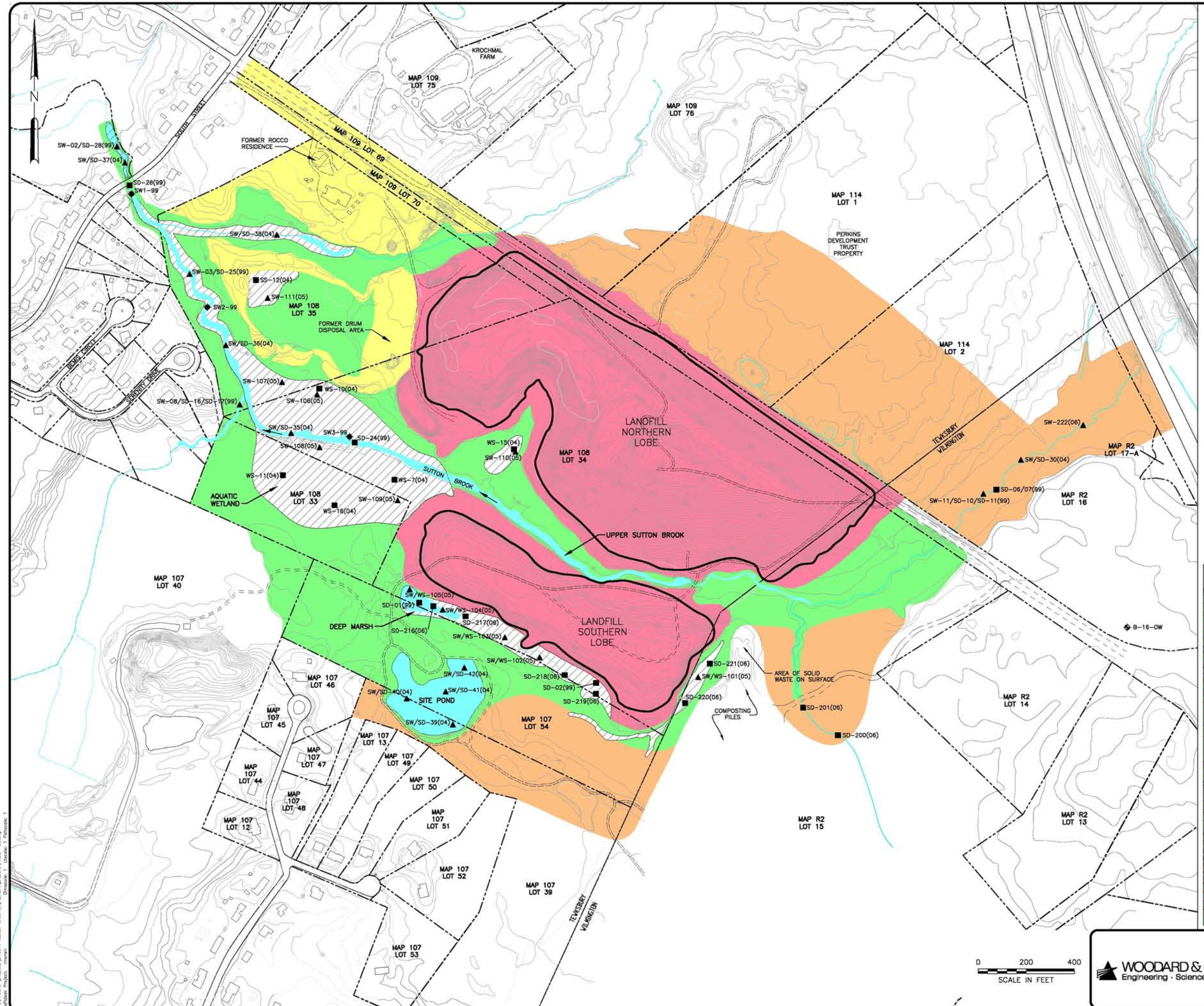

LEGEND

SS-1 ● SOIL SAMPLING LOCATION (START – 1999) (W&C 2004, 2005)

SW/SD-33 ▲ SURFACE WATER OR SURFACE WATER AND SEDIMENT SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)

SD-23 ■ SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)

SW1 ◆ SURFACE WATER SAMPLE COLLECTED AT STREAM PIEZOMETER LOCATION (1999)

(99) – INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

INTERPRETIVE LIMITS OF SOLID WASTE

APPROXIMATE LOCATION OF PROPERTY LINES

PAVED ROAD — DRIVEWAY

UNPAVED ROAD — FENCE

WATER — BUILDING

HABITAT AREAS

LANDFILL AREA

WETLAND SOILS HABITAT AREA

UPLAND SOILS HABITAT AREA (FORMER DRUM DISPOSAL AREA AND RESIDENCE, GARAGE, AND STORAGE AREA

REFERENCE LOCATIONS

OPEN WATER AREAS

AQUATIC WETLAND HABITAT AREA

ADDITIONAL REFERENCE LOCATIONS

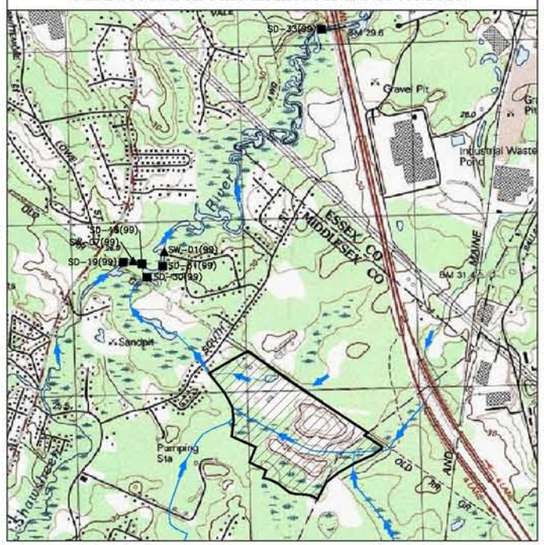

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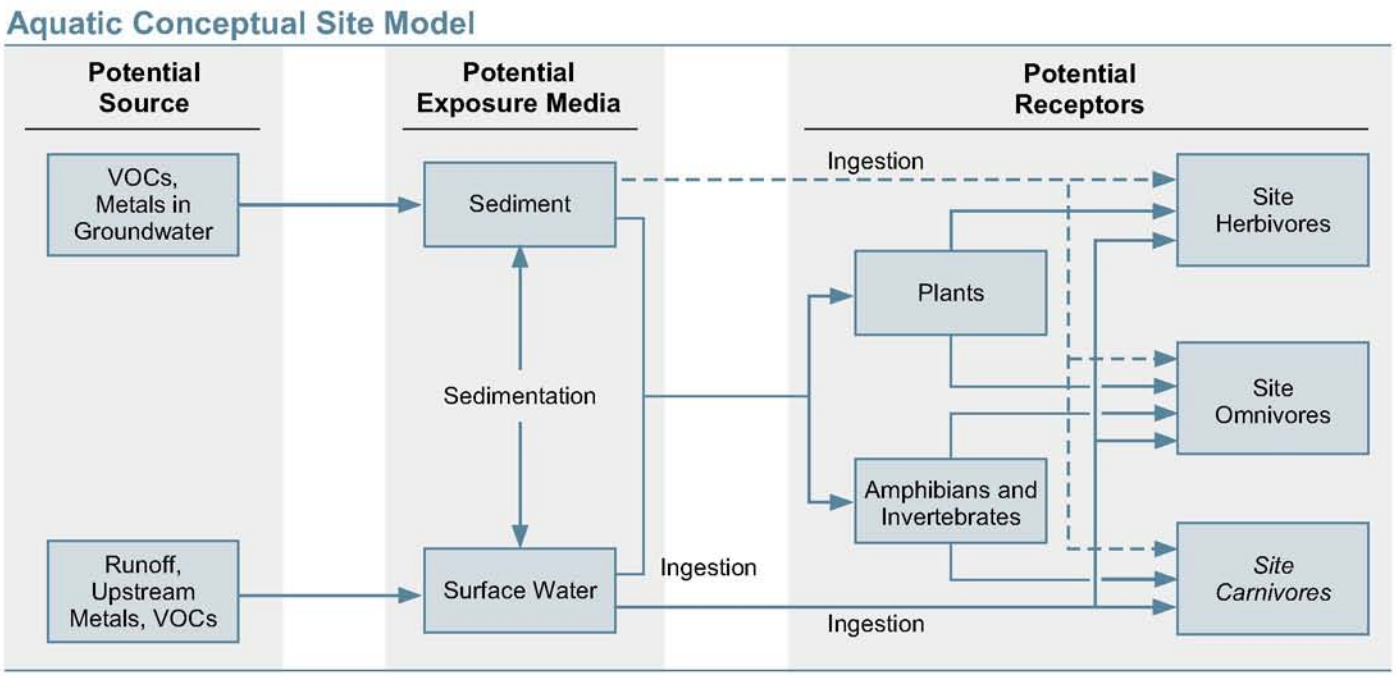
FIGURE 4–4
AQUATIC WETLAND HABITAT AND SITE POND HABITAT AREA AND SAMPLE LOCATIONS
SUTTON BROOK DISPOSAL AREA



NOTE:
Italics indicate that no risk was identified in the SLERA for this feeding guild.

Figure 4-5
Aquatic Wetland Ecological Conceptual Site Model
Sutton Brook Disposal Area

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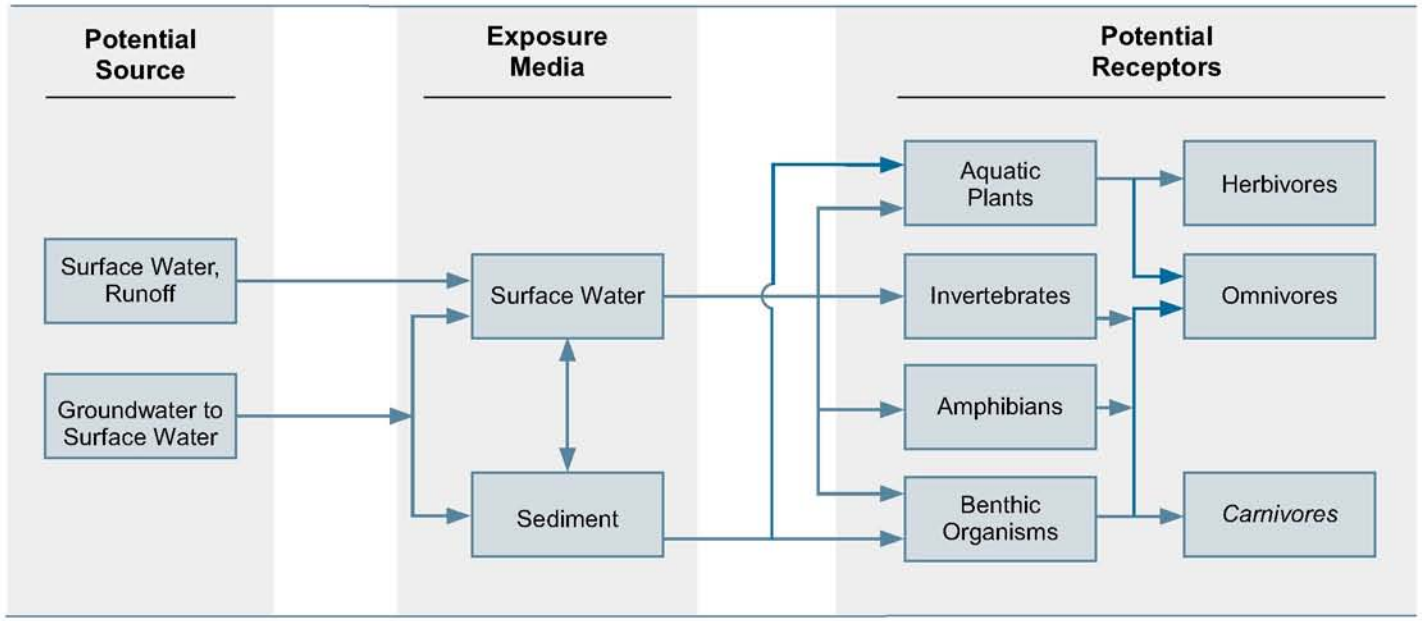

NOTE:
Italics indicate that no risk was identified in the SLERA for this feeding guild.

Figure 4-6
Site Pond Ecological Conceptual Site Model
Sutton Brook Disposal Area

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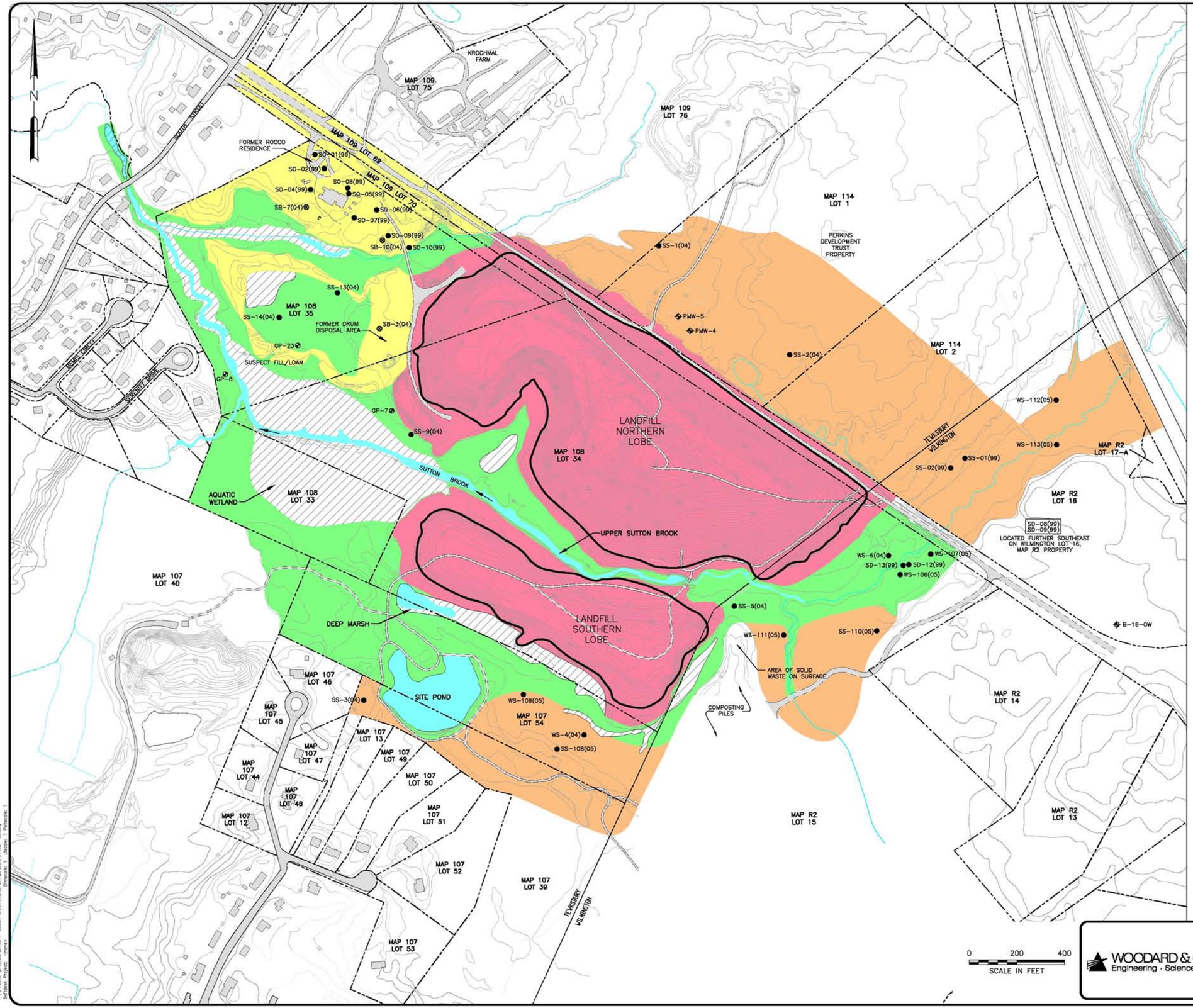

LEGEND

MW-6	MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)
SB-1	SOIL BORING LOCATION (W&C 2004)
GP-1	TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)
SS-1	SOIL SAMPLING LOCATION (START – 1999) (W&C 2004, 2005)
SW/SD-33	SURFACE WATER OR SURFACE WATER AND SEDIMENT SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)
SD-23	SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (START – 1999) (W&C 2004, 2005, 2006)

(99) – INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

INTERPRETIVE LIMITS OF SOLID WASTE
APPROXIMATE LOCATION OF PROPERTY LINES
PAVED ROAD
DRIVEWAY
UNPAVED ROAD
FENCE
WATER
BUILDING

HABITAT AREAS

LANDFILL AREA
WETLAND SOILS HABITAT AREA
UPLAND SOILS HABITAT AREA (FORMER DRUM DISPOSAL AREA AND RESIDENCE, GARAGE, AND STORAGE AREA
REFERENCE LOCATIONS
OPEN WATER AREAS
AQUATIC WETLAND HABITAT AREA

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FIGURE 4-7
WETLAND AND UPLAND SOILS HABITAT AREAS AND SOIL SAMPLE LOCATIONS
SUTTON BROOK DISPOSAL AREA

Wetland Soils Conceptual Site Model

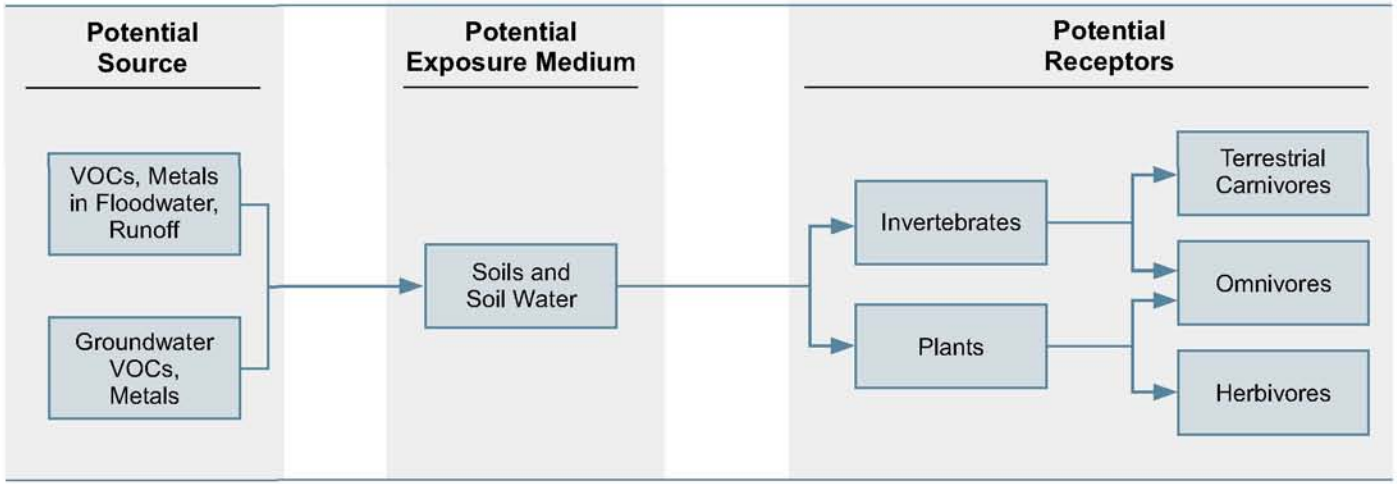

Figure 4-8
Wetland Soil Ecological Conceptual Site Model
Sutton Brook Disposal Area

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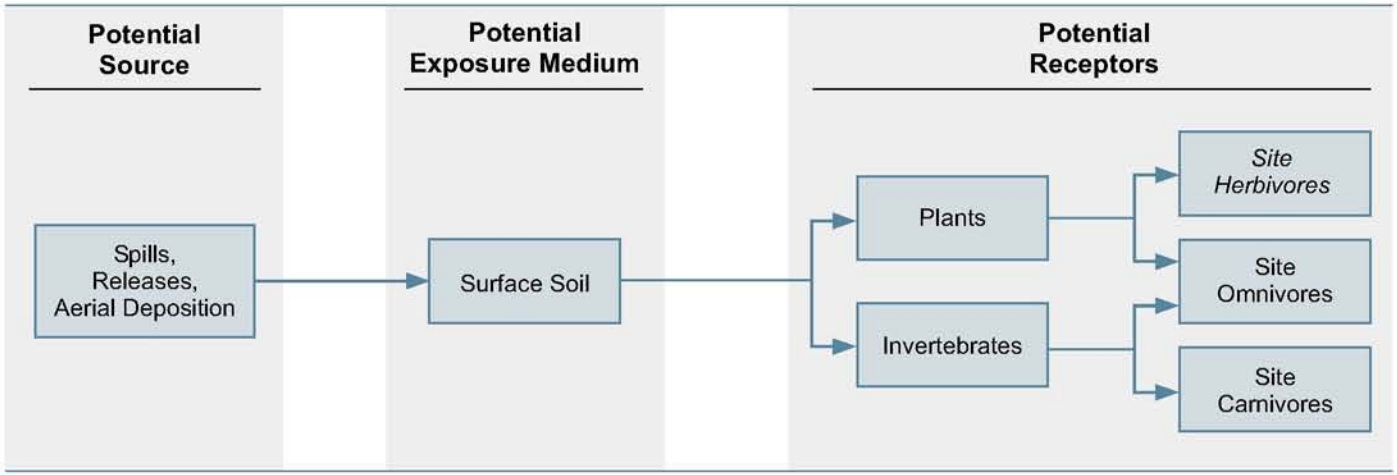

NOTE:
Italics indicate that no risk was identified in the SLERA for this feeding guild.

Figure 4-9
Upland Soils Ecological Conceptual Site Model
Sutton Brook Disposal Area

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5. HERA CONCLUSIONS

Risks assessments serve as the link between the Remedial Investigation and the Feasibility Study, since they provide quantitative information on the nature and magnitude of potential risks, which in turn form the basis for remedial goals for site media.

The objective of the baseline human health and ecological risk assessment (HERA) is to characterize potential human health and ecological risks under baseline conditions (i.e., assuming no additional remediation is performed), and to help evaluate whether or not remedial response actions are warranted.

The Sutton Brook Disposal Area Superfund Site is an inactive landfill primarily surrounded by open space, farming operations, a composting operation, and residential dwellings. Sutton Brook flows east to west through the Site, dividing the landfill into Northern and Southern lobes. Soil, groundwater, sediment, surface water, landfill gas and ambient air data have been collected at the Site as part of various site assessment activities conducted between 1989 and 2006. Sampling events and site data are described in sections of the previously submitted RI Report (February 2007).

The risk assessment considered the data set established for the RI, which excluded some historical data provided without laboratory reports, screening data, data rejected via data validation methods, and tentatively identified compounds (TICs) that were screened out in accordance with the project-specific TIC Data Assessment process. This evaluation includes one exception to the general exclusion of data qualified as rejected ('R'-flagged); R-flagged data for non-detected compounds from select sediment samples with low percent moisture were retained in this evaluation (further details have been provided in Section 3.1.2.5 and Section 4.1.1 of this Report).

Activities associated with the RI, risk assessment, and FS were developed and implemented with the presumption that the existing waste material in the two landfill lobes will be closed in-place using current landfill capping technology. Additional soil characterization sampling within the landfill lobes for risk characterization was not performed; samples for physical characteristics of the cover material and from adjacent groundwater, surface water, and sediments were collected and included in the RI and risk characterizations. The conclusions of the risk characterizations are thus predicated on this presumption with regard to the landfill lobes.

The conclusions of each of these risk assessments are presented in this section.

5.1 HUMAN HEALTH RISK ASSESSMENT (HHRA) CONCLUSIONS

A number of receptors and exposure scenarios were evaluated under both existing and potential future site conditions. Based on the potential for exposure, impacted media, and/or likely activities and uses, the Site was subdivided into several "groups" including: Groups 1 and 2 (former landfill lobes), Group 3 (Former Drum Disposal Area), Group 4 (Former Residence, Garage and Storage Area), Group 5 (Sutton Brook and associated wetlands and tributaries), Group 6 (Areas South of the Southern Landfill Lobe), and Group 7 (Reference locations).

As described above, it has been presumed that the former landfill lobes (Groups 1 and 2) will be capped as part of the site remedy. Accordingly, exposures to soils and waste in these areas were not quantified in this HHRA since the capping will eliminate access/exposures to these areas.

Receptors assumed to have potential exposures under current and potential future conditions included the Trespassers/Recreational users. These receptors were assumed to trespass onto upland site areas (Group 3

or 4) and engage in recreational activities in wetland areas and/or Sutton Brook and its tributaries (Groups 5 and 6).

Additional receptors (to those listed above) evaluated under (hypothetical) future uses and conditions, which assumed to include redevelopment of upland site areas (i.e., Groups 3 and 4) for commercial and/or residential use, included:

- Site Residents,
- Commercial facility workers, and
- Construction workers.

For some of the receptors listed above, exposures were assumed to occur at several exposure points (e.g., future residents were assumed to be exposed to COPCs in either Group 3 or Group 4, as well as to surface water, wetland soil and/or sediments in Groups 5 and 6). Specifically, the residential receptors were assumed to live in Group 3 or Group 4. However, the Group 3 and Group 4 residential receptor was also assumed to come in contact with sediment, wetland soil and surface water in Groups 5 and 6 and to groundwater (as a potable water source) in Groups 3-6. In addition, risks were evaluated separately for residents who were assumed to use Groups 1&2 groundwater as a source of potable water.

Due to the classification of groundwater underlying the site as potentially usable for potable purposes (in the future), both residential and commercial development scenarios assumed extraction of groundwater for potable purposes. In addition, potential exposures to multiple media (soil, groundwater, airborne dust, vapors, surface water, and/or sediment) were evaluated, as appropriate, for each receptor at each exposure point. Lastly, both central tendency (CT) and reasonable maximum exposure (RME) scenarios were evaluated for each of these receptors. This was done to better understand the potential range of health risks that may occur under "typical" (CT) and upper bound/reasonable worst case (RME) conditions.

Pathway-specific risks for each receptor group were summed so that the cumulative receptor risks could be compared to USEPA criteria. These risk management criteria correspond to a cumulative hazard index (HI) of 1 and a target cancer risk range of 1×10^{-4} to 1×10^{-6}.

Three separate pathway and cumulative risks were estimated for each receptor, the results of which are summarized below:

- Total Risks: these risks reflect calculated HIs and cancer risk estimates associated with exposure to ***all*** COPCs within each medium;

- Site-related Risks: these risks reflect calculated HIs and cancer risk estimates associated with exposure to COPCs which were assumed to be site-related based on collected information and analytical data and their concentrations relative to measured reference concentrations: and,

- Reference Risks: these risks reflect calculated HIs and cancer risk estimates associated with exposure to COPCs which are present at levels consistent with measured reference concentrations.

In the risk assessment, all three types of risks were presented with the site-related risks being the focus of comparisons to USEPA criteria. Also, for the purpose of this conclusion section, calculated non-cancer risk estimates were described relative to the hazard index criterion of 1, and calculated cancer risk estimates were classified as *above the USEPA risk range* (i.e., greater than 1×10^{-4}), *within the EPA risk range* (between 1×10^{-6} and 1×10^{-4}) or *below the USEPA risk range* (less than 1×10^{-6}). For ease of presentation, we summarized the results for current and then hypothetical future receptors.

These summary conclusions highlight the data group(s), media, and chemicals that were the most significant contributor(s) to risks identified in excess of the USEPA non-cancer and cancer criteria described above. If risks were below the non cancer limit or below/within the caner risk range, explanation of these specifics, such as COPCs drivers, was not included in this section. Refer to Section 3.4.2 of this report for a detailed summary of all of the human health risk estimates, including those below, within and/or above the USEPA risk limit or ranges described above.

5.1.1 Current Conditions

Under current conditions for the CT scenario, both of the cumulative (receptor) HIs for the Trespasser/Recreator receptors *were at or below 1*. All of the CT cancer risk estimates for these current receptors were *within USEPA's target risk range*. Similarly, under the RME scenario, all of the cumulative HIs *were at or below 1* and the ILCR estimates were *within the USEPA risk range.*

In summary, neither the Group 3 or Group 4 Trespasser/Recreational user had non-cancer risks above the cumulative limit of 1 or cancer risks above the USEPA risk range (i.e., greater than 1×10^{-4}) .

5.1.2 Future Conditions

Under future conditions, the risks are identical for the Group 3 Trespasser/Recreational user as those presented under current conditions; therefore they are not repeated in this section.

- For the CT and RME scenarios, the residential receptors (Groups 1&2 [groundwater only], Group 3, and Group 4) and the facility worker receptors (Group 3 and Group 4) all had *cumulative HIs greater than 1 and cumulative cancer risks above the USEPA risk range*. In the case of both the residential receptors (in all Groups described above) and the facility worker receptors (Groups 3 and 4), the assumed use of groundwater from either Groups 1&2 or Groups 3-6 for potable purposes resulted in the highest exposure medium risks. Arsenic in Groups 1 and 2 groundwater contributed most significantly to both the cumulative HI and ILCR for the residential receptor in these areas, with chlorinated and non-chlorinated VOCs and phenols also contributing significantly to non-cancer risks. For residential receptors and facility worker receptors in both Group 3 and 4, potable water was assumed to be drawn from groundwater underlying Groups 3-6 collectively. For these receptor groups, arsenic and acrylonitrile in groundwater contributed significantly to both non-cancer and cancer risks, with numerous VOCs, SVOCs and heavy metals in groundwater also contributing to the non-cancer risk. Although other media (such as wetland and upland soil) contained individual chemicals associated with non-cancer risks above 1 or cancer risks above 1×10^{-6} , the contribution of these other media were typically small when compared to the potable groundwater risks. The only exceptions to this were for upland soils in Group 4, where elevated cancer risks were associated with carcinogenic PAHs, notably, benzo(a)pyrene, and for sediments in Groups 5&6. However, as explained below, the drivers of sediment associated cancer risks were found at site concentrations consistent with data collected from upstream (reference) locations. Hence, *site-related* risks for sediment were relatively low when compared to groundwater.

- Under both the CT and RME scenarios, the Group 4 trespasser/recreators had *non-cancer risks below the limit of 1,* while the cancer risks were *within the acceptable risk range.*

- Under the CT scenarios, both the Group 3 and Group 4 construction workers had cumulative HIs and ILCR estimates *below or within applicable USEPA target risks and risk ranges,* respectively. The Group 4 construction worker also had *no risks above the target risk or risk range* identified under the RME scenario. Under the RME scenario, the Group 3 construction

worker receptor had a cumulative *non-cancer risk (HI) slightly greater than 1,* primarily associated with the dermal contact with arsenic and phthalates in soil, while the ILCR estimate for this receptor was *within the target risk range*. Note that arsenic in soil is consistent with reference conditions.

Generally, the site-related human health risk estimates that were most significantly above the USEPA target risks or risk ranges were associated with exposure to groundwater, primarily through its assumed potable use in the future. The chemicals contributing most significantly to these groundwater risks included arsenic, phenols, aromatic VOCs and tetrahydrofuran in Groups 1&2 groundwater, and arsenic, acrylonitrile, xylenes, ketones and phenolic compounds in Groups 3-6 groundwater. Exposure to upland soils in Group 3 generally resulted in risks below or within the target risk range, whereas residential exposures to upland soils in Group 4 were associated with risks above the risk range, primarily associated with exposure to carcinogenic PAHs (e.g., benzo(a)pyrene). Exposures to wetland soils and/or surface water in Groups 5&6 by trespassers/recreational users and/or future site residents were not associated with risks above the applicable risk limit or range. Lastly, although the cumulative (total) risks to sediments in Group 5&6 by trespassers/recreational users and/or hypothetical future site residents were above the target risk range, the site-related risks for this medium were at or below applicable limits, since the excess risk was almost completely due to levels of PAHs and arsenic, both found to be consistent with levels detected in sediments upstream of the site (refer to Section 3.1.4).

5.2 ECOLOGICAL RISK ASSESSMENT (BERA) CONCLUSIONS

In the BERA, concentrations of COPCs in surface water, sediment and site soils were used to estimate the potential for effects on aquatic and semi-aquatic receptors, waterfowl, and terrestrial wildlife at the Site. Risks to these different receptors were evaluated by either comparison to ecological benchmarks or estimation of exposure doses and comparison to established Toxicity Reference Values (TRVs). These comparisons were supplemented by the results of toxicity testing to refine levels of effect in sediment.

Risks were evaluated at five separate areas, which generally correlate to different habitats types and exposure points. These areas consist of: the Upper Sutton Brook, which was further subdivided into the Eastern Reach, Southern Tributary, and Site Channel; the Aquatic Wetland; the Site Pond; Wetland Soils; and Upland Soils. To better understand the potential range of risks, three separate exposure point concentrations were considered for each of these areas: average, 95% UCL, and maximum concentrations. In general, the arithmetic average concentration is considered to be the most reasonable and likely since feeding and/or exposure potential was equally probable at any location in that exposure area. An exception is the shrew, which, because of a small home range, was evaluated by use of maximum values.

Assessment endpoints varied by Habitat Area but included for aquatic environments: benthic invertebrates, fish, amphibians, and waterfowl. Assessment endpoints for terrestrial environments included: plants, soil invertebrates, and mammalian or avian wildlife. Estimated concentrations were compared first to conservative no-effect benchmarks in a Screening Level Ecological Risk Assessment (SLERA). COPCs that exceeded no-effect benchmarks in the SLERA were further evaluated in the BERA by considering the magnitude and location of the exceedances and the COPC concentrations relative to lowest-effect level values. To aid in assessing the data, concentration of inorganic COPCs were also compared to reference concentrations in some instances.

Two areas, the Upper Sutton Brook Site Channel and the Former Drum Disposal Area, were not subject to additional evaluation in the BERA. Risk conclusions for these areas were based on the results of the SLERA alone.

Based on the results of the BERA, the following areas were associated with potential risks:

Upper Sutton Brook:

Reach:	Eastern Reach
Media:	Surface water
Assessment Endpoints:	Fish and pelagic invertebrates
COPCs:	Iron (exceedance of chronic WQC)

Reach:	Site Channel
Media:	Surface water
Assessment Endpoints:	Fish and pelagic invertebrates
COPCs:	DDT, ethylbenzene, toluene, xylenes, barium, and manganese (from NOAEL exceedances in SLERA)

Reach:	Site Channel
Surface Water:	Sediment
Assessment Endpoint:	Benthic invertebrates
COPCs:	1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methyl-2-pentanone, acetone, carbon disulfide, chloroethane, ethylbenzene, xylenes, toluene, arsenic, and manganese (from NOAEL exceedances in SLERA)

Aquatic Wetland

Media:	Surface Water
Assessment Endpoint:	Aquatic life
COPCs:	Iron (exceedance of chronic WQC)

Media:	Surface Water
Assessment Endpoint:	Amphibians
COPCs:	Aluminum

Former Drum Disposal Area - Soils:

Assessment Endpoint:	Plants
COPCs:	Bis(2-Ethylhexyl)phthalate, ethylbenzene, naphthalene, xylenes

Assessment Endpoint:	Soil Invertebrates
COPCs:	1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, ethylbenzene, toluene, xylenes

Assessment Endpoint:	Carnivores (robin)
COPCs:	1,2,4-Trimethylbenzene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, xylenes

Upland Soils (excluding Former Drum Disposal Area):

Assessment Endpoint:	Soil invertebrates
COPCs:	Zinc (localized)

Assessment Endpoint:	Carnivores
COPCs:	di-n-octylphthalate and lead