APPENDIX A2
PRE-REMEDIATION HUMAN HEALTH RISK ASSESSMENT AT AOC 2

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SECTION A2.1

INTRODUCTION

A2.1.1 INTRODUCTION

This baseline human health risk assessment (HHRA) has been prepared by Parsons for Area of Concern (AOC) 2, Former Bivouac Area/Post Commander's Landfill. This HHRA will be used to support the evaluation and selection of a remedial action alternative for controlling the risks posed by soil, groundwater, sediment, surface water and waste material found on the site. The specific objective of this HHRA is to determine the potential risk to human health associated with exposure to contaminated environmental media at AOC 2. The goal of the HHRA was to support the U.S. Army Corps of Engineers (USACE), the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH) in assessing the human health risks posed by contamination at AOC 2.

A2.1.2 FACILITY AND SITE DESCRIPTION

A2.1.2.1 AOC 2 is part of the former Schenectady Army Depot, Voorheesville Area (SADVA). SADVA is located 0.25 mile southeast of the Village of Guilderland Center, New York. The Department of Defense (DoD) held ownership of the SADVA property from 1941 through 1969. The site was originally constructed as a regulating station and a holding and reconsignment point, and later became a general Army depot. The principal mission of the installation was the receipt, storage, maintenance, and distribution of supply items for the U.S. Department of the Army (DOA).

A2.1.2.2 In 1963, approximately 40 acres on the west side of Route 201 were sold to a private party for use as a residence. This parcel was designated AOC 2. SADVA was closed in 1969. The most of the SADVA property was sold to the Town of Guilderland Urban Renewal Agency (GURA). GURA leased the property to Galesi Group, Inc., which established the Northeast Industrial Park (NEIP). The NEIP has been in operation as an industrial park since that time. Various open spaces and buildings on the property are leased to tenants. The leased area has been used for manufacturing, maintenance and repair operations and storage of goods.

A2.1.2.3 During the first phase of the Remedial Investigation (RI) at AOC 2, performed between June and May 2001, it was determined that an imminent threat to human health was not present at the site. Available background information for the site and initial RI results indicated that the extent of contamination was limited to an area littered with small pill bottles containing salt and iodine tablets. Additional interviews with property neighbors, and a second phase of field activities for the RI, performed from June through December 2004, showed four additional areas of highly impacted soil and surface water. Various types of waste material were found in these areas, including tar buckets, lead-based paint residues, and drums and glass jars containing solvents and unknown substances. Based on the sources of contamination and on contaminant concentrations in soil, groundwater, surface water and sediment, AOC 2 became a candidate for remediation. An Engineering Evaluation/Cost Analysis (EECA) was initiated in 2005 to assess a

range of options for remediating the site. The focus of the EECA was to assess options for remediating wastes and contaminated media associated with the wastes, including the areas of soil containing pill bottles, tar buckets, lead-based paint residues, and drums and glass jars with solvent and unknown contents. The EECA recommended soil and waste excavation, removal and disposal in appropriate landfills. That work was eventually completed in 2005-2006. This HHRA describes the human health risks that were present at the site before the remedial action was initiated, and as such, is termed a "pre-remediation human health risk assessment".

A2.1.3 REGULATORY STATUS

A2.1.3.1 This HHRA comes under the authority of the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS). The SADVA site is DERP-FUDS site number C02NY0002.

A2.1.3.2 Using the site characterization data from the RI, the USACE, NYSDOH and NYSDEC worked together to identify the primary human health concerns at AOC 2. Using this pre-remediation HHRA, USACE and the State decided on an appropriate site clean-up remedy, and USACE prepared a remedial design for the clean-up action, and eventually completed the clean-up process. A Restoration Advisory Board (RAB) has been active throughout the RI and will continue to participate in the process through the final clean-up action. The selection of an acceptable method for remediating AOC 2 allowed the current property owner to continue residential use of the property.

A2.1.3.3 Based on the RI and other previous investigations at AOC 2, general assumptions were developed to describe the overall HHRA process for the site. The general assumptions used in the HHRA are listed below.

- Residential exposure scenarios will be evaluated.
- Soil, groundwater, sediment and surface water will be evaluated as the environmental media of concern. Completed sediment and surface water pathways will be evaluated for direct contact.
- All chemicals that were detected as part of the RI will be used to quantify potential carcinogenic and noncarcinogenic risk.
- The maximum detected concentrations of chemicals will be used in the HHRA.

A2.1.3.4 As part of the RI and EECA for AOC 2, this HHRA refers to information provided in the RI report. The RI Report contains specific information related to the site history and regulatory status, land use, environmental setting (*e.g.*, surface features, hydrogeology, geology, and soils), and nature and extent of contamination. This HHRA refers to the RI Report for more detailed information as needed.

A2.1.4 RISK ASSESSMENT PROCESS

A2.1.4.1 Techniques and methodology developed or recognized by the USEPA were used to assess risks and hazards associated with potential exposure to contaminants at AOC 2. Guidance under the Comprehensive Environmental Response, Compensation, and Liability Act

(CERCLA), as provided in the *Risk Assessment Guidance for Superfund* (RAGS) (USEPA, 1989), was followed as the primary methodology for this HHRA. Supplemental USEPA and/or other federal and state guidelines have also been used in conjunction with RAGS. The HHRA methods were based on, but not limited to, the following sources:

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),* Interim Final (USEPA, 1989);
- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors*, Interim Final (USEPA, 1991a);
- *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (USEPA, 1991b);
- *Guidance for Data Useability in Risk Assessment (Part A)* (USEPA, 1992a);
- *Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure*, Draft--- (USEPA, 1993);
- *Exposure Factors Handbook* (USEPA, 1999); and
- *Risk Assessment Guidance for Superfund (RAGS), Volume I,* Final, (USEPA, 2001).

A2.1.4.2 Exposure factors and other chemical-specific properties that were used in the HHRA calculations are referenced in footnotes of the risk calculation tables (Tables A2.9.1 through A2.9.45 in Section 8), as well as in the References Section of this HHRA (Section A.7).

A2.1.5 ORGANIZATION OF AOC 2 RISK ASSESSMENT REPORT

The risk assessment process consists of four key steps: data evaluation, exposure assessment, toxicity assessment, and risk characterization. These four steps of risk assessment provide the general outline of a baseline risk assessment report. The overall format of this HHRA is consistent with USEPA guidelines as presented in RAGS and supporting supplemental guidance. This HHRA is organized into eight sections, as outlined below.

A2.1 Introduction,

A2.2 Data Evaluation and Identification of Chemicals of Potential Concern,

A2.3 Exposure Assessment,

A2.4 Toxicity Assessment,

A2.5 Risk Characterization Methodology,

A2.6 Risk Assessment Results,

A2.7 References, and

A2.8 Acronyms and Abbreviations

A2.9 Exposure and Risk Calculation Tables.

SECTION A2.2

DATA EVALUATION AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

A2.2.1 INTRODUCTION

A2.2.1.1 Chemicals of potential concern (COPCs) at AOC 2 are those identified in the RI as posing a potential impact on human health. Soils, groundwater, sediment and surface water were sampled as part of the RI. Initial samples for the RI were collected between June and December 2000, with additional samples collected to complete the RI from June through December 2004. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) including carcinogenic polycyclic aromatic hydrocarbons (CPAHs), noncarcinogenic polycyclic aromatic hydrocarbons (NPAHs), pesticides, polychlorinated biphenyls (PCBs), and metals. Sampling results for the chemicals detected in each of the environmental media are summarized in Section 3 of the RI Report. Appendix B of the RI report includes all of the analytical data, as well as the data validation reports. USEPA Level III data validation was performed on all of the data. This level of validation is appropriate for evaluating the useability of analytical data in a quantitative risk assessment.

A2.2.1.2 All chemicals detected in soil, groundwater, sediment and surface water were compared to available and applicable NYSDEC and/or background criteria. The RI identified NYSDEC criteria for each of the detected chemicals in each environmental media. Site-specific background samples were also collected for each of the environmental media and were used in conjunction with the NYSDEC criteria to evaluate nature and extent of contamination. Numerous chemicals, predominantly metals, were found to be above the NYSDEC and/or background criteria for soil, groundwater, sediment, and surface water. Based on these results, this HHRA was warranted to evaluate the potential impact of exposure to contaminants found in soil, groundwater, sediment and surface water at AOC 2.

A2.2.1.3 The potential cancer risk and noncancer hazard has been quantified for each contaminated media. Therefore, all chemicals detected in soils, groundwater, sediment and surface water are included in the HHRA so that the overall impact to human health is assessed. For this HHRA, maximum detected chemical concentrations are the exposure point concentrations (EPCs) used to calculate risk; use of maximum concentrations provides a conservative (*i.e.*, most health-protective) estimate of exposure to that chemical.

A2.2.1.4 Table A2.1 summarizes the analytical data used in the HHRA. The table provides a summary of the maximum detected concentrations of all contaminants detected at the site for all environmental media: surface soil, mixed soil (surface and subsurface soils), groundwater, sediment, and surface water. The table also shows the sample location where the maximum concentration of the contaminant was detected. The table also gives the available and applicable NYSDEC and/or background criteria of each contaminant for soil, groundwater, sediment, and surface water. Analytical results that exceed the NYSDEC and/or background criteria are shaded on the table. If two or more values are available as criteria (*e.g.*, both a NYSDEC standard and a

background concentration are available), the higher of the values is used for comparison and the chemical concentration that exceeds the higher of the two values is shaded.

A2.2.2 NYSDEC AND SITE-BACKGROUND CRITERIA

A2.2.2.1 In addition to Table A2.2.1 of this HHRA, more detail on the identification and use of NYSDEC and background criteria was discussed in Section 3 of the RI Report.

A2.2.2.2 Detected compounds were compared to applicable and available NYSDEC criteria and background concentrations as outlined below.

- The soil results were compared to NYSDEC soil criteria and background concentrations. Background samples were collected at nine locations that represent background areas for the site. The criteria for metals were derived by integrating the NYSDEC criteria with the background concentrations and using the higher concentration as the criteria (NYSDEC, 1994).
- Groundwater results were compared to NYSDEC Class GA groundwater standards (NYSDEC, 1998) and background (upgradient) concentrations. Class GA groundwater standards provide protection for groundwater designated as a source of drinking water and all other uses. Sample results for a well upgradient of AOC 2 were also used as site-background concentrations.
- Sediment sample results were compared to NYSDEC sediment criteria and/or background (upstream in Black Creek) concentrations. The NYSDEC sediment criteria were adjusted for total organic carbon (TOC) using an average site-specific background TOC concentration (NYSDEC, 1999). Background samples were collected at upstream/background locations in Black Creek and were used in conjunction with NYSDEC sediment quality criteria (established for protection of aquatic life, not human health).
- Surface water results were compared to NYSDEC Class A and Class C surface water standards/guidance values (NYSDEC, 1998) and/or background (upstream Black Creek) concentrations. Background samples were collected at five upstream/background locations which represent background for the site. AOC 2 is located within the Black Creek drainage area. A portion of AOC 2 extends within New York State Wetland V-19. Surface water exits the site by flowing downhill to the wetland area and eventually reached Black Creek via two Black Creek tributaries. These tributaries of Black Creek are classified as Class C waters, suitable for fishing, fish propagation, and primary and secondary recreation. These tributaries enter Black Creek upstream of a stretch of the creek that is classified as Class B. Class B waters are suitable for primary contact recreation and any other uses except as a source of water supply for drinking, culinary, or food processing purposes (NYSDEC, 1985). Black Creek flows north and joins the BozenKill, which enters the Watervliet Reservoir approximately 4.5 miles north of AOC 2. The Watervliet Reservoir is a Class A water body which is suitable for drinking, culinary or food processing, and all other uses.

A2.2.3 SURFACE AND MIXED SOIL SAMPLES

A2.2.3.1 Contaminants detected in surface and subsurface soils were evaluated in this HHRA. All surface soil samples were collected at depths from 0 to 1 foot. Therefore, surface soil at the site is defined as soil collected at depths less than 1 foot from the surface and would include exposure pathways with no, or very minor, soil disturbance (*e.g.*, wind dispersion of surface soil, planting and gardening in surface soil).

A2.2.3.2 Subsurface samples from the site were collected at depths between 1 and 18 feet. The subsurface sampling results were combined with the surface sampling results to evaluate exposure pathways involving mixed soils (*e.g.*, land development involving excavation activities). The exposure assessment assumes that surface and subsurface soils are mixed during excavation activities, and that potential exposure occurs to contaminants brought to the surface. Therefore, the maximum detected concentrations of contaminants in mixed (surface/subsurface) soils were used in the HHRA.

A2.2.3.3 Surface and subsurface soil samples were collected from a total of 19 locations at AOC 2. Section 3 of the RI Report summarizes the sampling locations and sampling depths, and the contaminants that exceed NYSDEC soil quality criteria (including background concentrations for the site as described above). Table A2.2.1 of this HHRA further summarizes the analytical data for surface soil and mixed (surface/subsurface) soils.

A2.2.3.4 Dioxin samples were collected at 11 of the 12 surface soil sampling locations. A duplicate sample was collected at one of the 11 locations; thus a total of 12 sample results are described for dioxins. None of the individual sample concentrations exceeded the NYSDEC soil criteria. Toxicity equivalents (TEQs) were also calculated to further evaluate the dioxin concentrations at each of the sampling locations. The TEQs also did not exceed the NYSDEC criteria. (A discussion of how TEQs were calculated is provided in Section A2.6 of this HHRA.)

A2.2.3.5 Based upon review of the RI data by the NYSDOH, it was determined that dioxins in surface soil do not pose a threat to human health or the environment. NYSDOH determined that no further action was necessary for dioxins based on the levels of dioxins detected at the site, and because no other organic compound concentrations in the samples exceeded NYSDEC soil criteria. However, the dioxin results, along with all other chemicals detected in soils, were included in the HHRA to assess the cumulative risks and hazards from exposure to all of the soil contaminants. Additional information on the use of dioxins in the HHRA is given in Section A2.4.

A2.2.4 GROUNDWATER SAMPLES

A2.2.4.1 Groundwater samples were collected from 11 locations at and around AOC 2. Groundwater samples were collected from just below the top of the water table from depths ranging from approximately 1 to 12 feet. Two former domestic wells were also sampled, one located at the house and one located downgradient of AOC 2 on neighboring property.

A2.2.4.2 Section 3 of the RI Report summarizes the sample locations and the contaminants that exceed NYSDEC Class GA groundwater standards and the upgradient well contaminant

concentrations. Table A2.2.1 of this Appendix further summarizes the analytical data for groundwater samples.

A2.2.4.3 As described above, Class GA standards provide protection for groundwater designated as a source of drinking water and all other uses. There were several samples which exceeded Class GA groundwater standards that coincided with the location of the waste materials. Based on these results, a correlation can be drawn between the waste materials and an impact to groundwater at the site. It is noted that no VOCs, SVOCs, pesticides, PCBs or metals were detected above Class GA groundwater standards in GW01, the on-site residential well. Three metals were detected above groundwater standards in GW02, the private well on adjacent property that is no longer in use.

A2.2.4.4 As discussed in the exposure assessment in Section A.3, the exposure pathway for groundwater at the site is complete. The potential for risk from exposure to contaminants in groundwater may also increase over time if contaminated soils and waste remaining at the site are not remediated.

A2.2.5 SEDIMENT SAMPLES

A2.2.5.1 A total of 14 sediment samples were collected at AOC 2. The samples were collected from the wetland area, drainage areas (including the discolored and visibly stressed drainage way leading from the disposal area toward Black Creek), areas with intermittent ponded water, and areas with contaminated debris or other visual evidence of potential impact. One sample was also collected from the pond behind the house to evaluate potential direct risks to the residents. Section 3 of the RI Report summarizes the sample locations and the contaminants that exceed NYSDEC sediment quality criteria and/or upstream concentrations. Table A2.2.1 of this HHRA further summarizes the analytical data for sediment samples.

A2.2.5.2 Based on the analytical results, it does not appear that sediment has been impacted by the on-site waste and contamination. It is also noted that no VOCs, SVOCs, CPAHs, NPAHs, pesticides, PCBs or metals were detected above sediment criteria in SD9, the sediment sample collected from the pond behind the residence.

A2.2.5.3 Although the overall concentrations of chemicals in sediments were considered to be low, the results were still important in the quantitative HHRA. This HHRA considers the overall potential risk from exposure to all contaminants in all environmental media at the site, all detected chemical concentrations in the environmental media, and all potentially complete exposure pathways. As discussed in the exposure assessment in Section A2.3, the exposure pathways for sediment at the site is complete. The potential for risk from exposure to contaminants in sediment may also increase over time if contaminated soils and waste remaining at the site are not remediated.

A2.2.6 SURFACE WATER SAMPLES

A2.2.6.1 A total of 14 surface water samples were collected from approximately the same areas as the sediment samples, including one sample at the pond behind the residence. Section 3 of the RI Report summarizes the sampling locations and the contaminants that exceed NYSDEC

Class A and Class C surface water standards and/or background concentrations. Table A2.2.1 of this HHRA also summarizes the analytical data for surface water samples.

A2.2.6.2 The New York State Bureau of Watershed Management and the NYSDEC have classified the section of Black Creek adjacent to SADVA as a Class C stream, suitable for recreation and human consumption of fish. As mentioned above, AOC 2 is located within the Black Creek drainage area. AOC 2 lies within part of New York State Wetland V-19. Surface water entering Wetland V-19 exits the site via two tributaries of Black Creek, located approximately 0.4 mile from the site. These tributaries are classified as Class C waters, suitable for fishing, fish propagation, and primary and secondary recreation. These tributaries enter Black Creek upstream of a stretch of the creek that is classified as Class B. Class B waters are suitable for primary contact recreation and any other uses except as a source of water supply for drinking, culinary, or food processing purposes (NYSDEC, 1985). Black Creek flows north and joins the BozenKill, which enters the Watervliet Reservoir approximately 4.5 miles north of AOC 2. The Watervliet Reservoir is a Class A water body which is suitable for drinking, culinary or food processing, and all other uses. The Watervliet Reservoir water supply serves a population of over 40,000.

A2.2.6.3 There were no VOCs, SVOCs, pesticides, CPAHs, NPAHs, PCBs, pesticides or metals detected above available Class A and C surface water standards in SW9, the sample collected from the pond behind the residence. In several other samples, results exceeded NYSDEC Class A and Class C surface water standards for certain VOCs, SVOCs, and numerous pesticides and metals. The SVOC exceedances were located in the solvent bottle disposal area. Surface water in this area may be impacted by the solvent bottle wastes currently present at AOC 2. Ten pesticides were detected at concentrations above the Class A and C surface water standards. Numerous pesticides were detected throughout the wetland area at the base of the hill, and in the area between the defoliated drainage way and the pill bottle fill area.

A2.2.6.4 As discussed in the exposure assessment in Section A2.3, exposure pathways for surface water at the site are complete. This HHRA considers the overall potential risk from exposure to all contaminants in all environmental media, all detected chemical concentrations in the environmental media, and all potentially complete exposure pathways. Contaminants entering surface water may also increase over time if contaminated soils and waste remaining at the site are not remediated.

Table A2.2.1
Summary of Maximum Detected Concentrations, Sample Locations, and NYSDEC and Background Criteria

CHEMICALS DETECTED AT AREA OF CONCERN 2	Units	SURFACE SOIL					MIXED SOIL					GROUNDWATER					SEDIMENT					SURFACE WATER				
		NYSDEC Soil Criteria	Maximum Detected Conc.	Location of Maximum Conc.	Depth of Sample (feet)	Date of Sampling (year)	NYSDEC Soil Criteria	Maximum Detected Conc.	Location of Maximum Conc.	Depth of Sample (feet)	Date of Sampling (year)	NYSDEC Class GA Value	Upgradient Background Conc.	Maximum Detected Conc.	Location of Maximum Conc.	Date of Sampling (year)	NYSDEC Sediment Criteria	Maximum Background Conc.	Maximum Detected Conc.	Location of Maximum Conc. (0-0.5 feet)	Date of Sampling (year)	Higher of NYSDEC Class A or Class C Values	Maximum Background Conc.	Maximum Detected Conc.	Location of Maximum Conc.	Date of Sampling (year)
VOLATILES																										
Acetone	µg/kg	407	2.2	AOC2-SB03A	0-1	2000	407	290	AOC2-HP09I	16-18'	2000	50 (G)	ND	21	AOC2-HP01	2000	---	ND	ND	---	---	---	2.3	7.8	SD-W-TP27	2004
Benzene	µg/kg	215	180	SD-TP31AOC2	0.5-0.75'	2004	215	180	SD-TP31AOC2	0.5-0.75'	2004	1	ND	3.6	AOC2-HP01	2000	---	ND	ND	---	---	---	---	ND	---	---
Bromomethane	µg/kg	NS	200	SD-TP31AOC2	0.5-0.75'	2004	NS	200	SD-TP31AOC3	0.5-0.75'	2004	---	0.22	ND	---	---	---	ND	ND	---	---	---	---	ND	---	---
2-Butanone	µg/kg	833	ND	---	---	---	833	3.5	AOC2-SB01B	2-4'	2000	50 (G)	ND	10	SD-GW06-AOC2	2004	---	ND	ND	---	---	---	---	ND	---	---
Carbon disulfide	µg/kg	9990	ND	---	---	---	9990	1.7	AOC2-SB01B	2-4'	2000	NS	ND	0.59	AOC2-GW02	2000	---	ND	ND	---	---	---	---	ND	---	---
1,2-Dichloroethane	µg/kg	---	ND	---	---	---	---	ND	---	---	---	0.6	ND	0.57	AOC2-HP01	2000	---	ND	ND	---	---	---	---	ND	---	---
Ethylbenzene	µg/kg	10000	4100	SD-TP31AOC2	0.5-0.75'	2004	10000	4100	SD-TP31AOC2	0.5-0.75'	2004	---	ND	ND	---	---	---	ND	ND	---	---	---	---	ND	---	---
Toluene	µg/kg	5550	2000	SD-TP31AOC2	0.5-0.75'	2004	5550	2000	SD-TP31AOC3	0.5-0.75'	2004	5	ND	1.7	AOC2-HP01	2000	---	ND	ND	---	---	6000	---	2.2	AOC2-SW8	2000
Xylenes (total)	µg/kg	4440	81000	SD-TP31AOC2	0.5-0.75'	2004	4440	81000	SD-TP31AOC4	0.5-0.75'	2004	5	ND	0.79	SD-GW06-AOC2	2004	---	ND	ND	---	---	---	---	ND	---	---
SEMIVOLATILES																										
4-Chloro-3-methylphenol	µg/kg	870	ND	---	---	---	870	170	AOC2-TP14B	2.5'	2000	---	ND	ND	---	---	---					---	---	ND	---	---
bis(2-Ethylhexyl) phthalate	µg/kg	50000	60	AOC2-HP02A	0-1'	2000	50000	1100	AOC2-SB01D	6-8'	2000	5	ND	31	AOC2-HP04	2000	2925 (C)	ND	100	AOC2-SD8	2000	0.6 A(C)	26	140	AOC2-SW7	2000
Butylbenzylphthalate	µg/kg	---	ND	---	---	---	---	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	---	---	0.76	SD-SW12	2004
Diethyl phthalate	µg/kg	---	ND	---	---	---	---	ND	---	---	---	50 (G)	ND	0.35	SD-GW04-AOC-2	2004	---	ND	ND	---	---	---	---	0.34	SD-SW13	2004
Di-n-butyl phthalate	µg/kg	29970	ND	---	---	---	29970	63	AOC2-TP07B	2.5'	2000	50	ND	0.78	SD-GW04-AOC-2	2004	---	ND	ND	---	---	---	---	0.67	SD-SW14-AOC-2	2004
Di-n-octyl phthalate	µg/kg	---	ND	---	---	---	---	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	---	---	0.67	SD-SW13	2004
Fluorene	µg/kg	50000	ND	---	---	---	50000	ND	---	---	---	50 (G)	ND	0.13	SD-GW06-AOC2	2004	---	ND	ND	---	---	---	---	ND	---	---
Isophorone	µg/kg	---	ND	---	---	---	---	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	---	---	0.49	SD-SW110	2004
Phenol	µg/kg	---	ND	---	---	---	---	ND	---	---	---	1	ND	3.1	AOC2-HP01	2000	---	ND	ND	---	---	---	---	ND	---	---
NPAHs																										
2-Methylnaphthalene	µg/kg	50000	780	SD-TP31AOC2	0.5-0.75'	2004	50000	ND	---	---	---	NS	ND	0.87	SD-GW06-AOC2	2004	---	ND	ND	---	---	---	---	ND	---	---
Fluoranthene	µg/kg	50000	ND	---	---	---	50000	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	---	---	0.12	SD-SW13	2004
Naphthalene	µg/kg	48100	2300	SD-TP31AOC2	0.5-0.75'	2004	48100	ND	---	---	---	10 (G)	ND	0.65	SD-GW06-AOC2	2004	---	ND	ND	---	---	---	---	ND	---	---
Phenanthrene	µg/kg	50000	ND	---	---	---	50000	18	AOC2-TP07B	2.5'	2000	---	ND	ND	---	---	---	ND	ND	---	---	---	---	ND	---	---
Pyrene	µg/kg	50000	ND	---	---	---	50000	15	AOC2-HP02C	4-6'	2000	---	ND	ND	---	---	---	ND	ND	---	---	4.6 A(C)	---	0.11	SD-SW13	2004
PESTICIDES																						---				
Aldrin	µg/kg	41	ND	---	---	---	41	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	0.001	---	0.0043	AOC2-SW8	2000
alpha-BHC	µg/kg	111	0.15	AOC2-HP07A	0-1'	2000	111	0.23	AOC2-HP04C	4-6'	2000	---	ND	ND	---	---	---	ND	ND	---	---	0.00002	---	ND	---	---
delta-BHC	µg/kg	1221	0.19	AOC2-SB01A	0-1'	2000	1221	1.7	AOC2-TP05B	3'	2000	---	ND	ND	---	---	---	ND	0.12	AOC2-SD8	2000	0.008	---	0.0052	AOC2-SW3	2000
gamma-BHC (Lindane)	µg/kg	---	0.19	AOC2-SB03A	0-1	2000	---	0.19	AOC2-SB03A	0-1'	2000	---	ND	ND	---	---	---	ND	ND	---	---	0.00002	---	ND	---	---
Dieldrin	µg/kg	44	0.37	AOC2-HP07A	0-1'	2000	44	1.7	AOC2-SB01B	2-4'	2000	---	ND	ND	---	---	---	ND	ND	---	---	0.0000006	---	0.027	SD-SW110	2004
4,4'-DDE	µg/kg	2100	140	AOC2-HP09A	0-1'	2000	2100	140	AOC2-HP09A	0-1'	2000	---	ND	ND	---	---	14.7 (W)	0.23	4.3	AOC2-SD6	2000	0.000007	---	0.0081	SD-SW11	2004
Endrin	µg/kg	339	0.66	AOC2-SB02A	0-1'	2000	339	0.66	AOC2-SB02A	0-1'	2000	---	ND	ND	---	---	59 (C)	ND	0.73	AOC2-SD2	2000	0.002	---	0.0098	SD-SW13	2004
Endrin aldehyde	µg/kg	---	ND	---	---	---	---	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	5	---	0.0069	SD-W-TP27	2004
Endrin Ketone	µg/kg	---	ND	---	---	---	---	0.99	SD-TP25AOC2	1-2'	2004	---	ND	ND	---	---	---	ND	ND	---	---	---	---	ND	---	---
Endosulfan II	µg/kg	---	ND	---	---	---	---	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	---	---	0.0062	SD-SW13	2004
Endosulfan sulfate	µg/kg	---	ND	---	---	---	---	ND	---	---	---	NS	ND	0.0067	SD-GW06-AOC2	2004	---	ND	ND	---	---	---	---	0.0039	SD-SW13	2004
Heptachlor	µg/kg	444	ND	---	---	---	444	ND	---	---	---	---	ND	ND	---	---	1.47 (C)	ND	0.33	AOC2-SD1	2000	0.0002	---	0.006	AOC2-SW8	2000
Heptachlor epoxide	µg/kg	20	ND	---	---	---	20	ND	---	---	---	---	ND	ND	---	---	---	ND	ND	---	---	0.0003	---	0.012	AOC2-SW8	2000
4,4'-DDD	µg/kg	2900	4.9	AOC2-HP09A	0-1'	2000	2900	140	AOC2-TP07B	2.5'	2000	---	ND	ND	---	---	14.7 (W)	ND	2.2	AOC2-SD6	2000	0.000011	---	0.019	AOC2-SW3	2000
4,4'-DDT	µg/kg	2100	51	AOC2-HP09A	0-1'	2000	2100	90	AOC2-TP03B	2'	2000	0.2	ND	0.002	SD-GW07-AOC2	2004	14.7 (C)	ND	7.3	AOC2-SD1	2000	0.00001	---	0.012	SD-SW110	2004
Methoxychlor	µg/kg	10000	2.4	AOC2-SB01A	0-1'	2000	10000	4.6	SD-TP25AOC2	1-2'	2004	35	ND	0.0098	SD-GW06-AOC2	2004	---	ND	ND	---	---	0.03 A(C)	---	0.012	SD-SW10	2004
alpha-Chlordane	µg/kg	540	0.61	AOC2-HP07A	0-1'	2000	540	0.61	AOC2-HP07A	0-1'	2000	0.05	ND	0.0032	SD-GW06-AOC2	2004	0.44 (C)	ND	1.1	AOC2-SD4	2000	0.00002	---	0.0063	SD-SW11	2004
gamma-Chlordane	µg/kg	540	0.37	AOC2-HP08A	0-1'	2000	540	0.37	AOC2-HP08A	0-1'	2000	---	ND	ND	---	---	---	ND	ND	---	---	0.00002	---	0.0078	SD-SW10	2004
METALS																										
Aluminum	mg/kg	12800	16800	SD-TP31AOC2	0.5-0.75'	2004	12800	16800	SD-TP31AOC2	0.5-0.75'	2004	NS	60.6	2610	AOC2-HP09	2000	---	17900	25900	SD-SD-13-0-0.5	2004	100 (1)	158	15300	AOC2-SW6	2000
Antimony	mg/kg	0.59	0.73	AOC2-HP01A	0-1'	2000	0.59	0.85	AOC2-SB01B	2-4'	2000	---	---	ND	---	---	2 (L)	0.44	0.61	AOC2-SD7	2000	---	---	3.6	SD-SW11	2004
Arsenic	mg/kg	16.4	7.8	SD-TP31AOC2	0.5-0.75'	2004	16.4	10.4	AOC2-TP14B	2.5'	2000	---	---	ND	---	---	6 (L)	4.5	7.3	AOC2-SD8	2000	150 (2) A(C)	---	19.6	AOC2-SW8	2000
Barium	mg/kg	300	81.2	SD-TP31AOC2	0.5-0.75'	2004	300	95.2	SD-TP25AOC2	1-2'	2004	1000	20.1	102	SD-GW06-AOC2	2004	---	141	1760	AOC2-SD6	2000	---	26.3	643	SD-W-TP27	2004
Beryllium	mg/kg	0.67	1.2	SD-TP31AOC2	0.5-0.75'	2004	0.67	1.2	SD-TP31AOC2	0.5-0.75'	2004	3 (G)	0.53	0.85	SD-GW04-AOC-2	2004	---	0.92	1.1	SD-SD-13-0-0.5	2004	1100	0.16	1.1	SD-SW12	2004
Cadmium	mg/kg	1	0.46	AOC2-HP04A	0-1'	2000	1	0.46	AOC2-HP04A	0-1'	2000	5	ND	6.1	AOC2-HP01	2000	0.6 (L)	0.75	1.5	SD-SD-14-0-0.5	2004	---	---	ND	---	---
Calcium	mg/kg	46600	12700	AOC2-SB03A	0-1	2000	46600	34000	AOC2-TP14C	4.5'	2000	NS	494000	573000	AOC2-HP09	2000	---	6700	10500	AOC2-SD8	2000	---	64400	115000	SD-SW13	2004
Chromium	mg/kg	17.5	24.3	SD-TP31AOC2	0.5-0.75'	2004	17.5	24.3	SD-TP31AOC2	0.5-0.75'	2004	50	ND	4.3	AOC2-HP09	2000	26 (L)	22	28.3	SD-SD-13-0-0.5	2004	56.8 - 316 (2) A(C)	1.4	19.1	AOC2-SW6	2000
Cobalt	mg/kg	30	17	AOC2-HP04A	0-1'	2000	30	20.3	AOC2-HP05F & -HP071	10-12' & 16-18'	2000	NS	1.3	46.6	AOC2-HP07	2000	---	14	13.8	AOC2-SD8	2000	5 A(C)	---	5.7	AOC2-SW6	2000
Copper	mg/kg	26.9	41.6	SD-TP31AOC2	0.5-0.75'	2004	26.9	41.8	AOC2-TP07C	4.5'	2000	200	ND	6.8	AOC2-HP01	2000	16 (L)	27.7	38.7	SD-SD-13-0-0.5	2004	7.7 - 21.5 (2) A(C)	2.5	35.4	AOC2-SW8	2000
Iron	mg/kg	25700	32400	SD-TP31AOC2	0.5-0.75'	2004	25700	36300	AOC2-TP03B	2'	2000	300	1260	50100	SD-GW06-AOC2	2004	20000 (L)	25400	33800	AOC2-SD7	2000	300	998	15500	AOC2-SW6	2000
Lead	mg/kg	60.8	76.3	AOC2-HP01A	0-1'	2000	60.8	76.3	AOC2-HP01A	0-1'	2000	---	ND	ND	---	---	31 (L)	20.9	69.9	AOC2-SD5	2000	3.1 - 11.3 (2) A(C)	---	27.2	AOC2-SW6	2000
Magnesium	mg/kg	13100	6460	AOC2-SB01A	0-1'	2000	13100	10200	AOC2-TP07C	4.5'	2000	35000 (G)	228000	407000	SD-GW04-AOC-2	2004	---	5190	6100	AOC2-SD8	2000	---	11500	99200	SD-W-TP27	2004
Manganese	mg/kg	875	669	SD-TP31AOC2	0.5-0.75'	2004	875	1150	AOC2-TP03B	2'	2000	300	1220	2160	AOC2-HP09	2000	460 (L)	647	545	AOC2-SD8	2000	---	691	364	SD-SW13	2004
Mercury	mg/kg	0.1	0.066	AOC2-HP03A	0-1'	2000	0.1	0.066	AOC2-HP03A	0-1'	2000	0.7	ND	0.1	AOC2-HP04	2000	0.15 (L)	0.091	0.18	AOC2-SD5	2000	0.0007	0.093	0.063	AOC2-SW7	2000
Nickel	mg/kg	24.8	32.4	SD-TP31AOC2	0.5-0.75'	2004	24.8	38.1	AOC2-TP14C	4.5'	2000	100	3.9	129	AOC2-HP01	2000	16 (L)	24.5	26.1	AOC2-SD8	2000	44.9 - 124 (2) A(C)	6.2	13.4	AOC2-SW6	2000
Potassium	mg/kg	1660	1750	SD-TP31AOC2	0.5-0.75'	2004	1660	2170	AOC2-HP07I	16-18'	2000	NS	15600	46000	AOC2-HP04	2000	---	1530	1920	SD-SD-13-0-0.5	2004	---	2640	6470	AOC2-SW6	2000
Selenium	mg/kg	2	1.3	SD-TP31AOC2	0.5-0.75'	2004	2	1.6	SD-TP25AOC2	1-2'	2004	---	ND	ND	---	---	---	0.81	2.1	AOC2-SD5	2000	4.6 (2)	---	2.9	AOC2-SW6	2000
Silver	mg/kg	0.17	0.37	AOC2-SB01A	0-1'	2000	0.17	0.37	AOC2-SB01A	0-1'	2000	50	0.4	0.99	AOC2-HP07	2000	1 (L)	0.5	0.77	AOC2-SD5	2000	0.1 (1)	---	0.63	SD-W-TP27	2004
Sodium	mg/kg	619	480	AOC2-SB02A	0-1'	2000	619	5700	AOC2-SB01B	2-4'	2000	20000	62200	278000	AOC2-HP04	2000	---	790	274	SD-SD-10-0-0.5	2004	---	15000	212000	AOC2-SW8	2000
Thallium	mg/kg	0.67	ND	---	---	---	0.67	0.72	AOC2-TP14B	2.5'	2000	---	ND	ND	---	---	---	1.5	1.5	AOC2-SD1	2000	---	---	ND	---	---
Vanadium	mg/kg	150	30	SD-TP31AOC2	0.5-0.75'	2004	150	30	SD-TP31AOC2	0.5-0.75'	2004	NS	ND	11.3	AOC2-HP09	2000	---	28.4	39.3	SD-SD-13-0-0.5	2004	14	3.4	27.7	AOC2-SW6	2000
Zinc	mg/kg	134	83.9	SD-TP31AOC2	0.5-0.75'	2004	134	218	AOC2-TP14B	2.5'	2000	2000 (G)	17.7	13.8	AOC2-HP09	2004	120 (L)	118	407	AOC2-SD6	2000	71.2 - 198 (2) A(C)	22.1	214	AOC2-SW6	2000
DIOXINS																										
Total	µg/kg	1000	0.293	Conglomerate	0-1'	2000	1000	0.293	Conglomerate	0-1'	2000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

(1) - Ionic form.
(2) - Dissolved form.
A(C) - Protection of Fish Propagation.
(G) Guidance Value.
L = Lowest Effect Level (metals) (NYSDEC, 1999).
W = Wildlife Bioaccumulation Criteria (TOC Adjusted) (NYSDEC, 1999).
C = Benthic Aquatic Chronic Criteria (TOC Adjusted) (NYSDEC, 1999).
--- Not available or not applicable.
Concentration above applicable NYSDEC or background criteria.
* - based on average hardness value.
ND Not detected in environmental media.
NS Not sampled.

SECTION A2.3

EXPOSURE ASSESSMENT

A2.3.1 INTRODUCTION

The objective of the exposure assessment is to estimate the type and magnitude of potential exposures to COPCs at the site. The exposure assessment includes identification of potential exposure pathways, receptors, and exposure scenarios, and quantification of exposure. Characterization of the exposure setting and identification of all potentially exposed receptors and exposure pathways are discussed in this section. A conceptual site model (CSM) showing results of the exposure assessment is shown on Figure A2.3.1 at the end of this section. Quantification of exposure involves quantifying the magnitude, frequency, and duration of exposure for the receptors and exposure pathways of concern. Quantification of exposure, including the exposure parameters *(e.g.*, ingestion rate, exposure duration) and the algorithms to quantify the magnitude of exposure and risk, are shown and referenced in the tables in which they are used, Tables A2.9.1 through A2.9.45.

A2.3.2 CONCEPTUAL SITE MODEL

A2.3.2.1 A CSM is an effective tool for defining site dynamics, streamlining risk assessments, establishing exposure hypotheses, and developing appropriate corrective actions. The CSM for AOC 2 is provided in Figure A2.3.1 at the end of this section. CSMs are useful for identifying completed exposure pathways between the contaminated media and potential receptors. The purpose of the CSM is to aid in understanding and describing a site and presents the assumptions regarding:

- Suspected sources and types of contaminants present;
- Contaminant release and transport mechanisms;
- Affected media;
- Potential receptors that could come in contact with site-related contaminants in affected media under current and future land use scenarios; and
- Potential routes of exposure.

A2.3.2.2 A general discussion of sources, release mechanisms, affected media, land uses, environmental transport/exposure media, potential receptors, and potential exposure pathways is provided in the following subsections. Further description of site characterization information is described in the RI and EECA reports.

A2.3.3 SITE HISTORY AND CONTAMINANT SOURCES

A2.3.3.1 AOC 2 is the former Bivouac Area located west of County Route 201. This 40.6-acre parcel was part of the SADVA from its inception (in 1941) until its sale to a private landowner in 1963. Historical information indicates the parcel was used as a transit troop

bivouac area and officer's family housing area in the 1950s and 1960s. After purchasing the property in 1963, the new owners noticed a disposal area (later referred to as the Post Commander's Landfill). The existence of the landfill was subsequently reported to the NYSDEC.

A2.3.3.2 The site background and previous investigations were discussed in detail in Sections 2 and 3 of the Remedial Investigation Report. Much of the site history is based on previous investigation reports and available aerial photographs. This HHRA further summarizes information that is relevant to the exposure assessment.

A2.3.3.3 AOC 2 was agricultural land with farm buildings, open areas, orchards, and a dirt path leading to a 4-acre wooded area until 1943. In a 1943 aerial photo, approximately 1 acre of the wooded area had been cleared. A 1952 aerial photo showed a 0.5-acre excavation that contained a ponded area. Storage containers were not observed. By 1961, the excavation had been backfilled and was almost completely vegetated. A 0.75-acre area north of the original area had been cleared and a building had been constructed. Small circular areas near the loop in the dirt path/road and southwest of the building appear to be disturbed areas. In a 1963 aerial photo, the building was no longer present, the excavated area was being backfilled, and vegetation was encroaching on the cleared area. By 1968, the area was inactive. Three slightly depressed areas were still visible. A small stream ran between the former excavation areas and a wetland to the west. The property was purchased by private individuals on May 31, 1963. The property has been used as a residence and family farm from 1963 through the present.

A2.3.3.4 A 1982 investigation at AOC 2 (USEPA/NUS, 1983) concluded that the residential property may present a public health problem to the Guilderland community. There is unlimited access to the pills, powders, and drums on site. The 1982 investigation also concluded that the contaminants in groundwater at the residential well may impair the groundwater potability of the area. Also, the investigation concluded that during times of high surface water runoff, Black Creek, the receiving surface water body, may receive contaminated runoff from the property.

A2.3.3.5 Numerous investigations have been performed at AOC 2 since initial investigations started in 1982. This RI was initiated in June 2000. The purpose of the RI was to determine the nature and extent of contamination on the property. The analytical results from the RI, in addition to visual observations made during field activities, were used to delineate the lateral and vertical extent of impacted soils, groundwater, sediment and surface water resulting from the waste materials present at the site. Six distinct areas have been identified, each containing a different type of waste material (see Figure A2.3.2 at the end of this section).

A2.3.3.6 Area A is the largest and easternmost delineated area. This area was found to contain pill bottles. Area B, located adjacent to the northwestern corner of Area A, was found to contain tar buckets. Area C, located adjacent to the southwestern corner of Area A and south of Area B, was found to contain the remains of paint cans and dried paint "pucks." Area D, to the west side of Areas B and C, was found to contain an unknown number of drums. The condition of the drums varies, and the contents have not been identified. Area E, located to the north and

west of Area D in a defoliated drainage area, was also found to contain pill bottles. Area F, located in the hardwood wetland area on the eastern portion of the site, north of Area A, was found to contain solvent bottles containing an unidentified liquid. The house on the property is located approximately 1,000 feet east of the disposal area.

A2.3.4 RELEASE MECHANISMS

A2.3.4.1 Chemical release mechanisms and contaminant migration pathways are influenced by specific site conditions. For example, surface topography, hydrology, vegetation, and impermeable surfaces such as pavement will influence surface runoff and leaching. Climate, soil type, and depth to groundwater also affect contaminant leaching. Hydrogeological characteristics, groundwater geochemistry, and chemical-specific characteristics affect the vertical and horizontal extent and rate of dissolved contaminant plume migration. As environmental media at a site become contaminated, they may serve as secondary sources of contamination by acting as reservoirs of chemicals that are slowly released into other media. The RI report provides detailed information on the surface and subsurface conditions at AOC 2 that may affect contaminant release and transport mechanisms (*e.g.*, surface topography, hydrology, geology, and hydrogeology).

A2.3.4.2 At AOC 2, there are numerous sources of contamination. These include pill bottles, tar buckets, lead-based paint residues, solvent-containing drums and jars, and drums and jars containing unknown materials. These sources of contamination have released contaminants into environmental media at the site. Soil is in direct contact with these wastes and has become contaminated. Visible staining of the soil is present at the site. Further contamination of the groundwater, sediment and surface water have occurred over time and may continue to occur if the wastes are not removed. Clean up of the wastes and contaminated soil associated with the wastes will control further environmental contamination, as well as eliminate contact with impacted soils so that the current residential land use of the property can be maintained.

A2.3.5 AFFECTED MEDIA

Affected media at the site include soils, groundwater, sediment, and surface water. The risks associated with each of the affected media were evaluated, but the soils are the primary media of concern at the site. The soils are visibly contaminated and are in direct contact with the wastes. Groundwater, sediment and surface water have also been impacted by the wastes and the waste-contaminated soils. It is expected that clean up of the wastes and contaminated soil would control future groundwater, sediment, and surface water contamination.

A2.3.6 LAND USE SCENARIOS

A2.3.6.1 The former SADVA is located in the Town of Guilderland, New York. According to the 2000 census, the Town of Guilderland has a population of 32,688. In 1980, the population in the Town of Guilderland was 26,515 (USACE, 1999). SADVA is currently zoned industrial, while most properties adjacent to the site are zoned agricultural. According to the 1983 census of agriculture, about 27.2 percent of the area in Albany County was farmed (USACE, 1999). There are also residences occupying the various agricultural parcels. Other properties zoned as

single-family residences are located in the area. Park Guilderland Apartments, an apartment complex which is zoned multi-residential, is located north of the SADVA. A small shopping center, zoned as a large business, is located adjacent to the Park Guilderland Apartments. Tawasentha Park, which is zoned open space, is situated northeast of the SADVA.

A2.3.6.2 AOC 2 was agricultural land until 1941 when it became part of SADVA. In 1963, the land was sold to a private party for use as a residence. The property has remained residential since that time. Currently, the occupants live in the eastern portion of the property. Land use is currently residential and is assumed to remain residential. The house is approximately 1,000 feet east of the disposal area. Fill areas are located west of the barn on the property.

A2.3.7 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS

A2.3.7.1 Potential human receptors are defined as individuals who may contact (*i.e.*, be exposed to) site-related contaminants in environmental media. Consistent with USEPA (1989, 1995) guidance, current and reasonably anticipated land uses were considered in the receptor selection process. The site has been residential since 1963, and for purposes of this HHRA, the site is assumed to remain residential. Residential receptors and exposure pathways are considered to provide a conservative estimate of risk for other receptors and for typical exposure pathways (*i.e.*, non-intrusive workers who perform activities that do not disturb the soil, such as landscape workers, and intrusive workers, such as utility workers excavating an area to repair an underground pipeline).

A2.3.7.2 USEPA (1989) defines an exposure pathway as: "The course a chemical or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (*e.g.*, air) or media (in cases of intermedia transfer) is also included."

A2.3.7.3 A review of potential exposure pathways links the sources, locations, and types of environmental releases with receptor locations and activity patterns to determine the significant pathways of concern. These are discussed below.

Surface Soil Exposure Pathways

A2.3.7.4 Contaminants detected in surface and mixed soils were evaluated in this HHRA. Receptors include the people living at the site. The on-site residents will frequently come in contact with site soils. There is also unlimited access to the property; thus, other persons may infrequently come in contact with the soils. As discussed above, the receptors evaluated in this HHRA are the residents who live at the site. A residential scenario provides a conservative (*i.e.*, most health-protective) estimate of risk for other receptors and typical exposure pathways.

A2.3.7.5 As covered in Section A.2, all surface soil samples were collected at depths from 0 to 1 foot. Therefore, surface soil at the site is defined as soil collected at depths less than 1 foot from the surface and would include exposure pathways with no, or very minor, soil disturbance

(*e.g.*, hiking, general grounds maintenance, planting and gardening in shallow soil). Exposure occurs by direct contact and wind dispersion of contaminants. The pathways evaluated for surface soil include:

- Incidental ingestion of surface soil;
- Dermal contact with surface soil;
- Inhalation of particulates from surface soil; and
- Inhalation of volatiles from surface soil.

A2.3.7.6 Exposure and risk calculations for these pathways are presented in Table A2.9.1 through Table A2.9.12.

Mixed Soil Exposure Pathways

A2.3.7.7 Also as covered in Section A2.2, subsurface samples were collected between depths of 1 and 18 feet. The subsurface sampling results were combined with the surface sampling results to evaluate exposure pathways involving mixed soils (*e.g.*, land development involving excavation activities). The exposure assessment assumes that surface and subsurface soils are mixed during excavation/digging activities, and that potential exposure occurs to contaminants brought to the surface. Thus, the same pathways evaluated for surface soils were also evaluated for mixed soils:

- Incidental ingestion of mixed soil;
- Dermal contact with mixed soil;
- Inhalation of particulates from mixed soil; and
- Inhalation of volatiles from mixed soil.

A2.3.7.8 Exposure and risk calculations for these pathways are presented in Table A2.9.13 through Table A2.9.24.

Groundwater Exposure Pathways

A2.3.7.9 In the past, groundwater was the source of drinking water for the residence at AOC 2 and two residences on neighboring property. Homes northwest, west, and southwest of AOC 2 currently use private wells (Town of Guilderland, 2000). The on-site residence utilized a drinking water well adjacent to the house. The well is no longer in use (EAEST, 1999).

A2.3.7.10 The two private wells located on adjacent property are also no longer in use. One of these wells is located in a farm field just south of the fill area. This property is downgradient from AOC 2. Water from this well was reportedly pumped up the hill to the property owner's well (Rivers, 2000). It was mainly used during dry periods to replenish the well when it was not capable of supplying sufficient quantities of water.

A2.3.7.11 Groundwater was also used in the vicinity of AOC 2 by the Voorheesville Depot for general washing and septic purposes; bottled water was provided for drinking. In addition,

groundwater has been used at the Guilderland Central School for irrigation of school grounds/athletic fields. The school, former SADVA, and most residences in the vicinity of AOC 2 are now on the Town of Guilderland public water supply (Town of Guilderland, 2000). The public water supply system was developed after SADVA operations ended. The public used domestic wells before the water system was installed.

A2.3.7.12 The exposure pathway of concern is the domestic use of groundwater in the area. Although site groundwater is not currently used as a water supply on site, homes northwest, west, and southwest of AOC 2 currently use private wells. In addition, future groundwater use at, or downgradient of, the site is unknown. The pathway evaluated for groundwater in this HHRA is:

- Ingestion of groundwater as a source of drinking water.

A2.3.7.13 Exposure and risk calculations for this pathway are presented in Tables A2.9.25 through A2.9.28. This pathway is considered to have the most impact for the site and is usually the most conservative (health-protective) pathway. Other pathways such as dermal contact while showering and inhalation of volatiles while showering are not expected to be significant for the site.

Sediment Exposure Pathways

A2.3.7.14 Possible receptors for exposure to contaminants in sediment are the on-site residents who could frequently come in contact with the sediments. There is also unlimited access to the property; thus, other persons may infrequently come in contact with the soils. As discussed above, the receptors for this HHRA are the residents who live at the site. A residential scenario provides a conservative (*i.e.*, most health-protective) estimate of risk for other receptors and typical exposure pathways.

A2.3.7.15 The exposure areas on the property include the pond directly behind the landowner's house, the wetland area, drainage areas (including the discolored and visibly stressed drainage way leading from the disposal area toward Black Creek), areas with intermittent ponded water, and areas with contaminated debris or other visual evidence of potential impact. The HHRA evaluates direct exposure to sediment found at AOC 2.

A2.3.7.16 The exposure pathways evaluated for sediment include:

- Incidental ingestion of sediment; and
- Dermal contact with sediment.

A2.3.7.17 The exposure and risk calculations for these pathways are presented in Table A2.9.29 through Table A2.9.36.

Surface Water Exposure Pathways

A2.3.7.18 Exposure pathways evaluated for surface water in this HHRA are similar to the exposure pathways for sediment. Possible receptors are the on-site residents who may frequently

come in contact with surface water. Because of unlimited access to the property; other persons could also infrequently come in contact with surface water at the site. As discussed above, the receptors for this HHRA are the residents who live at the site. A residential scenario provides a conservative (*i.e.*, most health-protective) estimate of risk for other receptors and typical exposure pathways.

A2.3.7.19 The exposure areas on the property include the pond directly behind the landowner's house, the wetland area, and areas with intermittent ponded water. The HHRA evaluates direct exposure to surface water on site.

A2.3.7.20 The surface water exposure pathways include:

- Incidental ingestion of sediment; and
- Dermal contact with sediment.

A2.3.7.21 The exposure and risk calculations for these pathways are presented in Table A2.9.37 through Table A2.9.45.

A2.3.8 EXPOSURE CALCULATIONS

A2.3.8.1 The exposure algorithms and exposure parameters used to estimate exposure to potential human receptors for each of the evaluated exposure routes are presented in the exposure and risk calculation tables in Section 9 (Tables A2.9.1 through A2.9.45). Each table presents the algorithms for the exposure and risk calculations, the exposure parameters used in the calculations and the references for the exposure parameters. The exposure parameters were determined using USEPA recommended values.

A2.3.8.2 Two types of exposure estimates are currently used for HHRAs: reasonable maximum exposure (RME) and central tendency (CT) exposure. The RME is designed to be a measure of "high-end" exposure. More specifically, "high-end" exposure is the use of confidence limits above the 90^{th} percentile of the distribution and average values for all but a few exposure parameters. The most sensitive exposure parameters are identified and the maximum of several of these are used along with average values for the remaining parameters. This approach is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters (such as exposure frequency or averaging time). RME represents the highest exposure that is reasonably expected to occur at a site, but still within the range of possible exposures. CT represents exposure to the average individual, is evaluated for informational purposes in discussing uncertainties, and is generally based on mean (*i.e.*, average) exposure parameters. The RME and CT exposure parameters are provided in Tables A2.9.1 through A2.9.45.

743440 SADVA-CSM.DWG

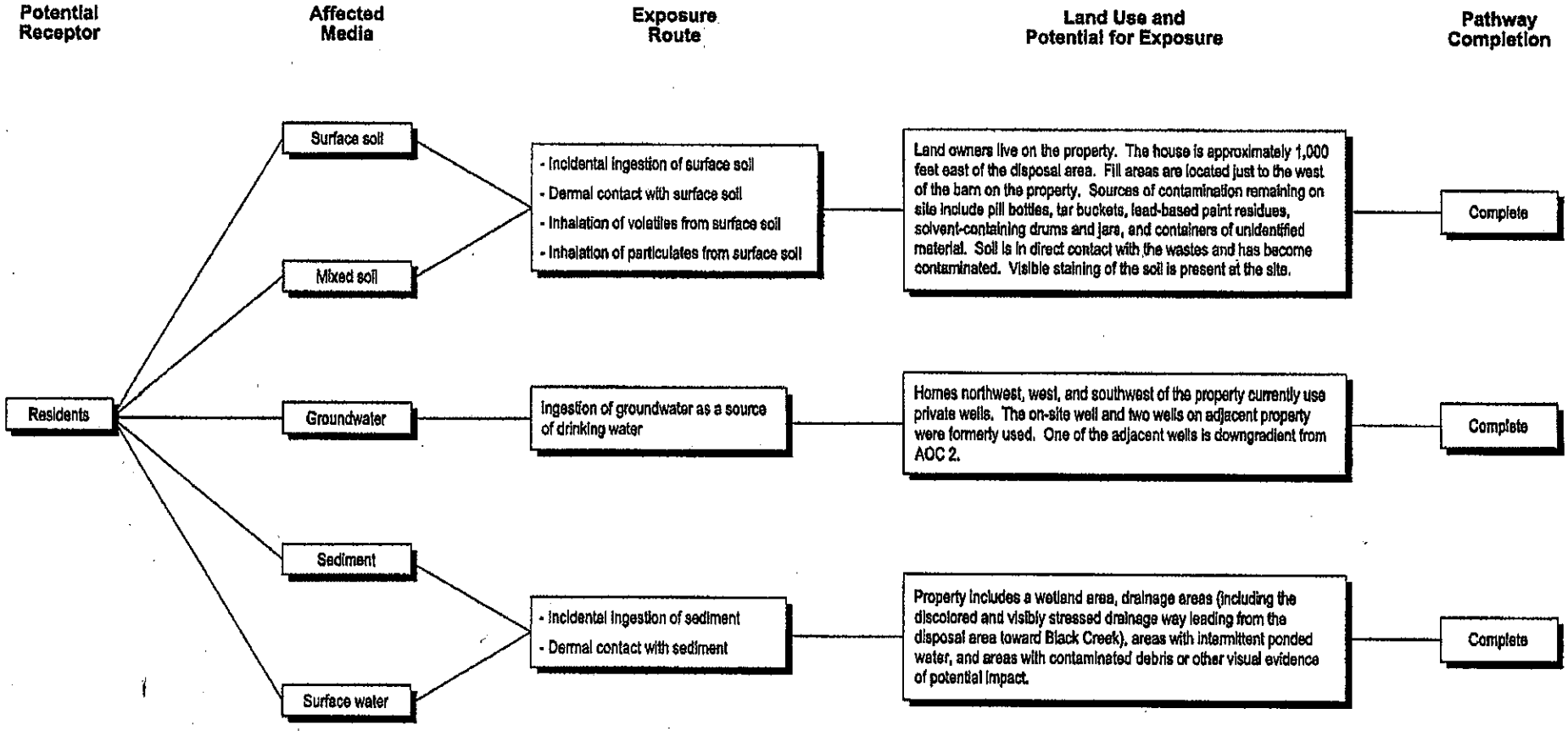
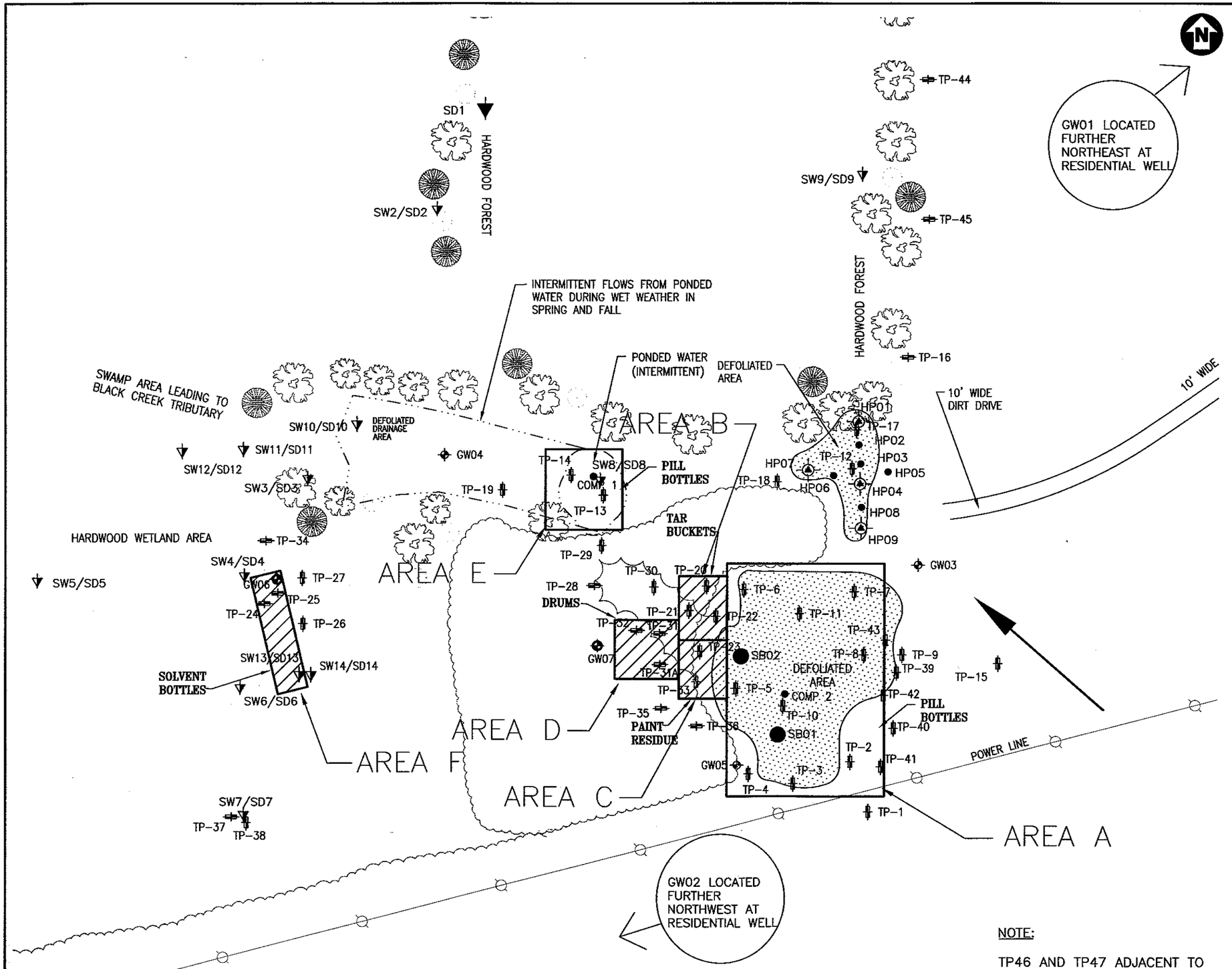
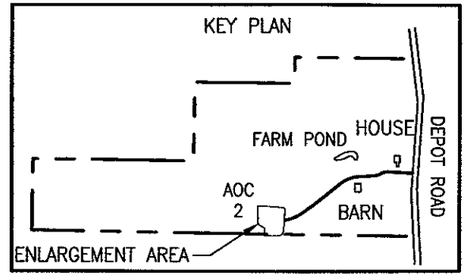


Figure A2.3.1
CONCEPTUAL SITE MODEL FOR POTENTIAL HUMAN EXPOSURE PATHWAYS

PARSONS



KEY PLAN



TP–2	TEST PIT LOCATION
GW03	EXISTING MONITORING WELL LOCATION
GW07	MONITORING WELL LOCATION (INSTALLED NOVEMBER 2004)
COMP 1	SOIL SAMPLE PERFORMED FOR WASTE CHARACTERIZATION
HP02	HYDROPUNCH SOIL BORING
SB01	SOIL BORING
HP03	HYDROPUNCH GROUNDWATER SAMPLE
SW4/SD4	SURFACE WATER AND SEDIMENT SAMPLE LOCATION
SD1	SEDIMENT SAMPLE LOCATION

CO–MINGLED WASTE/SOIL LIMITS TO BE ADDRESSED BY REMEDIAL ALTERNATIVE

DIRECTION OF GROUNDWATER FLOW

60 30 0 60 120

SCALE: 1"=60'

MAP SOURCE: USACE, 1999.

NOTE:

TP46 AND TP47 ADJACENT TO CONCRETE SLAB BELOW SHEDS AND NEAR ROAD. TP48, TP49, AND TP50 NEAR CURRENT BARN.

FIGURE A2.3.2

FORMER SADVA
GUILDERLAND, NEW YORK
AOC 2 – FORMER BIVOUAC AREA/
POST COMMANDER'S LANDFILL
EXTENT OF IMPACTED SOIL

PARSONS
290 ELWOOD DAVIS ROAD, SUITE 312, LIVERPOOL, N.Y. 13088, PHONE: 315–451–9560

P:\736741\WP\AOC2 FOCUSED FS\EECA\FIGURES\736741C009.dwg; 5/18/05; CLW
No XREFs

SECTION A2.4

TOXICITY ASSESSMENT

A2.4.1 To evaluate the cancer risks and noncancer hazards associated with potential exposure to COPCs at a site, the types of health effects that may result from exposure to each COPC and the quantitative relationship between the amount of exposure and the extent of potential effects must be identified. Per USEPA (1989) guidance, the toxicity assessment includes identification of appropriate exposure periods and determination of a carcinogenic/noncarcinogenic toxicity factor. The objectives of the toxicity assessment are to weigh available toxicological evidence regarding the potential for particular chemicals to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood and/or severity of adverse effects (*i.e.*, toxicity factors).

A2.4.2 This HHRA uses the most recently available toxicity factors to calculate cancer risks and noncancer hazards. USEPA (2003) has provided technical and policy recommendations concerning the hierarchy of sources of toxicological information to be used in an HHRA. This HHRA follows these recommendations. The toxicity value hierarchy is as follows:

Tier 1 - USEPA'S Integrated Risk Information System IRIS (USEPA, 2005) on-line database;

Tier 2 - USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) (USEPA, 2005); and

Tier 3 - Other Toxicity Values.

A2.4.3 IRIS is the first tier of the recommended hierarchy. IRIS generally contains reference doses (RfDs), reference concentrations (RfCs), cancer slope factors (CSFs), drinking water unit risk values, and inhalation unit risk values that have undergone a peer review and USEPA consensus review process. IRIS normally represents the official USEPA scientific position regarding the toxicity of the chemical based on the data available at the time of the review.

A2.4.4 PPRTVs represent the second tier of human health toxicity values. PPRTVs have been developed specifically for USEPA's Superfund program. These toxicity values differ in part from IRIS values in that PPRTVs have not received the multi-program consensus review provided for IRIS values. This is because IRIS values are generally intended to be used in all USEPA programs, while PPRTVs are developed specifically for the Superfund Program.

A2.4.5 The third tier includes other sources of information. When using other sources of information, priority should be given to sources that provide toxicity information based on similar methods and procedures as those used for Tier 1 and Tier 2. The sources should be transparent about the methods and processes used to develop the values and the values should be

peer-reviewed and available to the public. USEPA examples of a few of the sources of toxicity values that may be used for Tier 3 include: California EPA (Cal EPA) toxicity values; the Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs); and USEPA's Health Effects Assessment Summary Tables (HEAST).

A2.4.6 All toxicity values used in this HHRA were based on the USEPA's recommended toxicity value hierarchy. The priority among sources of toxicological data includes: (1) IRIS; (2) PPRTV; (3) Cal EPA, and (4) National Center for Exposure Assessment (NCEA). NCEA is used as a Tier 3 source. NCEA values are used by USEPA Region 3 and Region 6 in risk-based concentration tables.

A2.4.7 Table A2.4.1 (found at the end of this section) provides a comprehensive list of all chemicals detected in environmental media at AOC 2 and the toxicity values used for evaluating potential risk. The source of each toxicity value is also given. The table shows the oral cancer slope factor (CSF_o), the oral reference dose (RfD_o), the oral absorption factor (OAF), the unit risk factor (URF), and the reference concentration (RfC). Oral toxicity values reflect administered-dose values, which represent concentrations that will be protective following ingestion. Inhalation toxicity values are representative air concentrations that will be protective following inhalation (24 hours/day). The dermal route of exposure evaluates the toxicity of concentrations of chemicals in the blood (absorbed dose). Therefore, the absorbed-dose concentrations identified for dermal exposure must be compared to toxicity values adjusted for gastrointestinal absorption. Toxicity values adjusted for gastrointestinal absorption are derived by applying OAFs to administered-dose toxicity values.

Table A2.4.1
Toxicity Values for Chemicals of Potential Concern

Preliminary COPC		CAS Number	Toxicity Parameters									
			CSFo $(mg/kg\text{-}d)^{-1}$	Ref.	RfDo (mg/kg-d)	Ref.	OAF (unitless)	Ref.	URF $(\mu g/m^3)^{f/}$	Ref.	RfC $(\mu g/m^3)$	Ref.
Volatile Organic Compounds												
Acetone		67-64-1	--	--	9.00E-01	I	5.00E-01	USEPA, 2004	--	--	--	--
Benzene		71-43-2	5.50E-02	I	4.00E-03	I	1.00E+00	USEPA, 2004	7.80E-06	I	3.00E+01	I
Bromomethane		74-83-9	--	--	1.40E-03	I	1.00E+00	USEPA, 2004	--	--	5.00E+00	I
2-Butanone		78-93-3	--	--	6.00E-01	I	1.00E+00	USEPA, 2004	--	--	5.00E+03	I
Carbon disulfide		75-15-0	--	--	1.00E-01	I	1.00E+00	USEPA, 2004	--	--	7.00E+02	I
Chloroform		67-66-3	3.10E-02	Ca	1.00E-02	I	1.00E+00	USEPA, 2004	2.30E-05	I	4.50E+01	P
1,2-Dichloroethane		107-06-2	9.10E-02	I	2.00E-02	E	1.00E+00	USEPA, 2004	2.60E-05	I	--	--
Ethylbenzene		100-41-4	--	--	1.00E-01	I	1.00E+00	USEPA, 2004	--	--	1.02E+03	I
Toluene		108-88-3	--	--	2.00E-01	I	1.00E+00	USEPA, 2004	--	--	4.00E+02	I
Xylenes (total)		1330-20-7	--	--	2.00E-01	I	1.00E+00	USEPA, 2004	--	--	7.00E+02	x
Semivolatile Organic Compounds												
Butylbenzylphthalate		85-68-7	--	--	2.00E-01	I	1.00E+00	USEPA, 2004	--	--	--	--
4-Chloro-3-methylphenol		35421-8-0	--	--	--	--	1.00E+00	USEPA, 2004	--	--	--	--
bis(2-Ethylhexyl) phthalate		117-81-7	1.40E-02	I	2.00E-02	I	1.00E+00	USEPA, 2004	--	--	--	--
Diethyl phthalate		84-66-2	--	--	8.00E-01	I	1.00E+00	--	--	--	--	--
Di-n-butyl phthalate		84-74-2	--	--	1.00E-01	I	1.00E+00	USEPA, 2004	--	--	--	--
Di-n-octyl phthalate		117-84-0	--	--	4.00E-02	P	1.00E+00	--	--	--	--	--
NPAHs												
2-Methylnaphthalene		91-57-6	--	--	4.00E-03	I	5.80E-01	USEPA, 2004	--	--	--	--
Fluoranthene		206-44-0	--	--	4.00E-02	I	5.80E-01	USEPA, 2004	--	--	--	--
Fluorene		86-73-7	--	--	4.00E-02	I	5.80E-01	--	--	--	--	--
Naphthalene		91-20-3	--	--	2.00E-02	I	5.80E-01	USEPA, 2004	--	--	3.01E+00	I
Phenanthrene	a/	85-01-8	--	--	3.00E-02	I	5.80E-01	USEPA, 2004	--	--	--	--
Phenol		108-95-2	--	--	3.00E-01	I	5.80E-01	USEPA, 2004	--	--	--	--
Pyrene		129-00-0	--	--	3.00E-02	I	5.80E-01	USEPA, 2004	--	--	--	--
Pesticides												
alpha-BHC		319-84-6	6.30E+00	I	--	--	1.00E+00	USEPA, 2004	1.80E-03	I	--	--
delta-BHC	b/	319-86-8	1.00E-01	Ca	3.00E-04	I	1.00E+00	USEPA, 2004	--	--	--	--
gamma-BHC (Lindane)		58-89-9	1.00E-01	Ca	3.00E-04	I	1.00E+00	USEPA, 2004	--	--	--	--
alpha-Chlordane	c/	5103-71-9	3.50E-01	I	5.00E-04	I	8.00E-01	USEPA, 2004	1.00E-04	I	7.00E-01	I
gamma-Chlordane	c/	12789-03-6	3.50E-01	I	5.00E-04	I	8.00E-01	USEPA, 2004	1.00E-04	I	7.00E-01	I
Dieldrin		60-57-1	1.60E+01	I	5.00E-05	I	1.00E+00	USEPA, 2004	4.60E-03	I	--	--
4,4'-DDE		72-55-9	3.40E-01	I	--	--	7.00E-01	USEPA, 2004	--	--	--	--
4,4'-DDD		72-54-8	2.40E-01	I	--	--	7.00E-01	USEPA, 2004	--	--	--	--
4,4'-DDT		50-29-3	3.40E-01	I	5.00E-04	I	7.00E-01	USEPA, 2004	9.71E-05	I	--	--
Endosulfan II	d/	33213-65-9	--	--	6.00E-03	I	1.00E+00	USEPA, 2004	--	--	--	--
Endosulfan sulfate	d/	1031-07-8	--	--	6.00E-03	I	1.00E+00	USEPA, 2004	--	--	--	--
Endrin		72-20-8	--	--	3.00E-04	I	1.00E+00	USEPA, 2004	--	--	--	--
Endrin aldehyde	e/	7421-93-4	--	--	3.00E-04	I	1.00E+00	--	--	--	--	--
Endrin Ketone	e/	53494-70-5	--	--	3.00E-04	I	1.00E+00	USEPA, 2004	--	--	--	--
Heptachlor		76-44-8	4.50E+00	I	5.00E-04	I	1.00E+00	--	1.30E-03	I	--	--
Heptachlor epoxide		1024-57-3	9.10E+00	I	1.30E-05	I	1.00E+00	--	2.60E-03	I	--	--
Methoxychlor		72-43-5	--	--	5.00E-03	I	1.00E+00	--	--	--	--	--
Metals												
Aluminum		7429-90-5	--	--	1.00E+00	P	1.00E+00	USEPA, 2004	--	--	--	--
Antimony		7440-36-0	--	--	4.00E-04	I	1.50E-01	USEPA, 2004	--	--	--	--
Arsenic		744-03-82	1.50E+00	I	3.00E-04	I	9.50E-01	USEPA, 2004	4.31E-03	I	--	--
Barium		7440-39-3	--	--	7.00E-02	I	7.00E-02	USEPA, 2004	--	--	--	--
Beryllium		7440-41-7	--	--	2.00E-03	I	7.00E-03	USEPA, 2004	2.40E-03	I	2.00E-02	I
Cadmium		7440-43-9	--	--	5.00E-04	I	2.50E-02	USEPA, 2004	1.80E-03	I	--	--
Calcium		7440-70-2	--	--	--	--	1.00E+00	USEPA, 2004	--	--	--	--
Chromium	f/	18540-29-9	--	--	3.00E-03	I	2.50E-02	USEPA, 2004	1.20E-02	I	1.00E-01	I
Cobalt		7440-48-4	--	--	2.00E-02	P	1.00E+00	Bast and Borges, 1996	2.80E-03	P	2.00E-02	P
Copper		7440-50-8	--	--	3.71E-02	H	1.00E+00	Bast and Borges, 1996	--	--	--	--
Iron		743-98-96	--	--	3.00E-01	E	1.00E+00	Bast and Borges, 1996	--	--	--	--
Lead		7439-92-1	--	--	--	--	1.00E+00	--	--	--	--	--
Magnesium		7439-95-4	--	--	--	--	1.00E+00	--	--	--	--	--
Manganese		7439-96-5	--	--	1.40E-01	I	4.00E-02	USEPA, 2004	--	--	5.00E-02	I
Mercury		7439-97-6	--	--	3.00E-04	I	7.40E-01	USEPA, 2004	--	--	--	--
Nickel		7440-02-0	--	--	2.00E-02	I	4.00E-02	Bast and Borges, 1996	--	--	--	--
Potassium		7440-9-7	--	--	--	--	1.00E+00	--	--	--	--	--
Selenium		7782-49-2	--	--	5.00E-03	I	3.00E-01	USEPA, 2004	--	--	--	--
Silver		7440-22-4	--	--	5.00E-03	I	4.00E-02	Bast and Borges, 1996	--	--	--	--
Sodium		7440-23-5	--	--	--	--	1.00E+00	--	--	--	--	--
Thallium	g/	7740-28-0	--	--	8.00E-05	I	1.00E+00	USEPA, 2004	--	--	--	--
Vanadium		7440-62-2	--	--	1.00E-03	E	2.60E-02	USEPA, 2004	--	--	--	--
Zinc		7440-66-6	--	--	3.00E-01	I	1.00E+00	Bast and Borges, 1996	--	--	--	--
Dioxins									--	--	--	--
Total	h/		1.50E+05	H	--	--	5.00E-01	USEPA, 2004	3.30E+01	H	--	--

Sources: I = IRIS; H = Heast; P = Provisional Peer Reviewed Toxicity Values; E = NCEA; Ca = California OEHHA; USEPA, 2004 (RAGS E).
CSFo = Cancer Slope Factor, oral; RfDo = Reference Dose, oral; OAF = Oral Absorption Factor.
a/ tox values for pyrene were used.
b/ tox values for gamma BHC (lindane) were used.
c/ tox values for chlordane were used.
d/ tox values for endosulfan were used.
e/ tox values for endrin were used.
f/ tox values for chromium VI were used.
g/ tox values for thallium sulfate were used.
h/ tox values for 2,3,7,8-TCDD were used.

SECTION A2.5

RISK CHARACTERIZATION METHODOLOGY

A2.5.1 INTRODUCTION

The purpose of risk characterization is to: (1) quantitatively estimate the potential for cancer (*i.e.*, risk) and noncancer (*i.e.*, hazard) effects; and (2) assess uncertainties associated with all steps of the risk assessment. To characterize potential carcinogenic effects, the incremental probability of an individual developing cancer over a lifetime was calculated from estimated exposure levels and chemical-specific dose/response information (*i.e.*, carcinogenic toxicity factors). To characterize potential noncarcinogenic effects, comparisons were made between estimated exposure levels of COPCs and their toxicity values. Estimates of cancer risk for carcinogens and hazard quotient (HQ) for noncarcinogens were calculated as described below for each COPC having available toxicity factors. The results of the cancer risk and noncancer hazard calculations are presented in Section A2.6.

A2.5.2 CARCINOGENIC EFFECTS

Carcinogenic risk is expressed as an increased probability of developing cancer as a result of lifetime exposure. For a given COPC and route of exposure, carcinogenic risk was calculated using the following equations.

$$\text{Oral Risk} = \frac{(C)(IR)(EF)(ED)(FI)(CF)(SF_o)}{(BW)(AT_C)(365day/year)}$$

$$\text{Dermal Risk} = \frac{(DA_{event})(EV)(EF)(ED)(SA)(SF_d)}{(BW)(AT_C)(365day/year)}$$

$$\text{Inhalation Risk (Volatiles)} = \frac{(C_{air-VOC})(EF)(ED)(ET)(URF)}{(AT_C)(365day/year)}$$

$$\text{Inhalation Risk (Particulates)} = \frac{(C_{soil})(EF)(ED)(ET)(1/PEF)(URF)}{(AT_C)(365day/year)}$$

Where:

C	=	Chemical concentration (µg/kg soil/sediment, µg/L water);
$C_{air-VOC}$	=	Chemical concentration in ambient air ($\mu g/m^3$);
$SF_{(o,d)}$	=	Slope factor (oral, dermal) $(mg/kg\text{-}day)^{-1}$;
IR	=	Ingestion rate (mg/day soil/sediment, L/day water);
DA_{event}	=	Chemical absorbed dose per event (mg/cm^2-event);
FI	=	Fraction of contaminated media (unitless);

CF = Conversion factor (mg/µg);

BW = Body weight (kg);

SA = Surface area (cm^2);

EF = Exposure frequency (days/year);

ED = Exposure duration (years);

ET = Fraction of EF time breathing air at the site (unitless);

EV = Event frequency (events/day);

AT_c = Averaging time for carcinogens (years);

URF = Inhalation unit risk factor ($\mu g/m^3$); and

PEF = Particulate emission factor (m^3/kg).

A2.5.3 NONCARCINOGENIC EFFECTS

A2.5.3.1 The potential for noncarcinogenic effects was evaluated by comparing the estimated exposure level over a specified time period with noncarcinogenic toxicity factors derived for a similar exposure period. This ratio is termed the HQ, or in other words, the HQ is the ratio of the exposure level to the noncancer toxicity factor. Noncarcinogenic hazard was calculated using the following equations.

$$\text{Oral HQ} = \frac{(C)(IR)(EF)(ED)(FI)(CF)}{(RfD_o)(BW)(AT_C)(365day/year)}$$

$$\text{Dermal HQ} = \frac{(DA_{event})(EV)(EF)(ED)(SA)}{(RfD_d)(BW)(AT_C)(365day/year)}$$

$$\text{Inhalation HQ (Volatiles)} = \frac{(C_{air-VOC})(EF)(ED)(ET)}{(AT_{nc})(365day/year)(RfC)}$$

$$\text{Inhalation HQ (Particulates)} = \frac{(C_{soil})(EF)(ED)(ET)(1/PEF)}{(AT_{nc})(365day/year)(RfC)}$$

Where:

C = Chemical concentration (µg/kg soil/sediment, µg/L water);

$C_{air\text{-}VOC}$ = Chemical concentration in ambient air ($\mu g/m^3$);

$RfD_{(o,d)}$ = Reference dose (oral, dermal) (mg/kg-day);

IR = Ingestion rate (mg/day soil/sediment, L/day water);

DA_{event} = Chemical absorbed dose per event (mg/cm^2-event);

FI = Fraction of contaminated media (unitless);

CF = Conversion factor (mg/µg);

BW = Body weight (kg);

SA = Surface area (cm^2);

EF = Exposure frequency (days/year);

ED = Exposure duration (years);

ET = Fraction of EF time breathing air at the site (unitless);

EV = Event frequency (event/day);

AT_{nc} = Averaging time for noncarcinogens (years);

K = Volatilization factor (L/m^3);

RfC = Inhalation reference concentration ($\mu g/m^3$); and

PEF = Particulate emission factor (m^3/kg).

A2.5.3.2 The HQ approach assumes that there is a level of exposure (*i.e.*, RfD or RfC) below which it is unlikely that even sensitive populations would experience adverse health effects. If the exposure level exceeds the threshold (*i.e.*, if HQ exceeds 1.0), there may be concern for potential noncancer effects. Per USEPA (1989) guidance, the greater the HQ above 1.0, the greater the level of potential concern.

A2.5.4 CUMULATIVE EFFECTS

A2.5.4.1 For simultaneous exposure to several carcinogens via multiple exposure routes, cumulative risk was calculated using the following equation:

$$Risk_T = Risk_1 + Risk_2 + ... + Risk_i$$

Where:

$Risk_T$ = Total cancer risk, expressed as a unitless probability; and

Risk*i* = Risk estimate for the *ith* substance summed across all relevant exposure routes.

A2.5.4.2 To assess the overall potential for noncarcinogenic effects posed by more than one exposure route and more than one chemical (*i.e.*, cumulative hazards from exposure to multiple COPCs via multiple exposure routes), a hazard index (HI) approach has been developed by the USEPA (1989). This approach assumes that simultaneous subthreshold exposures to several chemicals via multiple exposure routes could result in an adverse health effect, while acting on the same target organ. The HI is calculated as follows:

$$HI = HQ_1 + HQ_2 + \ldots + HQ_i$$

Where:

HI = Total exposure hazard index; and

HQi = Hazard quotient for the *ith* toxicant summed across all relevant exposure routes.

A2.5.4.3 Calculation of an HI in excess of 1.0 indicates the potential for adverse health effects. HIs greater than 1.0 will be generated any time estimated exposure for any of the COPCs exceeds its RfD or RfC. If there are two or more COPCs, it is possible to generate a HI greater than 1.0, even if none of the estimated exposure levels for individual COPCs exceed their respective RfDs or RfCs.

SECTION A2.6

RISK CHARACTERIZATION RESULTS

A2.6.1 INTRODUCTION

A2.6.1.1 The primary objective of this HHRA was to quantitatively characterize the human health risk associated with current and reasonably expected future exposure to contaminated media at AOC 2. Site-specific risks and hazards associated with exposure to soils, groundwater, sediment and surface water were quantified for potential current and future residents. As discussed in Section A2.3, all potentially complete exposure pathways for the site were evaluated. The pathways were outlined in Section A2.3 and shown on the CSM (Figure A2.3.1). The results of the risk quantification are presented in this section. The calculations supporting quantification of exposure and risk are provided in Section A9 (Tables A2.9.1 through Table A2.9.45). These tables show the exposure and risk algorithms, the exposure parameters and references, the quantification of risks and hazards, and the main compounds contributing to the risks/hazards.

A2.6.1.2 Tables A2.6.1 and A2.6.2, at the end of this section, provide a summary of the carcinogenic and noncarcinogenic risk for each of the exposure pathways. The cumulative risk estimates and hazard indices for exposure to each of the contaminated media are also shown in Tables A2.6.1 and A2.6.2.

A2.6.2 SUMMARY OF CARCINOGENIC AND NONCARCINOGENIC RISK

Estimated Risks for Surface Soil

A2.6.2.1 As shown in Table A2.6.1, the estimated cumulative RME and CT cancer risks for a resident exposed to surface soil at AOC 2 are 1.6E-04 and 9.7E-06, respectively. The RME risk estimate is above the USEPA recommended risk goal of 1E-04 to 1E-06. The CT estimate is within the range of acceptable risks. The pathway contributing most to the cumulative cancer risk is incidental ingestion of surface soil. This individual pathway presents a risk level exceeding the USEPA's risk goal. The main chemicals contributing to the risk for incidental ingestion are dioxin (79% of risk) and arsenic (21% of risk). The dermal exposure pathway contributes to the estimated cumulative cancer risk to a lesser extent. The main chemicals contributing to risk from dermal exposure are dioxin (88%) and arsenic (12%). Inhalation of volatiles and particulates from surface soil are not major pathways contributing to risk. However, the main chemicals for inhalation of volatiles are benzene (93%) and dieldrin (7%), and the main chemicals for inhalation of particulates are chromium (75%), cobalt (12%), and arsenic (9%).

A2.6.2.2 Estimates of the cumulative noncancer hazards associated with exposure to surface soils for RME and CT are 5.55 and 0.96, respectively. The RME estimate is above the USEPA recommended goal of 1.0 and the CT estimate is nearly 1.0. As shown in Table A2.6.1, the predominant pathway contributing to the noncancer hazard is incidental ingestion of surface soil. This pathway alone is above the recommended goal of 1.0. The major contributors for the

ingestion pathway are: iron (53%), vanadium (15%), arsenic (13%), and aluminum (8%). Dermal contact, inhalation of volatiles and inhalation of particulates are not major pathways contributing to the noncancer hazard. However, the main chemicals for the dermal pathway are arsenic (88%), 2-methylnaphthalene (5%), and cadmium (4%). For inhalation of volatiles, the main chemicals are xylenes (37%), bromomethane (31%), and naphthalene (25%), and for inhalation of particulates, the main chemicals are manganese (92%) and cobalt (6%).

Estimated Risks for Mixed Soil

A2.6.2.3 As shown in Table A2.6.1, the estimated cumulative RME and CT cancer risks for a resident exposed to mixed soils are 1.75E-04 and 1.04E-05, respectively. The RME risk estimate is above the recommended risk goal of 1E-04 to 1E-06. The CT estimate is within the range of acceptable risks. Similar to surface soils, the predominant pathway contributing to the cumulative cancer risk is incidental ingestion. The main chemicals contributing to risk for this pathway include dioxin (74% of risk) and arsenic (26% of risk). The pathways for dermal contact, inhalation of volatiles and inhalation of particulates are not major contributors to risk. However, the main chemicals for the dermal pathway are dioxin (84%) and arsenic (16%). For inhalation of volatiles, 100% of the risk is from benzene. For inhalation of particulates, the main chemicals are chromium (72%), and cobalt (3%).

A2.6.2.4 The RME and CT estimates for cumulative hazards associated with exposure to mixed soils are 6.52 and 1.13, respectively. Both estimates are above the recommended goal of 1.0. As shown in Table A2.6.1, incidental ingestion of mixed soils represents a potential hazard at the site. The major contributors for incidental ingestion are: iron (51%), arsenic (14%), vanadium (13%), and aluminum (7%). The dermal, inhalation of volatiles and inhalation of particulates pathways are not major contributors to the noncancer hazard. However, the main chemicals for the dermal pathway are arsenic (90%), 2-methylnaphthalene (4%), and cadmium (3%). For inhalation of volatiles, the main chemicals are xylenes (37%), bromomethane (31%), and naphthalene (25%), and for inhalation of particulates, the main chemicals are manganese (95%) and cobalt (4%).

Estimated Risks for Groundwater

A2.6.2.5 As shown in Table A2.6.1, the estimated RME and CT cancer risks for ingestion of groundwater as a source of drinking water are 1.23E-05 and 1.5E-06. Both estimates of risk are within the 1E-04 to 1E-06 acceptable risk range. The risk is primarily due to bis(2-ethylhexyl)phthalate (BEHP) (63%), benzene (29%), and 1,2-dichlorathane (1,2-DCA) (8%).

A2.6.2.6 Estimates of the cumulative hazards associated with ingestion of groundwater for RME and CT are 25.7 and 9.97, respectively. Both of these values are considerably higher than the USEPA goal of 1.0 for noncancer hazards. The primary contributor to the noncancer hazard is iron, contributing to 74% of the risk. The other chemicals contributing to risk include manganese (7%), cadmium and vanadium (5% each), and nickel (3%).

Estimated Risks for Sediment

A2.6.2.7 As shown in Table A.6.2, the estimated cumulative RME and CT cancer risks for a resident potentially exposed to sediment are 3.44E-06 and 3.18E-07, respectively. The RME risk estimate is within the range of acceptable risks (1E-04 to 1E-06). The CT estimate is below that range. The predominant pathway contributing to the cumulative cancer risk is incidental ingestion. Dermal contact contributes to a lesser extent. For both of these pathways, 100% of the risk is from arsenic.

A2.6.2.8 The RME and CT estimates for cumulative noncancer hazards associated with exposure to sediments are 0.8 and 0.2, respectively. Both of these values are lower than the USEPA goal of 1.0 for noncancer hazards. Incidental ingestion is the predominant pathway for the cumulative noncancer hazard. The main chemicals for incidental ingestion are: iron (42%), vanadium (15%), aluminum (10%), and arsenic and barium (9% each). The main chemicals for dermal exposure are arsenic (86%) and cadmium (14%).

Estimated Risks for Surface Water

A2.6.2.9 As shown in Table A2.6.2, the estimated cumulative RME and CT cancer risks for a resident exposed to surface water at AOC 2 are 6.46E-06 and 1.87E-06, respectively. The main pathway contributing to risk is incidental ingestion of surface water. The primary chemicals for this pathway are arsenic (92%), BEHP (6%), and dieldrin (1%). The main chemicals for the dermal pathway are BEHP (70%), arsenic (16%), and dieldrin (7%).

A2.6.2.10 Estimates of the cumulative noncancer hazards associated with exposure to surface water for both RME and CT are 0.3. These noncancer hazard estimates are lower than the USEPA goal of 1.0. Incidental ingestion is the predominant pathway for the cumulative noncancer hazard. The main chemicals for incidental ingestion are: arsenic (33%), iron (26%), vanadium (14%), and aluminum (8%). The main chemicals for dermal exposure are vanadium (41%), chromium (20%), and BEHP (19%).

A2.6.3 SITE RISK SUMMARY AND UNCERTAINTIES

A2.6.3.1 The majority of the risk at AOC 2 is due to ingestion of contaminants in the environmental media. The cumulative RME cancer risk and cumulative RME noncarcinogenic hazard are above the acceptable risk range (1E-04 to 1E-06) for the surface soil exposure pathways and the mixed soil exposure pathways. The majority of health risk for these media is from the incidental ingestion pathway. This pathway alone presents an unacceptable cancer and noncancer health risk for both surface soil and mixed soil. For both surface soil and mixed soil, the cancer risk from ingestion is primarily due to dioxin; arsenic also contributed to the risk. Also for both pathways, the noncancer hazard is primarily due to iron; vanadium and arsenic were the two other chemicals contributing most to the hazard. The dermal pathway also contributes to the cancer risk but to a lesser extent. The dermal cancer risk for both surface soil and mixed soils are within the acceptable risk range (*i.e.*, above the lower bound of the risk range). The primary chemical contributing to the dermal cancer risk in both surface and mixed soils is dioxin; arsenic also contributed to the risk.

A2.6.3.2 Ingestion of groundwater also presents a noncarcinogenic hazard at the site. The RME noncancer hazard is above 1.0. The main chemical contributing to this hazard is iron. The cancer risk from ingestion of groundwater is within the acceptable cancer risk range. The main chemical contributing to this risk is BEHP.

A2.6.3.3 Incidental ingestion of contaminants in both sediment and surface water result in cancer risks within the risk range of 1E-04 to 1E-06. Arsenic was the only chemical of concern for these pathways.

A2.6.3.4 All other potential exposure pathways at the site do not pose unacceptable risks or hazards (*i.e.*, the values are below the lower bound of the cancer risk range and below the noncancer hazard value of 1.0).

A2.6.3.5 This HHRA shows unacceptable carcinogenic and noncarcinogenic health risks for AOC 2. The main contaminants of concern are dioxin, arsenic, iron, and vanadium.

A2.6.4 RISK ASSESSMENT UNCERTAINTIES

A2.6.4.1 Iron was found to be a chemical of concern in surface/mixed soils and groundwater. For groundwater, iron exposure contributes up to 74% of the total calculated noncarcinogenic risk. For surface and subsurface soils, iron contributes up to 53% of the risk. There are several sources of uncertainty associated with the use of iron in the HHRA. The hazard quotient calculations for iron used an RfD that is available through the NCEA and published in the USEPA Region 3 and Region 6 risk-based concentration tables. Iron is frequently eliminated from consideration in risk assessments due to the fact that it is an essential nutrient. Following EPA guidance (USEPA, 1989; 2001), essential nutrients that are present at low concentrations and toxic only at very high doses are eliminated from the risk assessment. For this HHRA, iron was above background in surface/mixed soils and groundwater for the site, indicating that sources of iron contamination from the site are possible. Therefore, iron was retained as a contaminant of concern in this HHRA.

A2.6.4.2 Another major contributor to health risk at the site is due to dioxins. None of the individual dioxin sample concentrations exceeded the NYSDEC soil criteria. TEQs were also calculated to further evaluate the dioxin concentrations at each of the sampling locations at the site. The TEQs also did not exceed the NYSDEC criteria. Following this evaluation, NYSDOH determined that dioxins in surface soil do not pose a threat to human health or the environment. It was determined that no further action was necessary based on the levels of dioxins detected at the site, and because no other organic compounds in the samples exceeded NYSDEC soil criteria. However, the dioxin results, along with all other chemicals detected in soils, were included in this HHRA to assess the cumulative risks and hazards from exposure to all of the soil contaminants. In addition, the use of dioxin data in this HHRA, used the maximum detected concentration of each dioxin-like compound and the maximum non-detected value of each dioxin-like compound from all sampling locations to calculate a ½ EDL TEQ. Thus, a very conservative EPC for dioxin was used in the risk calculations.

Table A2.6.1
Summary of Carcinogenic and Noncarcinogenic Risk Estimates
Surface Soil, Mixed Soil, and Groundwater

Exposure Route	Cancer Risk (RME)	Hazard Index (RME [a/])	Cancer Risk (CT)	Hazard Index (CT [b/])
SOIL				
Receptor: Adult Resident				
Surface Soil				
Incidental Ingestion Of Surface Soil	2.62E-05	2.79E-01	2.50E-06	9.13E-02
Dermal Contact With Surface Soil	5.65E-06	5.10E-03	1.54E-07	4.77E-04
Mixed Soil				
Incidental Ingestion Of Mixed Soil	2.81E-05	3.28E-01	2.68E-06	1.07E-01
Dermal Contact With Mixed Soil	5.89E-06	6.66E-03	1.60E-07	6.23E-04
Receptor: Child Resident				
Surface Soil				
Incidental Ingestion Of Surface Soil	1.22E-04	5.21E+00	6.67E-06	8.52E-01
Dermal Contact With Surface Soil	9.24E-06	3.34E-02	4.03E-07	4.37E-03
Mixed Soil				
Incidental Ingestion Of Mixed Soil	1.31E-04	6.12E+00	7.14E-06	1.00E+00
Dermal Contact With Mixed Soil	9.64E-06	4.36E-02	4.20E-07	5.71E-03
Receptor: Resident [c/]				
Surface Soil				
Inhalation of Particulates From Surface Soil	3.01E-08	2.64E-03	5.90E-09	2.22E-04
Inhalation of Volatiles From Surface Soil	5.56E-08	1.70E-02	1.09E-08	1.11E-02
Mixed Soil				
Inhalation of Particulates From Mixed Soil	2.26E-08	3.15E-03	6.21E-09	3.72E-04
Inhalation of Volatiles From Mixed Soil	2.06E-07	1.70E-02	4.04E-08	1.11E-02
Receptor: Resident				
Sum of Surface Soil Exposure Pathways (Cumulative Risk)	**1.63E-04**	**5.55**	**9.74E-06**	**0.96**
Sum of Mixed Soil Exposure Pathways (Cumulative Risk)	**1.75E-04**	**6.52**	**1.04E-05**	**1.13**
GROUNDWATER				
Receptor: Adult Resident				
Ingestion of Groundwater	7.41E-06	7.06E+00	8.79E-07	2.87E+00
Receptor: Child Resident				
Ingestion of Groundwater	4.88E-06	1.86E+01	6.20E-07	7.09E+00
Sum of Groundwater Exposure Pathways	**1.23E-05**	**25.70**	**1.50E-06**	**9.97**

[a/] RME = reasonable maximum exposure.

[b/] CT = central tendency.

[c/] Calculations of risk for inhalation pathways are not age-specific.

Table A2.6.2
Summary of Carcinogenic and Noncarcinogenic Risk Estimates
Sediment and Surface Water

Exposure Route	Cancer Risk (RME)	Hazard Index (RME [a/])	Cancer Risk (CT)	Hazard Index (CT [b/])
SEDIMENT				
Receptor: Adult Resident				
Incidental Ingestion of Sediment	5.73E-07	4.12E-02	8.36E-08	2.06E-02
Dermal Contact With Sediment	1.18E-07	3.55E-03	7.89E-09	7.10E-04
Sum of Exposure Routes	**6.91E-07**	**4.48E-02**	**9.15E-08**	**2.13E-02**
Receptor: Child Resident				
Incidental Ingestion Of Sediment	2.68E-06	7.70E-01	2.23E-07	1.92E-01
Dermal Contact With Sediment	7.23E-08	5.42E-04	3.01E-09	7.74E-05
Sum of Exposure Routes	**2.75E-06**	**7.71E-01**	**2.26E-07**	**1.92E-01**
Receptor: Resident				
Sum of Sediment Exposure Pathways (Cumulative Risk)	**3.44E-06**	**0.8**	**3.18E-07**	**0.2**
SURFACE WATER				
Receptor: Adult Resident				
Incidental Ingestion Of Surface Water	2.51E-06	4.58E-02	7.33E-07	4.58E-02
Dermal Contact With Surface Water	3.36E-07	1.30E-02	9.81E-08	1.30E-02
Sum of Exposure Routes	**2.85E-06**	**5.88E-02**	**8.31E-07**	**5.88E-02**
Receptor: Child Resident				
Incidental Ingestion Of Surface Water	3.42E-06	2.49E-01	9.77E-07	2.14E-01
Dermal Contact With Surface Water	1.93E-07	2.97E-02	6.43E-08	2.97E-02
Sum of Exposure Routes	**3.61E-06**	**2.79E-01**	**1.04E-06**	**2.44E-01**
Receptor: Resident				
Sum of Surface Water Exposure Pathways (Cumulative Risk)	**6.46E-06**	**0.3**	**1.87E-06**	**0.3**

[a/] RME = reasonable maximum exposure.

[b/] CT = central tendency.

SECTION A2.7

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SECTION A2.8

ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ATSDR	Agency for Toxic Substances and Disease Registry
BEHP	Bis(2-ethylhexyl)phthalate
Cal EPA	California EPA
CERCLA	Environmental Response, Compensation, and Liability Act
COPCs	Chemicals of potential concern
CPAHs	Chlorinated polycyclic aromatic hydrocarbons
CSF	Cancer slope factor
CSM	Conceptual site model
CT	Central tendency
DERP-FUDS	Defense Environmental Restoration Program for Formerly Used Defense Sites
DOA	U.S. Department of the Army
DoD	Department of Defense
EPC	Exposure point concentration
FS	Feasibility Study
GSA	U.S. General Services Administration
GURA	Guilderland Urban Renewal Agency
HEAST	Health Effects Assessment Summary Tables
HHRA	Human health risk assessment
MRL	Minimal Risk Level
NCEA	National Center for Exposure Assessment
NEIP	Northeast Industrial Park
NPAHs	Polycyclic aromatic hydrocarbons
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OAF	Oral absorption factor
PCBs	Polychlorinated biphenyls
PPRTVs	Provisional Peer Reviewed Toxicity Values
RAB	Restoration Advisory Board
RAGS	Assessment Guidance for Superfund
RfC	Reference concentration
RfD_o	Oral reference dose
RfDs	Reference doses
RI	Remedial Investigation
RME	Reasonable maximum exposure
SADVA	Schenectady Army Depot, Voorheesville Area
SVOC	Semivolatile organic compound
TEQ	Toxicity equivalent
TOC	Total organic carbon
URF	Unit risk factor
USACE	U.S. Army Corps of Engineers
VOCs	Volatile organic compounds

SECTION A2.9

EXPOSURE AND RISK CALCULATION TABLES

Table A2.9.1
Risk Calculations for Incidental Ingestion of Surface Soil by a Residential Adult
Reasonable Maximum Exposure Scenario

Exposure Assumptions[a/]		
Receptor	Adult Resident: RME Scenario	
COPC Concentration in Soil (C_{soil})	chemical-specific	µg/kg
Soil Ingestion Rate (IR_{soil})	100	mg soil/day
Exposure Frequency (EF)	350	days/yr
Exposure Duration (ED)	24	yr
Fraction Contaminated Soil Ingested (FI)	1	unitless
Conversion Factor (CF)	1.00E-09	kg/µg
Averaging Time, Carcinogens (AT_c)	70	yr
Averaging Time, Noncarcinogens (AT_N)	24	yr
Oral Slope Factor (SF_o)	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Body Weight (BW)	70	kg
Oral Reference Dose (RfD_o)	chemical-specific	mg/kg-day

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)(SF_o)}{(BW)(AT_c)(365 day/year)}$$

Noncarcinogenic:

$$Hazard = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)}{(RfD_o)(BW)(AT_{nc})(365 day/year)}$$

COPC[b/]	CAS Number[c/]	C_{soil} (µg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	RfD_o (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES								
Acetone	67-64-1	2.20E+00	--	9.00E-01	--		3.35E-09	< 1%
Benzene	71-43-2	1.80E+02	5.50E-02	4.00E-03	4.65E-09	< 1%	6.16E-05	< 1%
Bromomethane	74-83-9	2.00E+02	--	1.40E-03	--		1.96E-04	< 1%
Ethylbenzene	100-41-4	4.10E+03	--	1.00E-01	--		5.62E-05	< 1%
Toluene	108-88-3	2.00E+03	--	2.00E-01	--		1.37E-05	< 1%
Xylenes (total)	1330-20-7	8.10E+04	--	2.00E-01	--		5.55E-04	< 1%
SEMIVOLATILES								
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.40E-02	2.00E-02	3.95E-10	< 1%	4.11E-06	< 1%
NPAHs								
2-Methylnaphthalene	91-57-6	7.80E+02	--	4.00E-03	--		2.67E-04	< 1%
Naphthalene	91-20-3	2.30E+03	--	2.00E-02	--		1.58E-04	< 1%
PESTICIDES								
alpha-BHC	319-84-6	1.50E-01	6.30E+00	--	4.44E-10	< 1%	--	
delta-BHC	319-86-8	1.90E-01	1.00E-01	3.00E-04	8.92E-12	< 1%	8.68E-07	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	1.00E-01	3.00E-04	8.92E-12	< 1%	8.68E-07	< 1%
Dieldrin	60-57-1	3.70E-01	1.60E+01	5.00E-05	2.78E-09	< 1%	1.01E-05	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.40E-01	--	2.24E-08	< 1%	--	
Endrin	72-20-8	6.60E-01	--	3.00E-04	--		3.01E-06	< 1%
4,4'-DDD	72-54-8	4.90E+00	2.40E-01	--	5.52E-10	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.40E-01	5.00E-04	8.14E-09	< 1%	1.40E-04	< 1%
Methoxychlor	72-43-5	2.40E+00	--	5.00E-03	--		6.58E-07	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	3.50E-01	5.00E-04	1.00E-10	< 1%	1.67E-06	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	3.50E-01	5.00E-04	6.08E-11	< 1%	1.01E-06	< 1%
METALS								
Aluminum	7429-90-5	1.68E+07	--	1.00E+00	--		2.30E-02	8%
Antimony	7440-36-0	7.30E+02	--	4.00E-04	--		2.50E-03	< 1%
Arsenic	744-03-82	7.80E+03	1.50E+00	3.00E-04	5.50E-06	21%	3.56E-02	13%
Barium	7440-39-3	8.12E+04	--	7.00E-02	--		1.59E-03	< 1%
Beryllium	7440-41-7	1.20E+03	--	2.00E-03	--		8.22E-04	< 1%
Cadmium	7440-43-9	4.60E+02	--	5.00E-04	--		1.26E-03	< 1%
Calcium	7440-70-2	1.27E+07	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	3.00E-03	--		1.11E-02	4%
Cobalt	7440-48-4	1.70E+04	--	2.00E-02	--		1.16E-03	< 1%
Copper	7440-50-8	4.16E+04	--	3.71E-02	--		1.54E-03	< 1%
Iron	743-98-96	3.24E+07	--	3.00E-01	--		1.48E-01	53%
Lead	7439-92-1	7.63E+04	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	1.40E-01	--		6.55E-03	2%
Mercury	7439-97-6	6.60E+01	--	3.00E-04	--		3.01E-04	< 1%
Nickel	7440-02-0	3.24E+04	--	2.00E-02	--		2.22E-03	< 1%
Potassium	7440-9-7	1.75E+06	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	5.00E-03	--		3.56E-04	< 1%
Silver	7440-22-4	3.70E+02	--	5.00E-03	--		1.01E-04	< 1%
Sodium	7440-23-5	4.80E+05	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	1.00E-03	--		4.11E-02	15%
Zinc	7440-66-6	8.39E+04	--	3.00E-01	--		3.83E-04	< 1%
DIOXINS								
Total		2.93E-01	1.50E+05	--	2.07E-05	79%	--	

	Cancer Risk	Hazard Index
Pathway Sums:	2.62E-05	2.79E-01

[a/] Exposure Assumptions

IR = USEPA 1997 (Exposure Factors Handbook)

EF = USEPA 2005 (Region VI Medium Specific Screening Levels), USEPA 1991 (Exposure Factors).

ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)

AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.2
Risk Calculations for Incidental Ingestion of Surface Soil by a Residential Adult
Central Tendency Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Adult Resident: CTE Scenario	
COPC Concentration in Soil (C_{soil})	chemical-specific	µg/kg
Soil Ingestion Rate (IR_{soil})	50	mg soil/day
Exposure Frequency (EF)	229	days/yr
Exposure Duration (ED)	7	yr
Fraction Contaminated Soil Ingested (FI)	1	unitless
Conversion Factor (CF)	1.00E-09	kg/µg
Averaging Time, Carcinogens (AT_c)	70	yr
Averaging Time, Noncarcinogens (AT_N)	7	yr
Oral Slope Factor (SF_o)	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Body Weight (BW)	70	kg
Oral Reference Dose (RfD_o)	chemical-specific	mg/kg-day

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)(SF_o)}{(BW)(AT_c)(365 day/year)}$$

Noncarcinogenic:

$$Hazard = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)}{(RfD_o)(BW)(AT_{nc})(365 day/year)}$$

COPC [b/]	CAS Number [c/]	C_{soil} (µg/L)	SF_o $(mg/kg\text{-}day)^{-1}$	RfD_o (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES								
Acetone	67-64-1	2.20E+00	--	9.00E-01	--		1.10E-09	< 1%
Benzene	71-43-2	1.80E+02	5.50E-02	4.00E-03	4.44E-10	< 1%	2.02E-05	< 1%
Bromomethane	74-83-9	2.00E+02	--	1.40E-03	--		6.40E-05	< 1%
Ethylbenzene	100-41-4	4.10E+03	--	1.00E-01	--		1.84E-05	< 1%
Toluene	108-88-3	2.00E+03	--	2.00E-01			4.48E-06	< 1%
Xylenes (total)	1330-20-7	8.10E+04	--	2.00E-01	--		1.81E-04	< 1%
SEMIVOLATILES								
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.40E-02	2.00E-02	3.76E-11	< 1%	1.34E-06	< 1%
NPAHs								
2-Methylnaphthalene	91-57-6	7.80E+02	--	4.00E-03	--		8.74E-05	< 1%
Naphthalene	91-20-3	2.30E+03	--	2.00E-02	--		5.15E-05	< 1%
PESTICIDES								
alpha-BHC	319-84-6	1.50E-01	6.30E+00	--	4.23E-11	< 1%	--	
delta-BHC	319-86-8	1.90E-01	1.00E-01	3.00E-04	8.51E-13	< 1%	2.84E-07	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	1.00E-01	3.00E-04	8.51E-13	< 1%	2.84E-07	< 1%
Dieldrin	60-57-1	3.70E-01	1.60E+01	5.00E-05	2.65E-10	< 1%	3.32E-06	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.40E-01	--	2.13E-09	< 1%	--	
Endrin	72-20-8	6.60E-01	--	3.00E-04	--		9.86E-07	< 1%
4,4'-DDD	72-54-8	4.90E+00	2.40E-01	--	5.27E-11	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.40E-01	5.00E-04	7.77E-10	< 1%	4.57E-05	< 1%
Methoxychlor	72-43-5	2.40E+00	--	5.00E-03	--		2.15E-07	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	3.50E-01	5.00E-04	9.57E-12	< 1%	5.47E-07	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	3.50E-01	5.00E-04	5.80E-12	< 1%	3.32E-07	< 1%
METALS								
Aluminum	7429-90-5	1.68E+07	--	1.00E+00	--		7.53E-03	8%
Antimony	7440-36-0	7.30E+02	--	4.00E-04	--		8.18E-04	< 1%
Arsenic	744-03-82	7.80E+03	1.50E+00	3.00E-04	5.24E-07	21%	1.17E-02	13%
Barium	7440-39-3	8.12E+04	--	7.00E-02	--		5.20E-04	< 1%
Beryllium	7440-41-7	1.20E+03	--	2.00E-03	--		2.69E-04	< 1%
Cadmium	7440-43-9	4.60E+02	--	5.00E-04	--		4.12E-04	< 1%
Calcium	7440-70-2	1.27E+07	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	3.00E-03	--		3.63E-03	4%
Cobalt	7440-48-4	1.70E+04	--	2.00E-02	--		3.81E-04	< 1%
Copper	7440-50-8	4.16E+04	--	3.71E-02	--		5.02E-04	< 1%
Iron	743-98-96	3.24E+07	--	3.00E-01	--		4.84E-02	53%
Lead	7439-92-1	7.63E+04	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	1.40E-01	--		2.14E-03	2%
Mercury	7439-97-6	6.60E+01	--	3.00E-04	--		9.86E-05	< 1%
Nickel	7440-02-0	3.24E+04	--	2.00E-02	--		7.26E-04	< 1%
Potassium	7440-9-7	1.75E+06	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	5.00E-03	--		1.17E-04	< 1%
Silver	7440-22-4	3.70E+02	--	5.00E-03	--		3.32E-05	< 1%
Sodium	7440-23-5	4.80E+05	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	1.00E-03	--		1.34E-02	15%
Zinc	7440-66-6	8.39E+04	--	3.00E-01	--		1.25E-04	< 1%
DIOXINS					--		--	
Total		2.93E-01	1.50E+05	--	1.97E-06	79%	--	

Pathway Sums:	Cancer Risk	Hazard Index
	2.50E-06	9.13E-02

[a/] Exposure Assumptions
IR = USEPA 1997 (Exposure Factors Handbook)
EF = Represents year-round exposure, excluding December through March due to snow cover.
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.3
Risk Calculations for Dermal Contact with Surface Soil by a Residential Adult
Reasonable Maximum Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Adult Resident: RME Scenario	
COPC Absorbed Dose per Event (DA_{event})	chemical-specific	mg/cm^2-event
Event Frequency (EV)	1	events/day
Exposure Frequency (EF)	350	days/yr
Exposure Duration (ED)	24	yrs
Exposed Body Surface Area (SA)	5700	cm^2
Averaging Time, Carcinogens (AT_c)	70	yrs
Averaging Time, Noncarcinogens (AT_N)	24	yrs
Oral Slope Factor Adjusted for GI Absorption (SF_d) where: $SF_d = SF_{oral}/OAF$	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Body Weight (BW)	70	kg
Oral Reference Dose Adjusted for GI Absorption (RfD_d) where: $RfD_d = RfD_{oral}*OAF$	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Adherence Factor (AF) RME	0.07	(mg/cm^2)
Conversion Factor (CF)	1.00E-09	(kg/µg)
Gastrointestinal (oral) Absorption Fraction (OAF)	chemical-specific (see table A.4.1)	unitless

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(DA_{event})(EV)(EF)(ED)(SA)(SF_d)}{(BW)(AT_c)(365 days/year)}$$

Noncarcinogenic:

$$HQ = \frac{(DA_{event})(EV)(EF)(ED)(SA)}{(RfD_d)(BW)(AT_{nc})(365 days/year)}$$

$$DA_{event} = (AF)(CF)(C_{soil})(ABS_d)$$

Preliminary COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	ABSd (unitless)	DA_{event} (mg/cm^2-event)	SF_d $(mg/kg\text{-}day)^{-1}$	RfD_d (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES										
Acetone	67-64-1	2.20E+00	--	--	--	4.50E-01	--		--	
Benzene	71-43-2	1.80E+02	--	--	5.50E-02	4.00E-03	--		--	
Bromomethane	74-83-9	2.00E+02	--	--	--	1.40E-03	--		--	
Ethylbenzene	100-41-4	4.10E+03	--	--	--	1.00E-01	--		--	
Toluene	108-88-3	2.00E+03	--	--	--	2.00E-01	--		--	
Xylenes (total)	1330-20-7	8.10E+04	--	--	--	2.00E-01	--		--	
SEMIVOLATILES										
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.00E-01	4.20E-10	1.40E-02	2.00E-02	1.57E-10	< 1%	1.64E-06	< 1%
NPAHs										
2-Methylnaphthalene	91-57-6	7.80E+02	1.30E-01	7.098E-09	--	2.32E-03	--		2.39E-04	5%
Naphthalene	91-20-3	2.30E+03	1.30E-01	2.093E-08	--	1.16E-02	--		1.41E-04	3%
PESTICIDES										
alpha-BHC	319-84-6	1.50E-01	4.00E-02	4.2E-13	6.30E+00	--	7.08E-11	< 1%	--	
delta-BHC	319-86-8	1.90E-01	4.00E-02	5.32E-13	1.00E-01	3.00E-04	1.42E-12	< 1%	1.38E-07	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	4.00E-02	5.32E-13	1.00E-01	3.00E-04	1.42E-12	< 1%	1.38E-07	< 1%
Dieldrin	60-57-1	3.70E-01	1.00E-01	2.59E-12	1.60E+01	5.00E-05	1.11E-09	< 1%	4.04E-06	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.00E-02	2.94E-10	4.86E-01	--	3.82E-09	< 1%	--	
Endrin	72-20-8	6.60E-01	--	--	--	3.00E-04	--		--	
4,4'-DDD	72-54-8	4.90E+00	3.00E-02	1.03E-11	3.43E-01	--	9.44E-11	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.00E-02	1.071E-10	4.86E-01	3.50E-04	1.39E-09	< 1%	2.39E-05	< 1%
Methoxychlor	72-43-5	2.40E+00	1.00E-01	1.68E-11	--	5.00E-03	--		2.62E-07	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	4.00E-02	1.708E-12	4.38E-01	4.00E-04	2.00E-11	< 1%	3.33E-07	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	4.00E-02	1.036E-12	4.38E-01	4.00E-04	1.21E-11	< 1%	2.02E-07	< 1%
METALS										
Aluminum	7429-90-5	1.68E+07	--	--	--	--	--		--	
Antimony	7440-36-0	7.30E+02	--	--	--	6.00E-05	--		--	
Arsenic	744-03-82	7.80E+03	3.00E-02	1.638E-08	1.58E+00	2.85E-04	6.92E-07	12%	4.49E-03	88%
Barium	7440-39-3	8.12E+04	--	--	--	4.90E-03	--		--	
Beryllium	7440-41-7	1.20E+03	--	--	--	1.40E-05	--		--	
Cadmium	7440-43-9	4.60E+02	1.00E-03	3.22E-11	--	1.25E-05	--		2.01E-04	4%
Calcium	7440-70-2	1.27E+07	--	--	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	--	--	7.50E-05	--		--	
Cobalt	7440-48-4	1.70E+04	--	--	--	2.00E-02	--		--	
Copper	7440-50-8	4.16E+04	--	--	--	3.71E-02	--		--	
Iron	743-98-96	3.24E+07	--	--	--	3.00E-01	--		--	
Lead	7439-92-1	7.63E+04	--	--	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	--	--	5.60E-03	--		--	
Mercury	7439-97-6	6.60E+01	--	--	--	2.22E-04	--		--	
Nickel	7440-02-0	3.24E+04	--	--	--	8.00E-04	--		--	
Potassium	7440-9-7	1.75E+06	--	--	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	--	--	1.50E-03	--		--	
Silver	7440-22-4	3.70E+02	--	--	--	2.00E-04	--		--	
Sodium	7440-23-5	4.80E+05	--	--	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	--	--	2.60E-05	--		--	
Zinc	7440-66-6	8.39E+04	--	--	--	3.00E-01	--		--	
DIOXINS										
Total		2.93E-01	3.00E-02	6.16E-13	3.00E+05	--	4.95E-06	88%	--	
						Pathway Sums:	Cancer Risk 5.65E-06		Hazard Index 5.10E-03	

[a/] Exposure Assumptions
EV = USEPA 2001 (RAGS E)
EF = USEPA 2005 (Region VI Medium Specific Screening Levels), USEPA 1991 (Exposure Factors).
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
SA = USEPA 2001 (RAGS E).
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
ABS_d = USEPA 2001 (RAGS E), USEPA 2004 (Region VI Human Health Medium Specific Screening Levels).
AF = USEPA 2001 (RAGS E).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.4
Risk Calculations for Dermal Contact with Surface Soil by a Residential Adult
Central Tendency Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Adult Resident: CTE Scenario	
COPC Absorbed Dose per Event (DA_{event})	chemical-specific	mg/cm^2-event
Event Frequency (EV)	1	events/day
Exposure Frequency (EF)	229	days/yr
Exposure Duration (ED)	7	yrs
Exposed Body Surface Area (SA)	5700	cm^2
Averaging Time, Carcinogens (AT_c)	70	yrs
Averaging Time, Noncarcinogens (AT_N)	7	yrs
Oral Slope Factor Adjusted for GI Absorption (SF_d) where: $SF_d = SF_{oral}/OAF$	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Body Weight (BW)	70	kg
Oral Reference Dose Adjusted for GI Absorption (RfD_d) where: $RfD_d = RfD_{oral}$*OAF	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Adherence Factor (AF) CTE	0.01	(mg/cm^2)
Conversion Factor (CF)	1.00E-09	(kg/µg)
Gastrointestinal (oral) Absorption Fraction (OAF)	chemical-specific (see table A.4.1)	unitless

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(DA_{event})(EV)(EF)(ED)(SA)(SF_d)}{(BW)(AT_c)(365 days/year)}$$

Noncarcinogenic:

$$HQ = \frac{(DA_{event})(EV)(EF)(ED)(SA)}{(RfD_d)(BW)(AT_{nc})(365 days/year)}$$

$$DA_{event} = (AF)(CF)(C_{soil})(ABS_d)$$

Preliminary COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	ABSd (unitless)	DA_{event} (mg/cm^2-event)	SF_d $(mg/kg\text{-}day)^{-1}$	RfD_d (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES										
Acetone	67-64-1	2.20E+00	--	--	--	4.50E-01	--		--	
Benzene	71-43-2	1.80E+02	--	--	5.50E-02	4.00E-03	--		--	
Bromomethane	74-83-9	2.00E+02	--	--	--	1.40E-03	--		--	
Ethylbenzene	100-41-4	4.10E+03	--	--	--	1.00E-01	--		--	
Toluene	108-88-3	2.00E+03	--	--	--	2.00E-01	--		--	
Xylenes (total)	1330-20-7	8.10E+04	--	--	--	2.00E-01	--		--	
SEMIVOLATILES										
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.00E-01	6.00E-11	1.40E-02	2.00E-02	4.29E-12	< 1%	1.53E-07	< 1%
NPAHs										
2-Methylnaphthalene	91-57-6	7.80E+02	1.30E-01	1.014E-09	--	2.32E-03	--		2.23E-05	5%
Naphthalene	91-20-3	2.30E+03	1.30E-01	2.99E-09	--	1.16E-02	--		1.32E-05	3%
PESTICIDES										
alpha-BHC	319-84-6	1.50E-01	4.00E-02	6E-14	6.30E+00	--	1.93E-12	< 1%	--	
delta-BHC	319-86-8	1.90E-01	4.00E-02	7.6E-14	1.00E-01	3.00E-04	3.88E-14	< 1%	1.29E-08	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	4.00E-02	7.6E-14	1.00E-01	3.00E-04	3.88E-14	< 1%	1.29E-08	< 1%
Dieldrin	60-57-1	3.70E-01	1.00E-01	3.7E-13	1.60E+01	5.00E-05	3.02E-11	< 1%	3.78E-07	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.00E-02	4.2E-11	4.86E-01	--	1.04E-10	< 1%	--	
Endrin	72-20-8	6.60E-01	--	--	--	3.00E-04	--		--	
4,4'-DDD	72-54-8	4.90E+00	3.00E-02	1.47E-12	3.43E-01	--	2.57E-12	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.00E-02	1.53E-11	4.86E-01	3.50E-04	3.80E-11	< 1%	2.23E-06	< 1%
Methoxychlor	72-43-5	2.40E+00	1.00E-01	2.4E-12	--	5.00E-03	--		2.45E-08	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	4.00E-02	2.44E-13	4.38E-01	4.00E-04	5.45E-13	< 1%	3.12E-08	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	4.00E-02	1.48E-13	4.38E-01	4.00E-04	3.31E-13	< 1%	1.89E-08	< 1%
METALS										
Aluminum	7429-90-5	1.68E+07	--	--	--	--	--		--	
Antimony	7440-36-0	7.30E+02	--	--	--	6.00E-05	--		--	
Arsenic	744-03-82	7.80E+03	3.00E-02	2.34E-09	1.58E+00	2.85E-04	1.89E-08	12%	4.19E-04	88%
Barium	7440-39-3	8.12E+04	--	--	--	4.90E-03	--		--	
Beryllium	7440-41-7	1.20E+03	--	--	--	1.40E-05	--		--	
Cadmium	7440-43-9	4.60E+02	1.00E-03	4.60E-12	--	1.25E-05	--		1.88E-05	4%
Calcium	7440-70-2	1.27E+07	--	--	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	--	--	7.50E-05	--		--	
Cobalt	7440-48-4	1.70E+04	--	--	--	2.00E-02	--		--	
Copper	7440-50-8	4.16E+04	--	--	--	3.71E-02	--		--	
Iron	743-98-96	3.24E+07	--	--	--	3.00E-01	--		--	
Lead	7439-92-1	7.63E+04	--	--	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	--	--	5.60E-03	--		--	
Mercury	7439-97-6	6.60E+01	--	--	--	2.22E-04	--		--	
Nickel	7440-02-0	3.24E+04	--	--	--	8.00E-04	--		--	
Potassium	7440-9-7	1.75E+06	--	--	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	--	--	1.50E-03	--		--	
Silver	7440-22-4	3.70E+02	--	--	--	2.00E-04	--		--	
Sodium	7440-23-5	4.80E+05	--	--	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	--	--	2.60E-05	--		--	
Zinc	7440-66-6	8.39E+04	--	--	--	3.00E-01	--		--	
DIOXINS										
Total		2.93E-01	3.00E-02	8.80E-14	3.00E+05	--	1.35E-07	88%	--	

	Cancer Risk	Hazard Index
Pathway Sums:	1.54E-07	4.77E-04

[a/] Exposure Assumptions
EV = USEPA 2001 (RAGS E)
EF = Represents year-round exposure, excluding December through March due to snow cover.
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
SA = USEPA 2001 (RAGS E).
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
ABS_d = USEPA 2001 (RAGS E), USEPA 2004 (Region VI Human Health Medium Specific Screening Levels).
AF = USEPA 2001 (RAGS E).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.5
Risk Calculations for Incidental Ingestion of Surface Soil by a Residential Child
Reasonable Maximum Exposure Scenario

Exposure Assumptions[a/]		
Receptor	Child Resident: RME Scenario	
COPC Concentration in Soil (C_{soil})	chemical-specific	µg/kg
Soil Ingestion Rate (IR_{soil})	400	mg soil/day
Exposure Frequency (EF)	350	days/yr
Exposure Duration (ED)	6	yr
Fraction Contaminated Soil Ingested (FI)	1	unitless
Conversion Factor (CF)	1.00E-09	kg/µg
Averaging Time, Carcinogens (AT_c)	70	yr
Averaging Time, Noncarcinogens (AT_N)	6	yr
Oral Slope Factor (SF_o)	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Body Weight (BW)	15	kg
Oral Reference Dose (RfD_o)	chemical-specific	mg/kg-day

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)(SF_o)}{(BW)(AT_c)(365 day/year)}$$

Noncarcinogenic:

$$Hazard = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)}{(RfD_o)(BW)(AT_{nc})(365 day/year)}$$

COPC[b/]	CAS Number[c/]	C_{soil} (µg/L)	SF_o $(mg/kg\text{-}day)^{-1}$	RfD_o (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES								
Acetone	67-64-1	2.20E+00	--	9.00E-01	--		6.25E-08	< 1%
Benzene	71-43-2	1.80E+02	5.50E-02	4.00E-03	2.17E-08	< 1%	1.15E-03	< 1%
Bromomethane	74-83-9	2.00E+02	--	1.40E-03	--		3.65E-03	< 1%
Ethylbenzene	100-41-4	4.10E+03	--	1.00E-01	--		1.05E-03	< 1%
Toluene	108-88-3	2.00E+03	--	2.00E-01	--		2.56E-04	< 1%
Xylenes (total)	1330-20-7	8.10E+04	--	2.00E-01	--		1.04E-02	< 1%
SEMIVOLATILES								
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.40E-02	2.00E-02	1.84E-09	< 1%	7.67E-05	< 1%
NPAHs								
2-Methylnaphthalene	91-57-6	7.80E+02	--	4.00E-03	--		4.99E-03	< 1%
Naphthalene	91-20-3	2.30E+03	--	2.00E-02	--		2.94E-03	< 1%
PESTICIDES								
alpha-BHC	319-84-6	1.50E-01	6.30E+00	--	2.07E-09	< 1%	--	
delta-BHC	319-86-8	1.90E-01	1.00E-01	3.00E-04	4.16E-11	< 1%	1.62E-05	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	1.00E-01	3.00E-04	4.16E-11	< 1%	1.62E-05	< 1%
Dieldrin	60-57-1	3.70E-01	1.60E+01	5.00E-05	1.30E-08	< 1%	1.89E-04	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.40E-01	--	1.04E-07	< 1%	--	
Endrin	72-20-8	6.60E-01	--	3.00E-04			5.63E-05	< 1%
4,4'-DDD	72-54-8	4.90E+00	2.40E-01	--	2.58E-09	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.40E-01	5.00E-04	3.80E-08	< 1%	2.61E-03	< 1%
Methoxychlor	72-43-5	2.40E+00	--	5.00E-03	--		1.23E-05	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	3.50E-01	5.00E-04	4.68E-10	< 1%	3.12E-05	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	3.50E-01	5.00E-04	2.84E-10	< 1%	1.89E-05	< 1%
METALS								
Aluminum	7429-90-5	1.68E+07	--	1.00E+00	--		4.30E-01	8%
Antimony	7440-36-0	7.30E+02	--	4.00E-04	--		4.67E-02	< 1%
Arsenic	744-03-82	7.80E+03	1.50E+00	3.00E-04	2.56E-05	21%	6.65E-01	13%
Barium	7440-39-3	8.12E+04	--	7.00E-02	--		2.97E-02	< 1%
Beryllium	7440-41-7	1.20E+03	--	2.00E-03	--		1.53E-02	< 1%
Cadmium	7440-43-9	4.60E+02	--	5.00E-04	--		2.35E-02	< 1%
Calcium	7440-70-2	1.27E+07	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	3.00E-03	--		2.07E-01	4%
Cobalt	7440-48-4	1.70E+04	--	2.00E-02	--		2.17E-02	< 1%
Copper	7440-50-8	4.16E+04	--	3.71E-02	--		2.87E-02	< 1%
Iron	743-98-96	3.24E+07	--	3.00E-01	--		2.76E+00	53%
Lead	7439-92-1	7.63E+04	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	1.40E-01	--		1.22E-01	2%
Mercury	7439-97-6	6.60E+01	--	3.00E-04	--		5.63E-03	< 1%
Nickel	7440-02-0	3.24E+04	--	2.00E-02	--		4.14E-02	< 1%
Potassium	7440-9-7	1.75E+06	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	5.00E-03	--		6.65E-03	< 1%
Silver	7440-22-4	3.70E+02	--	5.00E-03	--		1.89E-03	< 1%
Sodium	7440-23-5	4.80E+05	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	1.00E-03	--		7.67E-01	15%
Zinc	7440-66-6	8.39E+04	--	3.00E-01			7.15E-03	
DIOXINS								
Total		2.93E-01	1.50E+05	--	9.64E-05	79%	--	

	Cancer Risk	Hazard Index
Pathway Sums:	1.22E-04	5.21E+00

[a/] Exposure Assumptions
IR = USEPA 1997 (Exposure Factors Handbook)
EF = USEPA 2005 (Region VI Medium Specific Screening Levels), USEPA 1991 (Exposure Factors).
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.6
Risk Calculations for Incidental Ingestion of Surface Soil by a Residential Child
Central Tendency Exposure Scenario

Exposure Assumptions [a/]			Risk and Hazard Equations
Receptor	Child Resident: CTE Scenario		Carcinogenic:
COPC Concentration in Soil (C_{soil})	chemical-specific	µg/kg	
Soil Ingestion Rate (IR_{soil})	100	mg soil/day	$Risk = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)(SF_o)}{(BW)(AT_c)(365 day/year)}$
Exposure Frequency (EF)	229	days/yr	
Exposure Duration (ED)	2	yr	
Fraction Contaminated Soil Ingested (FI)	1	unitless	
Conversion Factor (CF)	1.00E-09	kg/µg	Noncarcinogenic:
Averaging Time, Carcinogens (AT_c)	70	yr	
Averaging Time, Noncarcinogens (AT_N)	2	yr	
Oral Slope Factor (SF_o)	chemical-specific	$(mg/kg\text{-}day)^{-1}$	$Hazard = \frac{(C_{soil})(IR_{soil})(EF)(ED)(FI)(CF)}{(RfD_o)(BW)(AT_{nc})(365 day/year)}$
Body Weight (BW)	15	kg	
Oral Reference Dose (RfD_o)	chemical-specific	mg/kg-day	

COPC [b/]	CAS Number [c/]	C_{soil} (µg/L)	SF_o $(mg/kg\text{-}day)^{-1}$	RfD_o (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES								
Acetone	67-64-1	2.20E+00	--	9.00E-01	--		1.02E-08	< 1%
Benzene	71-43-2	1.80E+02	5.50E-02	4.00E-03	1.18E-09	< 1%	1.88E-04	< 1%
Bromomethane	74-83-9	2.00E+02	--	1.40E-03	--		5.98E-04	< 1%
Ethylbenzene	100-41-4	4.10E+03	--	1.00E-01	--		1.71E-04	< 1%
Toluene	108-88-3	2.00E+03	--	2.00E-01	--		4.18E-05	< 1%
Xylenes (total)	1330-20-7	8.10E+04	--	2.00E-01	--		1.69E-03	< 1%
SEMIVOLATILES								
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.40E-02	2.00E-02	1.00E-10	< 1%	1.25E-05	< 1%
NPAHs								
2-Methylnaphthalene	91-57-6	7.80E+02	--	4.00E-03	--		8.16E-04	< 1%
Naphthalene	91-20-3	2.30E+03	--	2.00E-02	--		4.81E-04	< 1%
PESTICIDES								
alpha-BHC	319-84-6	1.50E-01	6.30E+00	--	1.13E-10	< 1%	--	
delta-BHC	319-86-8	1.90E-01	1.00E-01	3.00E-04	2.27E-12	< 1%	2.65E-06	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	1.00E-01	3.00E-04	2.27E-12	< 1%	2.65E-06	< 1%
Dieldrin	60-57-1	3.70E-01	1.60E+01	5.00E-05	7.07E-10	< 1%	3.10E-05	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.40E-01	--	5.69E-09	< 1%	--	
Endrin	72-20-8	6.60E-01	--	3.00E-04	--		9.20E-06	< 1%
4,4'-DDD	72-54-8	4.90E+00	2.40E-01	--	1.41E-10	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.40E-01	5.00E-04	2.07E-09	< 1%	4.27E-04	< 1%
Methoxychlor	72-43-5	2.40E+00	--	5.00E-03	--		2.01E-06	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	3.50E-01	5.00E-04	2.55E-11	< 1%	5.10E-06	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	3.50E-01	5.00E-04	1.55E-11	< 1%	3.10E-06	< 1%
METALS								
Aluminum	7429-90-5	1.68E+07	--	1.00E+00	--		7.03E-02	8%
Antimony	7440-36-0	7.30E+02	--	4.00E-04	--		7.63E-03	< 1%
Arsenic	744-03-82	7.80E+03	1.50E+00	3.00E-04	1.40E-06	21%	1.09E-01	13%
Barium	7440-39-3	8.12E+04	--	7.00E-02	--		4.85E-03	< 1%
Beryllium	7440-41-7	1.20E+03	--	2.00E-03	--		2.51E-03	< 1%
Cadmium	7440-43-9	4.60E+02	--	5.00E-04	--		3.85E-03	< 1%
Calcium	7440-70-2	1.27E+07	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	3.00E-03	--		3.39E-02	4%
Cobalt	7440-48-4	1.70E+04	--	2.00E-02	--		3.56E-03	< 1%
Copper	7440-50-8	4.16E+04	--	3.71E-02	--		4.69E-03	< 1%
Iron	743-98-96	3.24E+07	--	3.00E-01	--		4.52E-01	53%
Lead	7439-92-1	7.63E+04	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	1.40E-01	--		2.00E-02	2%
Mercury	7439-97-6	6.60E+01	--	3.00E-04	--		9.20E-04	< 1%
Nickel	7440-02-0	3.24E+04	--	2.00E-02	--		6.78E-03	< 1%
Potassium	7440-9-7	1.75E+06	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	5.00E-03	--		1.09E-03	< 1%
Silver	7440-22-4	3.70E+02	--	5.00E-03	--		3.10E-04	< 1%
Sodium	7440-23-5	4.80E+05	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	1.00E-03	--		1.25E-01	15%
Zinc	7440-66-6	8.39E+04	--	3.00E-01	--		1.17E-03	< 1%
DIOXINS								
Total		2.93E-01	1.50E+05	--	5.26E-06	79%	--	

	Cancer Risk	Hazard Index
Pathway Sums:	6.67E-06	8.52E-01

[a/] Exposure Assumptions
IR = USEPA 1997 (Exposure Factors Handbook)
EF = Represents year-round exposure, excluding December through March due to snow cover.
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.7
Risk Calculations for Dermal Contact with Surface Soil by a Residential Child
Reasonable Maximum Exposure Scenario

Exposure Assumptions [a/]			Risk and Hazard Equations
Receptor	Child Resident: RME Scenari		Carcinogenic:
COPC Absorbed Dose per Event (DA_{event})	chemical-specific	mg/cm^2-event	$Risk = \frac{(DA_{event})(EV)(EF)(ED)(SA)(SF_d)}{(BW)(AT_c)(365 days/year)}$
Event Frequency (EV)	1	events/day	
Exposure Frequency (EF)	350	days/yr	
Exposure Duration (ED)	6	yrs	
Exposed Body Surface Area (SA)	2800	cm^2	Noncarcinogenic:
Averaging Time, Carcinogens (AT_C)	70	yrs	
Averaging Time, Noncarcinogens (AT_N)	6	yrs	$HQ = \frac{(DA_{event})(EV)(EF)(ED)(SA)}{(RfD_d)(BW)(AT_{nc})(365 days/year)}$
Oral Slope Factor Adjusted for GI Absorption (SF_d)	chemical-specific	$(mg/kg\text{-}day)^{-1}$	
where: $SF_d = SF_{oral}/OAF$			
Body Weight (BW)	15	kg	
Oral Reference Dose Adjusted for GI Absorption (RfD_d)	chemical-specific	$(mg/kg\text{-}day)^{-1}$	
where: $RfD_d = RfD_{oral}*OAF$			
Adherence Factor (AF) RME	0.2	(mg/cm^2)	$DA_{event} = (AF)(CF)(C_{soil})(ABS_d)$
Conversion Factor (CF)	1.00E-09	(kg/µg)	
Gastrointestinal (oral) Absorption Fraction (OAF)	chemical-specific (see table A.4.1	unitless	

Preliminary COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	ABSd (unitless)	DA_{event} (mg/cm^2-event)	SF_d $(mg/kg\text{-}day)^{-1}$	RfD_d (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES										
Acetone	67-64-1	2.20E+00	--	--	--	4.50E-01	--		--	
Benzene	71-43-2	1.80E+02	--	--	5.50E-02	4.00E-03	--		--	
Bromomethane	74-83-9	2.00E+02	--	--	--	1.40E-03	--		--	
Ethylbenzene	100-41-4	4.10E+03	--	--	--	1.00E-01	--		--	
Toluene	108-88-3	2.00E+03	--	--	--	2.00E-01	--		--	
Xylenes (total)	1330-20-7	8.10E+04	--	--	--	2.00E-01	--		--	
SEMIVOLATILES										
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.00E-01	1.2E-09	1.40E-02	2.00E-02	2.58E-10	< 1%	1.07E-05	< 1%
NPAHs										
2-Methylnaphthalene	91-57-6	7.80E+02	1.30E-01	2.028E-08	--	2.32E-03	--		1.56E-03	5%
Naphthalene	91-20-3	2.30E+03	1.30E-01	5.98E-08	--	1.16E-02	--		9.23E-04	3%
PESTICIDES										
alpha-BHC	319-84-6	1.50E-01	4.00E-02	1.2E-12	6.30E+00	--	1.16E-10	< 1%	--	
delta-BHC	319-86-8	1.90E-01	4.00E-02	1.52E-12	1.00E-01	3.00E-04	2.33E-12	< 1%	9.07E-07	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	4.00E-02	1.52E-12	1.00E-01	3.00E-04	2.33E-12	< 1%	9.07E-07	< 1%
Dieldrin	60-57-1	3.70E-01	1.00E-01	7.4E-12	1.60E+01	5.00E-05	1.82E-09	< 1%	2.65E-05	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.00E-02	8.4E-10	4.86E-01	--	6.26E-09	< 1%	--	
Endrin	72-20-8	6.60E-01	--	--	--	3.00E-04	--		--	
4,4'-DDD	72-54-8	4.90E+00	3.00E-02	2.94E-11	3.43E-01	--	1.55E-10	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.00E-02	3.06E-10	4.86E-01	3.50E-04	2.28E-09	< 1%	1.56E-04	< 1%
Methoxychlor	72-43-5	2.40E+00	1.00E-01	4.8E-11	--	5.00E-03	--		1.72E-06	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	4.00E-02	4.88E-12	4.38E-01	4.00E-04	3.28E-11	< 1%	2.18E-06	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	4.00E-02	2.96E-12	4.38E-01	4.00E-04	1.99E-11	< 1%	1.32E-06	< 1%
METALS										
Aluminum	7429-90-5	1.68E+07	--	--	--	--	--		--	
Antimony	7440-36-0	7.30E+02	--	--	--	6.00E-05	--		--	
Arsenic	744-03-82	7.80E+03	3.00E-02	4.68E-08	1.58E+00	2.85E-04	1.13E-06	12%	2.94E-02	88%
Barium	7440-39-3	8.12E+04	--	--	--	4.90E-03	--		--	
Beryllium	7440-41-7	1.20E+03	--	--	--	1.40E-05	--		--	
Cadmium	7440-43-9	4.60E+02	1.00E-03	9.2E-11	--	1.25E-05	--		1.32E-03	4%
Calcium	7440-70-2	1.27E+07	--	--	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	--	--	7.50E-05	--		--	
Cobalt	7440-48-4	1.70E+04	--	--	--	2.00E-02	--		--	
Copper	7440-50-8	4.16E+04	--	--	--	3.71E-02	--		--	
Iron	743-98-96	3.24E+07	--	--	--	3.00E-01	--		--	
Lead	7439-92-1	7.63E+04	--	--	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	--	--	5.60E-03	--		--	
Mercury	7439-97-6	6.60E+01	--	--	--	2.22E-04	--		--	
Nickel	7440-02-0	3.24E+04	--	--	--	8.00E-04	--		--	
Potassium	7440-9-7	1.75E+06	--	--	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	--	--	1.50E-03	--		--	
Silver	7440-22-4	3.70E+02	--	--	--	2.00E-04	--		--	
Sodium	7440-23-5	4.80E+05	--	--	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	--	--	2.60E-05	--		--	
Zinc	7440-66-6	8.39E+04	--	--	--	3.00E-01	--		--	
DIOXINS										
Total		2.93E-01	3.00E-02	1.76E-12	3.00E+05	--	8.10E-06	88%	--	

	Cancer Risk	Hazard Index
Pathway Sums:	9.24E-06	3.34E-02

[a/] Exposure Assumptions
EV = USEPA 2001 (RAGS E).
EF = USEPA 2005 (Region VI Medium Specific Screening Levels), USEPA 1991 (Exposure Factors).
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
SA = USEPA 2001 (RAGS E).
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
ABS_d = USEPA 2001 (RAGS E), USEPA 2004 (Region VI Human Health Medium Specific Screening Levels).
AF = USEPA 2001 (RAGS E).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.8
Risk Calculations for Dermal Contact with Surface Soil by a Residential Child
Central Tendency Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Child Resident: CTE Scenario	
COPC Absorbed Dose per Event (DA_{event})	chemical-specific	mg/cm^2-event
Event Frequency (EV)	1	events/day
Exposure Frequency (EF)	229	days/yr
Exposure Duration (ED)	2	yrs
Exposed Body Surface Area (SA)	2800	cm^2
Averaging Time, Carcinogens (AT_c)	70	yrs
Averaging Time, Noncarcinogens (AT_N)	2	yrs
Oral Slope Factor Adjusted for GI Absorption (SF_d) where: $SF_d = SF_{oral}/OAF$	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Body Weight (BW)	15	kg
Oral Reference Dose Adjusted for GI Absorption (RfD_d) where: $RfD_d = RfD_{oral}*OAF$	chemical-specific	$(mg/kg\text{-}day)^{-1}$
Adherence Factor (AF) CTE	0.04	(mg/cm^2)
Conversion Factor (CF)	1.00E-09	(kg/µg)
Gastrointestinal (oral) Absorption Fraction (OAF)	chemical-specific (see table A.4.1)	unitless

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(DA_{event})(EV)(EF)(ED)(SA)(SF_d)}{(BW)(AT_c)(365 days/year)}$$

Noncarcinogenic:

$$HQ = \frac{(DA_{event})(EV)(EF)(ED)(SA)}{(RfD_d)(BW)(AT_{nc})(365 days/year)}$$

$$DA_{event} = (AF)(CF)(C_{soil})(ABS_d)$$

Preliminary COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	ABSd (unitless)	DA_{event} (mg/cm^2-event)	SF_d $(mg/kg\text{-}day)^{-1}$	RfD_d (mg/kg-day)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES										
Acetone	67-64-1	2.20E+00	--	--	--	4.50E-01	--		--	
Benzene	71-43-2	1.80E+02	--	--	5.50E-02	4.00E-03	--		--	
Bromomethane	74-83-9	2.00E+02	--	--	--	1.40E-03	--		--	
Ethylbenzene	100-41-4	4.10E+03	--	--	--	1.00E-01	--		--	
Toluene	108-88-3	2.00E+03	--	--	--	2.00E-01	--		--	
Xylenes (total)	1330-20-7	8.10E+04	--	--	--	2.00E-01	--		--	
SEMIVOLATILES										
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	1.00E-01	2.40E-10	1.40E-02	2.00E-02	1.12E-11	< 1%	1.41E-06	< 1%
NPAHs										
2-Methylnaphthalene	91-57-6	7.80E+02	1.30E-01	4.056E-09	--	2.32E-03	--		2.05E-04	5%
Naphthalene	91-20-3	2.30E+03	1.30E-01	1.196E-08	--	1.16E-02	--		1.21E-04	3%
PESTICIDES										
alpha-BHC	319-84-6	1.50E-01	4.00E-02	2.4E-13	6.30E+00	--	5.06E-12	< 1%	--	
delta-BHC	319-86-8	1.90E-01	4.00E-02	3.04E-13	1.00E-01	3.00E-04	1.02E-13	< 1%	1.19E-07	< 1%
gamma-BHC (Lindane)	58-89-9	1.90E-01	4.00E-02	3.04E-13	1.00E-01	3.00E-04	1.02E-13	< 1%	1.19E-07	< 1%
Dieldrin	60-57-1	3.70E-01	1.00E-01	1.48E-12	1.60E+01	5.00E-05	7.92E-11	< 1%	3.47E-06	< 1%
4,4'-DDE	72-55-9	1.40E+02	3.00E-02	1.68E-10	4.86E-01	--	2.73E-10	< 1%	--	
Endrin	72-20-8	6.60E-01	--	--	--	3.00E-04	--		--	
4,4'-DDD	72-54-8	4.90E+00	3.00E-02	5.88E-12	3.43E-01	--	6.75E-12	< 1%	--	
4,4'-DDT	50-29-3	5.10E+01	3.00E-02	6.12E-11	4.86E-01	3.50E-04	9.95E-11	< 1%	2.05E-05	< 1%
Methoxychlor	72-43-5	2.40E+00	1.00E-01	9.6E-12	--	5.00E-03	--		2.25E-07	< 1%
alpha-Chlordane	5103-71-9	6.10E-01	4.00E-02	9.76E-13	4.38E-01	4.00E-04	1.43E-12	< 1%	2.86E-07	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	4.00E-02	5.92E-13	4.38E-01	4.00E-04	8.67E-13	< 1%	1.73E-07	< 1%
METALS										
Aluminum	7429-90-5	1.68E+07	--	--	--	--	--		--	
Antimony	7440-36-0	7.30E+02	--	--	--	6.00E-05	--		--	
Arsenic	744-03-82	7.80E+03	3.00E-02	9.36E-09	1.58E+00	2.85E-04	4.95E-08	12%	3.85E-03	88%
Barium	7440-39-3	8.12E+04	--	--	--	4.90E-03	--		--	
Beryllium	7440-41-7	1.20E+03	--	--	--	1.40E-05	--		--	
Cadmium	7440-43-9	4.60E+02	1.00E-03	1.84E-11	--	1.25E-05	--		1.72E-04	4%
Calcium	7440-70-2	1.27E+07	--	--	--	--	--		--	
Chromium	18540-29-9	2.43E+04	--	--	--	7.50E-05	--		--	
Cobalt	7440-48-4	1.70E+04	--	--	--	2.00E-02	--		--	
Copper	7440-50-8	4.16E+04	--	--	--	3.71E-02	--		--	
Iron	743-98-96	3.24E+07	--	--	--	3.00E-01	--		--	
Lead	7439-92-1	7.63E+04	--	--	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	--	--	5.60E-03	--		--	
Mercury	7439-97-6	6.60E+01	--	--	--	2.22E-04	--		--	
Nickel	7440-02-0	3.24E+04	--	--	--	8.00E-04	--		--	
Potassium	7440-9-7	1.75E+06	--	--	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	--	--	1.50E-03	--		--	
Silver	7440-22-4	3.70E+02	--	--	--	2.00E-04	--		--	
Sodium	7440-23-5	4.80E+05	--	--	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	--	--	2.60E-05	--		--	
Zinc	7440-66-6	8.39E+04	--	--	--	3.00E-01	--		--	
DIOXINS										
Total		2.93E-01	3.00E-02	3.52E-13	3.00E+05	--	3.53E-07	88%	--	
						Pathway Sums:	Cancer Risk 4.03E-07		Hazard Index 4.37E-03	

[a/] Exposure Assumptions
EV = USEPA 2001 (RAGS E)
EF = Represents year-round exposure, excluding December through March due to snow cover.
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
SA = USEPA 2001 (RAGS E).
AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).
ABS_d = USEPA 2001 (RAGS E), USEPA 2004 (Region VI Human Health Medium Specific Screening Levels).
AF = USEPA 2001 (RAGS E).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.9
Risk Calculations for Inhalation of Volatiles from Surface Soil by a Resident
Reasonable Maximum Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Adult Resident: RME Scenario	
COPC Concentration in Ambient Air Due to Volatile ($C_{air-VOC}$)	chemical-specific	µg/m³
Fraction of EF in Contact with Soil (ET)	0.25	unitless
Exposure Frequency (EF)	350	days/yr
Exposure Duration (ED)	30	yr
Averaging Time, Carcinogens (AT_C)	70	yr
Averaging Time, Noncarcinogens (AT_{NC})	30	yr
Inhalation Unit Risk Factor (URF)	chemical-specific	(µg/m3)$^{-1}$
Inhalation Reference Concentration (RfC)	chemical-specific	µg/m³
Volatilization Factor (VF)	chemical-specific	µg/kg

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(C_{air-VOC})(EF)(ED)(ET)(URF)}{(AT_c)(365 days/year)}$$

Noncarcinogenic:

$$Hazard = \frac{(C_{air-VOC})(EF)(ED)(ET)}{(AT_{nc})(365 days/year)(RFC)}$$

$$C_{air-VOC} = \frac{C_{soil}}{VF}$$

COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	VF (µg/kg)	URF (µg/m3)	RfC (µg/m3)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES									
Acetone	67-64-1	2.20E+00	1.30E+04	--	--	--		--	
Benzene	71-43-2	1.80E+02	2.80E+03	7.80E-06	3.00E+01	5.15E-08	93%	5.14E-04	3%
Bromomethane	74-83-9	2.00E+02	1.80E+03	--	5.00E+00	--		5.33E-03	31%
Ethylbenzene	100-41-4	4.10E+03	4.20E+03	--	1.02E+03	--		2.31E-04	1%
Toluene	108-88-3	2.00E+03	3.60E+03	--	4.00E+02	--		3.33E-04	2%
Xylenes (total)	1330-20-7	8.10E+04	4.40E+03	--	7.00E+02	--		6.30E-03	37%
SEMIVOLATILES									
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	--	--	--	--		--	
NPAHs									
2-Methylnaphthalene	91-57-6	7.80E+02	--	--	--	--		--	
Naphthalene	91-20-3	2.30E+03	4.30E+04	--	3.01E+00	--		4.26E-03	25%
PESTICIDES									
alpha-BHC	319-84-6	1.50E-01	--	1.80E-03	--	--		--	
delta-BHC	319-86-8	1.90E-01	2.70E+07	--	--	--		--	
gamma-BHC (Lindane)	58-89-9	1.90E-01	--	--	--	--		--	
Dieldrin	60-57-1	3.70E-01	4.30E+04	4.60E-03	--	4.07E-09	7%	--	
4,4'-DDE	72-55-9	1.40E+02	--	--	--	--		--	
Endrin	72-20-8	6.60E-01	3.10E+06	--	--	--		--	
4,4'-DDD	72-54-8	4.90E+00	3.10E+06	--	--	--		--	
4,4'-DDT	50-29-3	5.10E+01	--	9.71E-05	--	--		--	
Methoxychlor	72-43-5	2.40E+00	--	--	--	--		--	
alpha-Chlordane	5103-71-9	6.10E-01	--	1.00E-04	7.00E-01	--		--	
gamma-Chlordane	12789-03-6	3.70E-01	--	1.00E-04	7.00E-01	--		--	
					Pathway Sums:	Cancer Risk 5.56E-08		Hazard Index 1.70E-02	

[a/] Exposure Assumptions

EF = USEPA 2005 (Region VI Medium Specific Screening Levels), USEPA 1991 (Exposure Factors).

ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)

AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.10
Risk Calculations for Inhalation of Volatiles from Surface Soil by a Resident
Central Tendency Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Adult Resident: RME Scenario	
COPC Concentration in Ambient Air Due to Volatile ($C_{air-VOC}$)	chemical-specific	µg/m^3
Fraction of EF in Contact with Soil (ET)	0.25	unitless
Exposure Frequency (EF)	229	days/yr
Exposure Duration (ED)	9	yr
Averaging Time, Carcinogens (AT_c)	70	yr
Averaging Time, Noncarcinogens (AT_{NC})	9	yr
Inhalation Unit Risk Factor (URF)	chemical-specific	(µg/m^3)$^{-1}$
Inhalation Reference Concentration (RfC)	chemical-specific	µg/m^3
Volatilization Factor (VF)	chemical-specific	µg/kg

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(C_{air-VOC})(EF)(ED)(ET)(URF)}{(AT_c)(365 days/year)}$$

Noncarcinogenic:

$$Hazard = \frac{(C_{air-VOC})(EF)(ED)(ET)}{(AT_{nc})(365 days/year)(RFC)}$$

$$C_{air-VOC} = \frac{C_{soil}}{VF}$$

COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	VF (µg/kg)	URF (µg/m^3)	RfC (µg/m^3)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES									
Acetone	67-64-1	2.20E+00	1.30E+04	--	--	--		--	
Benzene	71-43-2	1.80E+02	2.80E+03	7.80E-06	3.00E+01	1.01E-08	93%	3.36E-04	3%
Bromomethane	74-83-9	2.00E+02	1.80E+03	--	5.00E+00	--		3.49E-03	31%
Ethylbenzene	100-41-4	4.10E+03	4.20E+03	--	1.02E+03	--		1.51E-04	1%
Toluene	108-88-3	2.00E+03	3.60E+03	--	4.00E+02	--		2.18E-04	2%
Xylenes (total)	1330-20-7	8.10E+04	4.40E+03	--	7.00E+02	--		4.12E-03	37%
SEMIVOLATILES									
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	--	--	--	--		--	
NPAHs									
2-Methylnaphthalene	91-57-6	7.80E+02	--	--	--	--		--	
Naphthalene	91-20-3	2.30E+03	4.30E+04	--	3.01E+00	--		2.79E-03	25%
PESTICIDES									
alpha-BHC	319-84-6	1.50E-01	--	1.80E-03	--	--		--	
delta-BHC	319-86-8	1.90E-01	2.70E+07	--	--	--		--	
gamma-BHC (Lindane)	58-89-9	1.90E-01	--	--	--	--		--	
Dieldrin	60-57-1	3.70E-01	4.30E+04	4.60E-03	--	7.98E-10	7%	--	
4,4'-DDE	72-55-9	1.40E+02	--	--	--	--		--	
Endrin	72-20-8	6.60E-01	3.10E+06	--	--	--		--	
4,4'-DDD	72-54-8	4.90E+00	3.10E+06	--	--	--		--	
4,4'-DDT	50-29-3	5.10E+01	--	9.71E-05	--	--		--	
Methoxychlor	72-43-5	2.40E+00	--	--	--	--		--	
alpha-Chlordane	5103-71-9	6.10E-01	--	1.00E-04	7.00E-01	--		--	
gamma-Chlordane	12789-03-6	3.70E-01	--	1.00E-04	7.00E-01	--		--	
					Pathway Sums:	Cancer Risk 1.09E-08		Hazard Index 1.11E-02	

[a/] Exposure Assumptions

EF = Represents year-round exposure, excluding December through March due to snow cover.

ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)

AT_c = USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

AT_N = AT for noncarcinogens is equal to ED, USEPA 1991 (RAGS Part C, Risk Evaluation of Remedial Alternatives).

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.11
Risk Calculations for Inhalation of Particulates from Surface Soil by a Resident
Reasonable Maximum Exposure Scenario

Exposure Assumptions [a/]		Risk and Hazard Equations
Receptor	Resident: RME Scenaric	Carcinogenic:
COPC Concentration in Soil (C_{soil})	chemical-specific µg/kg	
Fraction of EF in Contact with Soil (ET)	0.25 unitless	$Risk = \frac{(C_{soil})(EF)(ED)(ET)(1/PEF)(URF)}{(AT_c)(365day/year)}$
Exposure Frequency (EF)	350 days/yr	
Exposure Duration (ED)	30 yr	
Averaging Time, Carcinogens (AT_c)	70 yr	
Averaging Time, Noncarcinogens (AT_N)	30 yr	Noncarcinogenic:
Inhalation Slope Factor (SF_i)	chemical-specific $(mg/kg\text{-}day)^{-1}$	
Particulate Emission Factor (PEF)	1.32E+09 (m^3/kg) (default)	$Hazard = \frac{(C_{soil})(EF)(ED)(ET)(1/PEF)}{(AT_{nc})(365day/year)(RfC)}$
Reference Concentration (RfC)	chemical-specific µg/m^3	

COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	URF $(\mu g/m^3)^{-1}$	RfC (µg/m^3)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES								
Acetone	67-64-1	2.20E+00	--	--	--		--	
Benzene	71-43-2	1.80E+02	7.80E-06	3.00E+01	1.09E-13	< 1%	1.09E-09	< 1%
Bromomethane	74-83-9	2.00E+02	--	5.00E+00	--		7.26E-09	< 1%
Ethylbenzene	100-41-4	4.10E+03	--	1.02E+03	--		7.34E-10	< 1%
Toluene	108-88-3	2.00E+03	--	4.00E+02	--		9.08E-10	< 1%
Xylenes (total)	1330-20-7	8.10E+04	--	7.00E+02	--		2.10E-08	< 1%
SEMIVOLATILES								
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	--	--	--		--	
NPAHs								
2-Methylnaphthalene	91-57-6	7.80E+02	--	--	--		--	
Naphthalene	91-20-3	2.30E+03	--	3.01E+00	--		1.39E-07	< 1%
PESTICIDES								
alpha-BHC	319-84-6	1.50E-01	1.80E-03	--	2.10E-14	< 1%	--	
delta-BHC	319-86-8	1.90E-01	--	--	--		--	
gamma-BHC (Lindane)	58-89-9	1.90E-01	--	--	--		--	
Dieldrin	60-57-1	3.70E-01	4.60E-03	--	1.32E-13	< 1%	--	
4,4'-DDE	72-55-9	1.40E+02	--	--	--		--	
Endrin	72-20-8	6.60E-01	--	--	--		--	
4,4'-DDD	72-54-8	4.90E+00			--		--	
4,4'-DDT	50-29-3	5.10E+01	9.71E-05	--	3.86E-13	< 1%	--	
Methoxychlor	72-43-5	2.40E+00	--	--	--		--	
alpha-Chlordane	5103-71-9	6.10E-01	1.00E-04	7.00E-01	4.75E-15	< 1%	1.58E-10	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	1.00E-04	7.00E-01	2.88E-15	< 1%	9.60E-11	< 1%
METALS								
Aluminum	7429-90-5	1.68E+07	--	--	--		--	
Antimony	7440-36-0	7.30E+02	--	--	--		--	
Arsenic	744-03-82	7.80E+03	4.31E-03	--	2.62E-09	9%	--	
Barium	7440-39-3	8.12E+04	--	--	--		--	
Beryllium	7440-41-7	1.20E+03	2.40E-03	2.00E-02	2.24E-10	< 1%	1.09E-05	< 1%
Cadmium	7440-43-9	4.60E+02	1.80E-03	--	6.44E-11	< 1%	--	
Calcium	7440-70-2	1.27E+07	--	--	--		--	
Chromium	18540-29-9	2.43E+04	1.20E-02	1.00E-01	2.27E-08	75%	4.41E-05	2%
Cobalt	7440-48-4	1.70E+04	2.80E-03	2.00E-02	3.70E-09	12%	1.54E-04	6%
Copper	7440-50-8	4.16E+04	--	--	--		--	
Iron	743-98-96	3.24E+07	--	--	--		--	
Lead	7439-92-1	7.63E+04	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	5.00E-02	--		2.43E-03	92%
Mercury	7439-97-6	6.60E+01	--	--	--		--	
Nickel	7440-02-0	3.24E+04	--	--	--		--	
Potassium	7440-9-7	1.75E+06	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	--	--		--	
Silver	7440-22-4	3.70E+02	--	--	--		--	
Sodium	7440-23-5	4.80E+05	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	--	--		--	
Zinc	7440-66-6	8.39E+04	--	--	--		--	
DIOXINS								
Total		2.93E-01	3.30E+01	--	7.53E-10	3%	--	

	Cancer Risk	Hazard Index
Pathway Sums:	3.01E-08	2.64E-03

[a/] Exposure Assumptions
EF = USEPA 2004, RAGS E.
ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)
AT_N = AT for noncarcinogens is equal to ED, USEPA 2002.
PEF = Soil Screening Guidance Users Guide, USEPA 1996a; Soil Screening Guidance Technical Background Document 1996b.

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

-- = data not available.

Table A2.9.12
Risk Calculations for Inhalation of Particulates from Surface Soil by a Resident
Central Tendency Exposure Scenario

Exposure Assumptions [a/]		
Receptor	Resident: RME Scenario	
COPC Concentration in Soil (C_{soil})	chemical-specific	µg/kg
Fraction of EF in Contact with Soil (ET)	0.25	unitless
Exposure Frequency (EF)	229	days/yr
Exposure Duration (ED)	9	yr
Averaging Time, Carcinogens (AT_C)	70	yr
Averaging Time, Noncarcinogens (AT_N)	9	yr
Inhalation Slope Factor (SF_i)	chemical-specific	(mg/kg-day)$^{-1}$
Particulate Emission Factor (PEF)	1.32E+09	(m^3/kg) (default)
Reference Concentration (RfC)	chemical-specific	µg/m^3

Risk and Hazard Equations

Carcinogenic:

$$Risk = \frac{(C_{soil})(EF)(ED)(ET)(1/PEF)(URF)}{(AT_c)(365day/year)}$$

Noncarcinogenic:

$$Hazard = \frac{(C_{soil})(EF)(ED)(ET)(1/PEF)}{(AT_{nc})(365day/year)(RfC)}$$

COPC [b/]	CAS Number [c/]	C_{soil} (µg/kg)	URF (µg/m^3)$^{-1}$	RfC (µg/m^3)	Cancer Risk	% of Total	Hazard Quotient	% of Total
VOLATILES								
Acetone	67-64-1	2.20E+00	--	--	--		--	
Benzene	71-43-2	1.80E+02	7.80E-06	3.00E+01	2.14E-14	< 1%	9.17E-11	< 1%
Bromomethane	74-83-9	2.00E+02	--	5.00E+00	--		6.11E-10	< 1%
Ethylbenzene	100-41-4	4.10E+03	--	1.02E+03	--		6.17E-11	< 1%
Toluene	108-88-3	2.00E+03	--	4.00E+02	--		7.64E-11	< 1%
Xylenes (total)	1330-20-7	8.10E+04	--	7.00E+02	--		1.77E-09	< 1%
SEMIVOLATILES								
bis(2-Ethylhexyl) phthalate	117-81-7	6.00E+01	--	--	--		--	
NPAHs								
2-Methylnaphthalene	91-57-6	7.80E+02	--	--	--		--	
Naphthalene	91-20-3	2.30E+03	--	3.01E+00	--		1.17E-08	< 1%
PESTICIDES								
alpha-BHC	319-84-6	1.50E-01	1.80E-03	--	4.12E-15	< 1%	--	
delta-BHC	319-86-8	1.90E-01	--	--	--		--	
gamma-BHC (Lindane)	58-89-9	1.90E-01	--	--	--		--	
Dieldrin	60-57-1	3.70E-01	4.60E-03	--	2.60E-14	< 1%	--	
4,4'-DDE	72-55-9	1.40E+02	--	--	--		--	
Endrin	72-20-8	6.60E-01	--	--	--		--	
4,4'-DDD	72-54-8	4.90E+00	--	--	--		--	
4,4'-DDT	50-29-3	5.10E+01	9.71E-05	--	7.57E-14	< 1%	--	
Methoxychlor	72-43-5	2.40E+00	--	--	--		--	
alpha-Chlordane	5103-71-9	6.10E-01	1.00E-04	7.00E-01	9.32E-16	< 1%	1.33E-11	< 1%
gamma-Chlordane	12789-03-6	3.70E-01	1.00E-04	7.00E-01	5.65E-16	< 1%	8.08E-12	< 1%
METALS								
Aluminum	7429-90-5	1.68E+07	--	--	--		--	
Antimony	7440-36-0	7.30E+02	--	--	--		--	
Arsenic	744-03-82	7.80E+03	4.31E-03	--	5.14E-10	9%	--	
Barium	7440-39-3	8.12E+04	--	--	--		--	
Beryllium	7440-41-7	1.20E+03	2.40E-03	2.00E-02	4.40E-11	< 1%	9.17E-07	< 1%
Cadmium	7440-43-9	4.60E+02	1.80E-03	--	1.26E-11	< 1%	--	
Calcium	7440-70-2	1.27E+07	--	--	--		--	
Chromium	18540-29-9	2.43E+04	1.20E-02	1.00E-01	4.45E-09	75%	3.71E-06	2%
Cobalt	7440-48-4	1.70E+04	2.80E-03	2.00E-02	7.27E-10	12%	1.30E-05	6%
Copper	7440-50-8	4.16E+04	--	--	--		--	
Iron	743-98-96	3.24E+07	--	--	--		--	
Lead	7439-92-1	7.63E+04	--	--	--		--	
Magnesium	7439-95-4	6.46E+06	--	--	--		--	
Manganese	7439-96-5	6.69E+05	--	5.00E-02	--		2.04E-04	92%
Mercury	7439-97-6	6.60E+01	--	--	--		--	
Nickel	7440-02-0	3.24E+04	--	--	--		--	
Potassium	7440-9-7	1.75E+06	--	--	--		--	
Selenium	7782-49-2	1.30E+03	--	--	--		--	
Silver	7440-22-4	3.70E+02	--	--	--		--	
Sodium	7440-23-5	4.80E+05	--	--	--		--	
Vanadium	7440-62-2	3.00E+04	--	--	--		--	
Zinc	7440-66-6	8.39E+04	--	--	--		--	
DIOXINS								
Total		2.93E-01	3.30E+01	--	1.48E-10	3%	--	
				Pathway Sums:	Cancer Risk 5.90E-09		Hazard Index 2.22E-04	

[a/] Exposure Assumptions

EF = Represents year-round exposure, excluding December through March due to snow cover.

ED = USEPA 1993 (Draft Exposure Factors Handbook for the Central Tendency and Reasonable Maximum Exposure)

AT_N = AT for noncarcinogens is equal to ED, USEPA 2002.

PEF = Soil Screening Guidance Users Guide, USEPA 1996a; Soil Screening Guidance Technical Background Document 1996b.

[b/] Preliminary COPC = preliminary chemical of potential concern.

[c/] CAS = Chemical Abstracts Service number.

Table A2.9.13 Risk Calculations for Incidental Ingestion of Mixed Soil by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.14 Risk Calculations for Incidental Ingestion of Mixed Soil by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.15 Risk Calculations for Dermal Contact with Mixed Soil by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.16 Risk Calculations for Dermal Contact with Mixed Soil by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.17 Risk Calculations for Incidental Ingestion of Mixed Soil by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.18 Risk Calculations for Incidental Ingestion of Mixed Soil by a Residential Child - Central Tendency Exposure Scenario

Table A2.9.19 Risk Calculations for Dermal Contact with Mixed Soil by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.20 Risk Calculations for Dermal Contact with Mixed Soil by a Residential Child - Central Tendency Exposure Scenario

Table A2.9.21 Risk Calculations for Inhalation of Volatiles from Mixed Soil by a Resident - Reasonable Maximum Exposure Scenario

Table A2.9.22 Risk Calculations for Inhalation of Volatiles from Mixed Soil by a Resident - Central Tendency Exposure Scenario

Table A2.9.23 Risk Calculations for Inhalation of Particulates from Mixed Soil by a Resident - Reasonable Maximum Exposure Scenario

Table A2.9.24 Risk Calculations for Inhalation of Particulates from Mixed Soil by a Resident - Central Tendency Exposure Scenario

Table A2.9.25 Risk Calculations for Ingestion of Groundwater by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.26 Risk Calculations for Ingestion of Groundwater by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.27 Risk Calculations for Ingestion of Groundwater by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.28 Risk Calculations for Ingestion of Groundwater by a Residential Child - Central Tendency Exposure Scenario

Table A2.9.29 Risk Calculations for Incidental Ingestion of Sediment by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.30 Risk Calculations for Incidental Ingestion of Sediment by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.31 Risk Calculations for Dermal Contact with Sediment by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.32 Risk Calculations for Dermal Contact with Sediment by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.33 Risk Calculations for Incidental Ingestion of Sediment by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.34 Risk Calculations for Incidental Ingestion of Sediment by a Residential Child - Central Tendency Exposure Scenario

Table A2.9.35 Risk Calculations for Dermal Contact with Sediment by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.36 Risk Calculations for Dermal Contact with Sediment by a Residential Child - Central Tendency Exposure Scenario

Table A2.9.37 Calculation of Dose Absorbed Per Unit Area Per Event (DAevent) - Dermal Contact with Surface Water by a Resident

Table A2.9.38 Risk Calculations for Incidental Ingestion of Surface Water by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.39 Risk Calculations for Incidental Ingestion of Surface Water by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.40 Risk Calculations for Dermal Contact with Surface Water by a Residential Adult - Reasonable Maximum Exposure Scenario

Table A2.9.41 Risk Calculations for Dermal Contact with Surface Water by a Residential Adult - Central Tendency Exposure Scenario

Table A2.9.42 Risk Calculations for Incidental Ingestion of Surface Water by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.43 Risk Calculations for Incidental Ingestion of Surface Water by a Residential Child - Central Tendency Exposure Scenario

Table A2.9.44 Risk Calculations for Dermal Contact with Surface Water by a Residential Child - Reasonable Maximum Exposure Scenario

Table A2.9.45 Risk Calculations for Dermal Contact with Surface Water by a Residential Child - Central Tendency Exposure Scenario