APPENDIX L

SUPPORTING INFORMATION FOR THE HUMAN HEALTH RISK ASSESSMENT AT THE RAMSDELL QUARRY LANDFILL

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TABLES

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ACRONYMS

BCF_{inv}	water-to-tissue bioconcentration factor
BSAF	sediment-to-tissue bioaccumulation factor
BTF	biotransfer factor
COPC	chemical of potential concern
EC	exposure concentration
EPA	U. S. Environmental Protection Agency
EPC	exposure point concentration
foc	fraction organic carbon
HAZWRAP	Hazardous Waste Remedial Actions Program
HHRA	human health risk assessment
K_{ow}	octanol-water partitioning coefficient
RQL	Ramsdell Quarry Landfill
RVAAP	Ravenna Army Ammunition Plant

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L1.0 INTRODUCTION

This appendix includes supporting information for the human health risk assessment (HHRA) at the Ramsdell Quarry Landfill (RQL). Section L2 provides tables that support Chapter 6.0 of the main text (HHRA) and Section L3 documents the process for determining exposure point concentrations (EPCs) that are used in the HHRA for waterfowl.

L2.0 SUPPORTING TABLES FOR HUMAN HEALTH RISK ASSESSMENT

Tables L-1 to L-21 are provided in support of the HHRA for RQL (see Chapter 6.0 of the main text).

L3.0 DETERMINING WATERFOWL CONCENTRATIONS

Numerous waterfowl are harvested and eaten by humans in northeast Ohio, where the Ravenna Army Ammunition Plant (RVAAP) is located. Ohio is in the Mississippi Flyway, and many species of waterfowl migrate through the RVAAP area in the spring and fall (ODNR 2003). Other species breed in the area and are summer residents. A 1993 census of waterfowl at Ravenna found bufflehead, Canada goose, wood duck, hooded merganser, mallard, blue-winged teal, ring-necked duck, American coot, red-breasted merganser, greater scaup, red-headed duck, common goldeneye, Northern shoveler, and American widgeon (ODNR 1993). Several of these species may be hunted at RVAAP.

L3.1 METHODOLOGY FOR CALCULATING TISSUE CONCENTRATIONS IN WATERFOWL

The mallard is used as a representative species of dabbling-type ducks for the development of EPCs for the Hunter/Trapper scenario. According to Tim Morgan, Office of Species Conservation forester, the most likely species hunted at the Ravenna Training and Logistics Site are mallards, wood ducks, and Canadian Geese (Morgan 2003). The goose is primarily herbivorous, while the mallard and wood duck are omnivorous and dabble for seeds, rootlets, tubers of aquatic plants, and aquatic insects, such as snails, small clams, insects, worms, and crustaceans (Ducks Unlimited 2003; EPA 1993a).

To calculate the concentrations of chemicals of potential concern (COPCs) in duck whole-body tissue, biouptake and concentration factors are required for each transfer represented in the exposure model for the duck. The duck is exposed directly and indirectly via the food web to the measured concentrations of COPCs in sediment (Table L-3) and surface water (Table L-4) at RQL at RVAAP. For calculating whole-body concentrations, ducks are assumed to be exposed by the following routes:

- ingestion of aquatic plants that are exposed to surface water, sediment, and sediment porewater;
- ingestion of sediment invertebrates that are exposed to surface water, sediment, and sediment porewater;

Table L-1. COPC Screening for Groundwater at the Ramsdell Quarry Landfill

Chemical	CAS Number	Units	Frequency of Detection	Minimum Detect	Average Result	Maximum Detect	95% UCL of Mean	EPC	Site Background Criteria	Region 9 Tap Water PRG	COPC?
Inorganics											
Aluminum	7429-90-5	mg/L	3 / 6	7.9E-02	1.3E+00	6.1E+00	7.0E+06	6.1E+00	--	3.6E+01	No
Antimony	7440-36-0	mg/L	1 / 6	5.8E-04	2.3E-04	5.8E-04	3.7E-04	3.7E-04	0.0E+00	1.5E-02	No
Arsenic	7440-38-2	mg/L	4 / 6	9.5E-04	2.1E-03	6.8E-03	7.6E-02	6.8E-03	0.0E+00	4.5E-05	Yes
Barium	7440-39-3	mg/L	6 / 6	4.2E-03	2.2E-02	4.5E-02	3.3E-02	3.3E-02	2.6E-01	2.6E+00	No
Beryllium	7440-41-7	mg/L	4 / 6	7.6E-05	1.5E-04	5.7E-04	2.3E-02	5.7E-04	0.0E+00	7.3E-02	No
Cadmium	7440-43-9	mg/L	2 / 6	4.8E-04	2.4E-04	7.0E-04	4.7E-04	4.7E-04	0.0E+00	1.8E-02	No
Calcium	7440-70-2	mg/L	6 / 6	2.0E+01	1.1E+02	4.5E+02	1.5E+03	4.5E+02	5.3E+01	--	No
Cobalt	7440-48-4	mg/L	6 / 6	6.7E-03	2.7E-02	7.0E-02	1.6E-01	7.0E-02	0.0E+00	7.3E-01	No
Copper	7440-50-8	mg/L	3 / 6	2.0E-03	1.6E-03	3.4E-03	2.6E-03	2.6E-03	0.0E+00	1.5E+00	No
Iron	7439-89-6	mg/L	4 / 6	8.2E-03	2.6E+00	7.3E+00	5.1E+00	5.1E+00	1.4E+00	1.1E+01	No
Lead	7439-92-1	mg/L	2 / 6	5.1E-04	3.9E-04	1.3E-03	7.8E-04	7.8E-04	0.0E+00	--	Yes
Magnesium	7439-95-4	mg/L	6 / 6	9.0E+00	2.3E+01	5.7E+01	5.9E+01	5.7E+01	1.5E+01	--	No
Manganese	7439-96-5	mg/L	6 / 6	2.7E-01	2.3E+00	6.2E+00	4.4E+01	6.2E+00	1.3E+00	8.8E-01	Yes
Nickel	7440-02-0	mg/L	6 / 6	1.6E-02	9.0E-02	3.1E-01	1.0E+00	3.1E-01	8.3E-02	7.3E-01	No
Potassium	7440-09-7	mg/L	6 / 6	1.8E+00	3.3E+00	5.0E+00	4.9E+00	4.9E+00	5.8E+00	--	No
Sodium	7440-23-5	mg/L	6 / 6	1.5E+00	7.3E+00	2.3E+01	4.0E+01	2.3E+01	5.1E+01	--	No
Vanadium	7440-62-2	mg/L	1 / 6	1.6E-03	7.7E-04	1.6E-03	1.1E-03	1.1E-03	0.0E+00	3.6E-02	No
Zinc	7440-66-6	mg/L	6 / 6	8.2E-03	1.0E-01	3.1E-01	2.1E+01	3.1E-01	5.2E-02	1.1E+01	No
Organic Volatiles											
Carbon Disulfide	75-15-0	mg/L	6 / 6	6.6E-04	2.7E-03	7.9E-03	1.8E-02	7.9E-03	--	1.0E+00	No

COPC = Chemical of potential concern.
EPC = Exposure point concentration.
PRG = Preliminary remediation goal.
UCL = Upper confidence limit on the mean.
-- Criteria not available or insufficient data to calculate the UCL.

Table L-2. COPC Screening for Surface Soil at the Ramsdell Quarry Landfill

Chemical	CAS Number	Units	Frequency of Detection	Minimum Detect	Average Result	Maximum Detect	95% UCL of Mean	EPC	Site Background Criteria	Region 9 Residential PRG	COPC?
Inorganics											
Aluminum	7429-90-5	mg/kg	15 / 15	3.6E+03	1.1E+04	2.2E+04	1.5E+04	1.5E+04	1.8E+04	7.6E+03	Yes
Antimony	7440-36-0	mg/kg	11 / 15	1.4E-01	2.2E+00	1.6E+01	4.1E+00	4.1E+00	9.6E-01	3.1E+00	Yes
Arsenic	7440-38-2	mg/kg	15 / 15	8.7E+00	1.3E+01	3.0E+01	1.5E+01	1.5E+01	1.5E+01	3.9E-01	Yes
Barium	7440-39-3	mg/kg	15 / 15	2.4E+01	9.4E+01	2.7E+02	1.4E+02	1.4E+02	8.8E+01	5.4E+02	No
Beryllium	7440-41-7	mg/kg	13 / 15	2.5E-01	5.5E-01	1.3E+00	6.7E-01	6.7E-01	8.8E-01	1.5E+01	No
Cadmium	7440-43-9	mg/kg	10 / 15	2.9E-01	1.2E+00	4.7E+00	2.1E+00	2.1E+00	0.0E+00	3.7E+00	Yes
Calcium	7440-70-2	mg/kg	15 / 15	6.1E+02	5.3E+03	2.9E+04	1.3E+04	1.3E+04	1.6E+04	--	No
Chromium	7440-47-3	mg/kg	15 / 15	8.4E+00	3.1E+01	2.0E+02	5.2E+01	5.2E+01	1.7E+01	2.2E+01	Yes
Cobalt	7440-48-4	mg/kg	15 / 15	4.5E+00	9.2E+00	1.4E+01	1.1E+01	1.1E+01	1.0E+01	1.4E+02	No
Copper	7440-50-8	mg/kg	15 / 15	8.9E+00	5.7E+01	3.5E+02	9.4E+01	9.4E+01	1.8E+01	3.1E+02	Yes
Iron	7439-89-6	mg/kg	15 / 15	1.4E+04	2.7E+04	7.3E+04	3.4E+04	3.4E+04	2.3E+04	2.3E+03	No
Lead	7439-92-1	mg/kg	15 / 15	1.4E+01	3.0E+02	3.7E+03	7.3E+02	7.3E+02	2.6E+01	4.0E+02	Yes
Magnesium	7439-95-4	mg/kg	15 / 15	9.1E+02	5.5E+03	2.2E+04	9.8E+03	9.8E+03	3.0E+03	--	No
Manganese	7439-96-5	mg/kg	15 / 15	1.6E+02	5.2E+02	1.1E+03	7.7E+02	7.7E+02	1.5E+03	1.8E+02	No
Mercury	7439-97-6	mg/kg	13 / 15	3.0E-02	1.9E-01	8.9E-01	7.9E-01	7.9E-01	3.6E-02	2.3E+00	No
Nickel	7440-02-0	mg/kg	15 / 15	1.1E+01	2.9E+01	1.3E+02	4.2E+01	4.2E+01	2.1E+01	1.6E+02	No
Potassium	7440-09-7	mg/kg	15 / 15	4.5E+02	1.2E+03	3.3E+03	1.6E+03	1.6E+03	9.3E+02	--	No
Selenium	7782-49-2	mg/kg	2 / 15	6.0E-01	7.9E-01	2.0E+00	9.8E-01	9.8E-01	1.4E+00	3.9E+01	No
Silver	7440-22-4	mg/kg	10 / 15	6.4E-02	5.9E-01	1.3E+00	1.7E+00	1.3E+00	0.0E+00	3.9E+01	No
Sodium	7440-23-5	mg/kg	12 / 15	1.6E+01	1.7E+02	1.4E+02	3.9E+02	1.4E+02	1.2E+02	--	No
Thallium	7440-28-0	mg/kg	2 / 15	3.1E-01	2.8E-01	6.2E-01	4.0E-01	4.0E-01	0.0E+00	5.2E-01	Yes
Vanadium	7440-62-2	mg/kg	15 / 15	8.1E+00	2.0E+01	4.1E+01	2.5E+01	2.5E+01	3.1E+01	7.8E+00	Yes
Zinc	7440-66-6	mg/kg	15 / 15	7.3E+01	2.2E+02	7.4E+02	3.1E+02	3.1E+02	6.2E+01	2.3E+03	No
Organic Explosives											
1,3-Dinitrobenzene	99-65-0	mg/kg	1 / 15	3.9E+00	3.3E-01	3.9E+00	7.8E-01	7.8E-01	--	6.1E-01	Yes
2,4,6-Trinitrotoluene	118-96-7	mg/kg	3 / 15	2.1E-02	3.3E-01	4.0E+00	8.0E-01	8.0E-01	--	3.1E+00	Yes
2,4-Dinitrotoluene	121-14-2	mg/kg	1 / 15	4.7E-02	7.0E-02	4.7E-02	8.6E-02	4.7E-02	--	7.2E-01	No
2,6-Dinitrotoluene	606-20-2	mg/kg	1 / 15	8.2E+00	6.2E-01	8.2E+00	1.6E+00	1.6E+00	--	7.2E-01	Yes
2-Amino-4,6-Dinitrotoluene	35572-78-2	mg/kg	2 / 10	4.6E-01	9.5E-01	8.6E+00	2.5E+00	2.5E+00	--	--	Yes
2-Nitrotoluene	88-72-2	mg/kg	1 / 15	7.0E-02	1.1E-01	7.0E-02	1.1E-01	7.0E-02	--	8.8E-01	No
4-Amino-2,6-Dinitrotoluene	19406-51-0	mg/kg	2 / 10	1.1E-01	1.8E-01	1.3E+00	4.1E-01	4.1E-01	--	--	Yes
HMX	2691-41-0	mg/kg	5 / 15	1.3E-01	1.9E-01	6.8E-01	2.7E-01	2.7E-01	--	3.1E+02	No

Table L-2. COPC Screening for Surface Soil at the Ramsdell Quarry Landfill (continued)

Chemical	CAS Number	Units	Frequency of Detection	Minimum Detect	Average Result	Maximum Detect	95% UCL of Mean	EPC	Site Background Criteria	Region 9 Residential PRG	COPC?
Nitroglycerin	55-63-0	mg/kg	1 / 7	1.4E+02	2.2E+01	1.4E+02	6.0E+01	6.0E+01	--	3.5E+01	Yes
RDX	121-82-4	mg/kg	1 / 15	3.5E-01	1.7E-01	3.5E-01	2.1E-01	2.1E-01	--	4.4E+00	No
Organic Semivolatiles											
2-Methylnaphthalene	91-57-6	mg/kg	8 / 15	6.7E-02	4.5E+00	6.1E+01	1.2E+01	1.2E+01	--	5.6E+00	Yes
Acenaphthene	83-32-9	mg/kg	5 / 15	9.3E-02	2.4E+01	3.6E+02	6.7E+01	6.7E+01	--	3.7E+02	No
Acenaphthylene	208-96-8	mg/kg	2 / 15	4.6E-02	5.7E-01	4.3E+00	1.1E+00	1.1E+00	--	--	Yes
Anthracene	120-12-7	mg/kg	10 / 15	6.8E-02	6.7E+01	1.0E+03	1.9E+02	1.9E+02	--	2.2E+03	No
Benz(a)anthracene	56-55-3	mg/kg	12 / 15	1.8E-01	9.4E+01	1.4E+03	2.6E+02	2.6E+02	--	6.2E-01	Yes
Benzo(a)pyrene	50-32-8	mg/kg	12 / 15	1.2E-01	6.5E+01	9.6E+02	1.8E+02	1.8E+02	--	6.2E-02	Yes
Benzo(b)fluoranthene	205-99-2	mg/kg	12 / 15	2.0E-01	8.1E+01	1.2E+03	2.2E+02	2.2E+02	--	6.2E-01	Yes
Benzo(ghi)perylene	191-24-2	mg/kg	11 / 15	9.7E-02	4.4E+01	6.5E+02	1.2E+02	1.2E+02	--	--	Yes
Benzo(k)fluoranthene	207-08-9	mg/kg	11 / 15	8.5E-02	3.9E+01	5.8E+02	1.1E+02	1.1E+02	--	6.2E+00	Yes
Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	6 / 15	5.6E-02	2.0E+00	2.1E-01	5.2E+00	2.1E-01	--	3.5E+01	No
Carbazole	86-74-8	mg/kg	7 / 15	5.8E-02	3.1E+01	4.6E+02	8.5E+01	8.5E+01	--	2.4E+01	Yes
Chrysene	218-01-9	mg/kg	12 / 15	1.9E-01	6.8E+01	1.0E+03	1.9E+02	1.9E+02	--	6.2E+01	Yes
Dibenz(a,h)anthracene	53-70-3	mg/kg	3 / 15	1.7E-01	1.2E+01	1.8E+02	3.3E+01	3.3E+01	--	6.2E-02	Yes
Dibenzofuran	132-64-9	mg/kg	6 / 15	1.6E-01	1.8E+01	2.7E+02	5.0E+01	5.0E+01	--	1.5E+01	Yes
Fluoranthene	206-44-0	mg/kg	13 / 15	6.7E-02	2.1E+02	3.1E+03	5.7E+02	5.7E+02	--	2.3E+02	Yes
Fluorene	86-73-7	mg/kg	5 / 15	9.1E-02	3.0E+01	4.5E+02	8.3E+01	8.3E+01	--	2.7E+02	Yes
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	12 / 15	4.6E-02	4.3E+01	6.3E+02	1.2E+02	1.2E+02	--	6.2E-01	Yes
Naphthalene	91-20-3	mg/kg	6 / 15	9.5E-02	7.0E+00	1.0E+02	1.9E+01	1.9E+01	--	5.6E+00	Yes
Phenanthrene	85-01-8	mg/kg	12 / 15	2.3E-01	2.2E+02	3.2E+03	5.9E+02	5.9E+02	--	--	Yes
Pyrene	129-00-0	mg/kg	13 / 15	5.3E-02	2.0E+02	3.0E+03	5.5E+02	5.5E+02	--	2.3E+02	Yes
2-Butanone	78-93-3	mg/kg	2 / 6	6.5E-03	1.6E-02	3.5E-02	2.4E-02	2.4E-02	--	2.2E+03	No
Acetone	67-64-1	mg/kg	3 / 6	3.7E-03	2.7E-02	9.8E-02	3.0E-01	9.8E-02	--	1.4E+03	No
Methylene Chloride	75-09-2	mg/kg	1 / 6	7.3E-04	4.8E-03	7.3E-04	7.1E-03	7.3E-04	--	9.1E+00	No

COPC = Chemical of potential concern.
EPC = Exposure point concentration.
PRG = Preliminary remediation goal.
UCL = Upper confidence limit on the mean.
Criteria not available or insufficient data to calculate the UCL.

Table L-3. COPC Screening for Sediment at the Ramsdell Quarry Landfill

Chemical	CAS Number	Units	Frequency of Detection	Minimum Detect	Average Result	Maximum Detect	95% UCL of Mean	EPC	Site Background Criteria	Region 9 Residential PRG	COPC?
Inorganics											
Aluminum	7429-90-5	mg/kg	5 / 5	3.6E+03	1.3E+04	2.1E+04	1.9E+04	1.9E+04	1.4E+04	7.6E+03	Yes
Arsenic	7440-38-2	mg/kg	5 / 5	9.5E+00	2.0E+01	3.3E+01	4.2E+01	3.3E+01	2.0E+01	3.9E-01	Yes
Barium	7440-39-3	mg/kg	5 / 5	7.0E+01	1.2E+02	1.5E+02	1.5E+02	1.5E+02	1.2E+02	5.4E+02	No
Beryllium	7440-41-7	mg/kg	4 / 5	3.9E-01	5.3E-01	6.5E-01	6.2E-01	6.2E-01	3.8E-01	1.5E+01	No
Cadmium	7440-43-9	mg/kg	3 / 5	1.4E+00	2.3E+00	6.4E+00	6.9E+01	6.4E+00	0.0E+00	3.7E+00	Yes
Calcium	7440-70-2	mg/kg	5 / 5	4.0E+03	2.2E+04	4.7E+04	3.9E+04	3.9E+04	5.5E+03	--	No
Chromium	7440-47-3	mg/kg	5 / 5	1.3E+01	2.4E+01	3.1E+01	3.1E+01	3.1E+01	1.8E+01	2.2E+01	Yes
Cobalt	7440-48-4	mg/kg	5 / 5	8.0E+00	1.7E+01	3.4E+01	4.6E+01	3.4E+01	9.1E+00	1.4E+02	No
Copper	7440-50-8	mg/kg	5 / 5	2.9E+01	8.3E+01	1.3E+02	2.9E+02	1.3E+02	2.8E+01	3.1E+02	No
Cyanide	57-12-5	mg/kg	1 / 5	2.8E+00	9.6E-01	2.8E+00	1.9E+00	1.9E+00	0.0E+00	1.2E+02	No
Iron	7439-89-6	mg/kg	5 / 5	1.9E+04	3.3E+04	4.1E+04	4.3E+04	4.1E+04	2.8E+04	2.3E+03	No
Lead	7439-92-1	mg/kg	5 / 5	4.4E+01	6.5E+01	8.7E+01	8.1E+01	8.1E+01	2.7E+01	4.0E+02	No
Magnesium	7439-95-4	mg/kg	5 / 5	4.2E+03	2.1E+04	5.8E+04	5.5E+05	5.8E+04	2.8E+03	--	No
Manganese	7439-96-5	mg/kg	5 / 5	2.3E+02	1.3E+03	2.6E+03	2.2E+03	2.2E+03	2.0E+03	1.8E+02	Yes
Mercury	7439-97-6	mg/kg	5 / 5	6.7E-02	1.1E-01	1.8E-01	1.9E-01	1.8E-01	5.9E-02	2.3E+00	No
Nickel	7440-02-0	mg/kg	5 / 5	2.2E+01	4.4E+01	8.7E+01	1.2E+02	8.7E+01	1.8E+01	1.6E+02	No
Potassium	7440-09-7	mg/kg	5 / 5	4.2E+02	1.5E+03	3.0E+03	7.0E+03	3.0E+03	2.0E+03	--	No
Selenium	7782-49-2	mg/kg	1 / 5	1.1E+00	6.3E-01	1.1E+00	8.8E-01	8.8E-01	1.7E+00	3.9E+01	No
Sodium	7440-23-5	mg/kg	5 / 5	4.1E+01	6.6E+01	1.1E+02	1.2E+02	1.1E+02	1.1E+02	--	No
Thallium	7440-28-0	mg/kg	2 / 5	1.2E+00	9.2E-01	1.9E+00	1.5E+00	1.5E+00	8.9E-01	5.2E-01	Yes
Vanadium	7440-62-2	mg/kg	5 / 5	1.0E+01	2.5E+01	3.8E+01	3.5E+01	3.5E+01	2.6E+01	7.8E+00	Yes
Zinc	7440-66-6	mg/kg	5 / 5	2.6E+02	5.0E+02	8.9E+02	1.2E+03	8.9E+02	5.3E+02	2.3E+03	No
Organic Explosives											
2,4-Dinitrotoluene	121-14-2	mg/kg	1 / 5	6.4E-02	1.1E-01	6.4E-02	1.4E-01	6.4E-02	--	7.2E-01	No
3-Nitrotoluene	99-08-1	mg/kg	1 / 5	7.1E-02	1.1E-01	7.1E-02	1.4E-01	7.1E-02	--	7.3E+01	No
HMX	2691-41-0	mg/kg	2 / 5	1.1E-01	2.0E-01	1.2E-01	2.7E-01	1.2E-01	--	3.1E+02	No
Nitrocellulose	9004-70-0	mg/kg	1 / 5	4.3E+00	1.7E+00	4.3E+00	3.1E+00	3.1E+00	--	--	Yes
Organic Semivolatiles											
Anthracene	120-12-7	mg/kg	1 / 5	1.8E-01	3.1E-01	1.8E-01	3.8E-01	1.8E-01	--	2.2E+03	No
Benz(a)anthracene	56-55-3	mg/kg	2 / 5	9.9E-02	3.1E-01	4.3E-01	4.3E-01	4.3E-01	--	6.2E-01	No
Benzo(a)pyrene	50-32-8	mg/kg	2 / 5	1.1E-01	3.0E-01	3.4E-01	4.0E-01	3.4E-01	--	6.2E-02	Yes
Benzo(b)fluoranthene	205-99-2	mg/kg	2 / 5	1.7E-01	3.3E-01	4.3E-01	4.2E-01	4.2E-01	--	6.2E-01	No

Table L-3. COPC Screening for Sediment at the Ramsdell Quarry Landfill (continued)

Chemical	CAS Number	Units	Frequency of Detection	Minimum Detect	Average Result	Maximum Detect	95% UCL of Mean	EPC	Site Background Criteria	Region 9 Residential PRG	COPC?
Benzo(g,h,i)perylene	191-24-2	mg/kg	1 / 5	1.7E-01	3.1E-01	1.7E-01	3.8E-01	1.7E-01	--	--	Yes
Benzo(k)fluoranthene	207-08-9	mg/kg	1 / 5	1.8E-01	3.1E-01	1.8E-01	3.8E-01	1.8E-01	--	6.2E+00	No
Carbazole	86-74-8	mg/kg	1 / 5	1.3E-01	3.0E-01	1.3E-01	3.9E-01	1.3E-01	--	2.4E+01	No
Chrysene	218-01-9	mg/kg	2 / 5	1.2E-01	3.1E-01	4.1E-01	4.2E-01	4.1E-01	--	6.2E+01	No
Fluoranthene	206-44-0	mg/kg	4 / 5	8.2E-02	3.6E-01	1.0E+00	4.3E+00	1.0E+00	--	2.3E+02	No
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	2 / 5	8.6E-02	2.6E-01	2.0E-01	3.8E-01	2.0E-01	--	6.2E-01	No
Phenanthrene	85-01-8	mg/kg	2 / 5	9.4E-02	3.7E-01	7.0E-01	5.7E-01	5.7E-01	--	--	Yes
Pyrene	129-00-0	mg/kg	4 / 5	8.9E-02	3.0E-01	7.8E-01	3.1E+00	7.8E-01	--	2.3E+02	No
Organic Volatiles											
2-Butanone	78-93-3	mg/kg	3 / 5	5.7E-03	1.3E-02	1.0E-02	3.5E-02	1.0E-02	--	2.2E+03	No
Acetone	67-64-1	mg/kg	5 / 5	8.7E-03	2.1E-02	3.4E-02	6.8E-02	3.4E-02	--	1.4E+03	No

COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HMX = Hydro-1,3,5-trinitro-1,3,5-triazine.
PRG = Preliminary remediation goal.
UCL = Upper confidence limit on the mean.
-- Criteria not available or insufficient data to calculate the UCL.

Table L-4. COPC Screening for Surface Water at the Ramsdell Quarry Landfill

Chemical	CAS Number	Units	Frequency of Detection	Minimum Detect	Average Result	Maximum Detect	95% UCL of Mean	EPC	Site Background Criteria	Region 9 Tap Water PRG	COPC?
Inorganics											
Aluminum	7429-90-5	mg/L	6 / 9	1.4E-01	1.1E+01	5.0E+01	2.0E+05	5.0E+01	3.4E+00	3.6E+01	Yes
Arsenic	7440-38-2	mg/L	4 / 9	1.1E-02	1.3E-02	3.9E-02	2.2E-02	2.2E-02	3.2E-03	4.5E-05	Yes
Barium	7440-39-3	mg/L	9 / 9	2.8E-02	1.3E-01	4.1E-01	2.2E-01	2.2E-01	4.8E-02	2.6E+00	No
Cadmium	7440-43-9	mg/L	2 / 9	1.5E-03	2.3E-03	4.2E-03	3.0E-03	3.0E-03	0.0E+00	1.8E-02	No
Calcium	7440-70-2	mg/L	9 / 9	1.5E+01	4.3E+01	9.7E+01	8.1E+01	8.1E+01	4.1E+01	--	No
Chloride	16887-00-6	mg/L	2 / 3	1.7E+00	1.6E+00	2.2E+00	2.7E+00	2.2E+00	--	--	No
Chromium	7440-47-3	mg/L	4 / 9	3.6E-03	1.7E-02	6.5E-02	3.0E-02	3.0E-02	0.0E+00	1.1E-01	No
Cobalt	7440-48-4	mg/L	2 / 9	2.9E-02	2.6E-02	3.0E-02	2.7E-02	2.7E-02	0.0E+00	7.3E-01	No
Copper	7440-50-8	mg/L	5 / 7	5.0E-03	3.7E-02	1.6E-01	2.9E-01	1.6E-01	7.9E-03	1.5E+00	No
Iron	7439-89-6	mg/L	9 / 9	3.8E-01	2.4E+01	8.0E+01	1.0E+04	8.0E+01	2.6E+00	1.1E+01	No
Lead	7439-92-1	mg/L	5 / 9	3.2E-03	3.3E-02	1.4E-01	6.6E-02	6.6E-02	0.0E+00	--	Yes
Magnesium	7439-95-4	mg/L	9 / 9	2.5E+01	5.8E+01	2.0E+02	9.2E+01	9.2E+01	1.1E+01	--	No
Manganese	7439-96-5	mg/L	9 / 9	6.7E-02	1.6E+00	5.6E+00	5.1E+01	5.6E+00	3.9E-01	8.8E-01	Yes
Mercury	7439-97-6	mg/L	4 / 9	7.3E-05	1.3E-04	2.6E-04	1.6E-04	1.6E-04	0.0E+00	1.1E-02	No
Nickel	7440-02-0	mg/L	3 / 9	3.5E-02	3.3E-02	7.0E-02	4.6E-02	4.6E-02	0.0E+00	7.3E-01	No
Nitrate/Nitrite (NO3/NO2-N)	N599	mg/L	1 / 3	4.0E-01	1.7E-01	4.0E-01	5.1E-01	4.0E-01	--	1.0E+00	No
Potassium	7440-09-7	mg/L	9 / 9	1.1E+00	4.3E+00	9.6E+00	1.1E+01	9.6E+00	3.2E+00	--	No
Selenium	7782-49-2	mg/L	1 / 9	4.6E-03	2.7E-03	4.6E-03	3.2E-03	3.2E-03	0.0E+00	1.8E-01	No
Sodium	7440-23-5	mg/L	8 / 9	1.5E+00	3.3E+00	6.2E+00	5.9E+00	5.9E+00	2.1E+01	--	No
Sulfate	14808-79-8	mg/L	3 / 3	2.0E+02	2.5E+02	2.9E+02	3.3E+02	2.9E+02	--	--	Yes
Thallium	7440-28-0	mg/L	3 / 9	1.3E-03	1.2E-03	1.8E-03	1.4E-03	1.4E-03	0.0E+00	2.4E-03	No
Vanadium	7440-62-2	mg/L	3 / 9	3.8E-02	3.5E-02	8.5E-02	4.7E-02	4.7E-02	0.0E+00	3.6E-02	Yes
Zinc	7440-66-6	mg/L	6 / 9	1.7E-02	3.1E-01	1.6E+00	2.2E+01	1.6E+00	4.2E-02	1.1E+01	No
Organic Explosives											
4-Nitrotoluene	99-99-0	mg/L	1 / 9	2.4E-04	1.6E-04	2.4E-04	2.2E-04	2.2E-04	--	6.6E-04	No
Organic Pesticides											
Aldrin	309-00-2	mg/L	1 / 3	1.2E-05	2.1E-05	1.2E-05	3.3E-05	1.2E-05	--	4.0E-06	Yes
Organic Volatiles											
Acetone	67-64-1	mg/L	1 / 9	6.3E-03	5.1E-03	6.3E-03	5.4E-03	5.4E-03	--	5.5E+00	No
Methylene Chloride	75-09-2	mg/L	1 / 9	1.2E-02	3.6E-03	1.2E-02	5.5E-03	5.5E-03	--	4.3E-03	Yes
Tetrachloroethene	127-18-4	mg/L	1 / 9	6.0E-04	2.3E-03	6.0E-04	2.7E-03	6.0E-04	--	1.0E-04	Yes

Table L-4. COPC Screening for Surface Water at the Ramsdell Quarry Landfill (continued)

COPC = Chemical of potential concern.
EPC = Exposure point concentration.
PRG = Preliminary remediation goal.
UCL = Upper confidence limit on the mean.
-- Criteria not available or insufficient data to calculate the UCL.

Table L-5. Chemical-specific Exposure Parameters for Ramsdell Quarry Landfill COPCs

COPC	Dermal Absorption Factor[a] (unitless)	Permeability Constant[b] (cm/hr)	Volatilization Factor[c] (m^3/kg)	Beef Transfer Coefficient[d] (kg/kg)	Milk Transfer Coefficient[d] (kg/kg	Soil-to-Plant Uptake Factor[d]	
						Dry Weight (days/kg)	Wet Weight (days/kg)
Inorganics							
Aluminum	1.0E-03	2.1E-03	--	1.5E-03	2.0E-04	4.0E-03	1.0E-03
Antimony	1.0E-03	1.1E-03	--	4.0E-05	2.5E-05	5.0E-02	1.0E-02
Arsenic	3.0E-02	1.9E-03	--	2.0E-03	6.0E-05	4.0E-02	1.0E-02
Cadmium	1.0E-03	3.5E-04	--	4.0E-04	1.0E-03	5.5E-01	1.4E-01
Chromium (as Chromium VI)	1.0E-03	1.0E-03	--	9.0E-03	1.0E-05	4.0E-02	1.0E-04
Copper	1.0E-03	3.1E-04	--	9.0E-03	1.5E-03	8.0E-01	8.0E-02
Manganese	1.0E-03	1.3E-03	--	5.0E-04	3.0E-05	6.8E-01	6.9E-02
Thallium (as Thallium carbomate)	1.0E-03	1.6E-04	--	4.0E-02	2.0E-03	4.0E-03	1.0E-03
Vanadium	1.0E-03	1.4E-03	--	2.5E-03	2.0E-05	5.5E-03	1.4E-03
Organics							
1,3-Dinitrobenzene	1.0E-01	2.1E-03	4.6E+04	1.0E-06	3.1E-07	4.5E+00	9.1E-01
2,4,6-Trinitrotoluene	1.0E-01	1.1E-03	--	5.0E-06	1.6E-06	1.8E+00	3.6E-01
2,6-Dinitrotoluene	1.0E-01	4.6E-03	--	1.3E-06	4.0E-07	3.9E+00	8.0E-01
2-Methylnaphthalene	1.0E-01	1.4E-01	2.6E+05	2.0E-04	6.3E-05	2.1E-01	4.2E-02
Aldrin	1.0E-02	4.7E-01	--	2.5E-05	7.9E-06	6.9E-01	1.4E-01
Benz(*a*)anthracene	1.3E-01	9.5E-01	--	1.3E-02	4.0E-03	1.9E-02	3.8E-03
Benzo(*a*)pyrene	1.3E-01	1.2E+00	--	3.1E-02	9.9E-03	1.1E-02	2.2E-03
Benzo(*b*)fluoranthene	1.3E-01	7.0E-01	--	3.1E-02	9.9E-03	1.1E-02	2.2E-03
Benzo(*k*)fluoranthene	1.3E-01	1.2E+00	--	1.6E-01	5.0E-02	4.3E-03	8.8E-04
Carbazole	1.0E-01	8.0E-02	--	1.6E-04	5.0E-05	2.4E-01	4.8E-02
Chrysene	1.3E-01	1.0E+00	--	1.3E-02	4.0E-03	1.9E-02	3.8E-03
Dibenz(*a,h*)anthracene	1.3E-01	1.7E+00	--	1.6E-01	5.0E-02	4.3E-03	8.8E-04
Dibenzofuran	1.0E-01	1.5E-01	--	3.3E-04	1.0E-04	1.5E-01	3.1E-02
Fluoranthene	1.3E-01	5.1E-01	--	2.0E-03	6.3E-04	5.5E-02	1.1E-02
Fluorene	1.0E-01	1.7E-01	--	6.3E-04	2.0E-04	1.1E-01	2.2E-02
Indeno(*1,2,3-cd*)pyrene	1.3E-01	2.2E+00	--	1.0E-01	3.1E-02	5.6E-03	1.1E-03
Methylene Chloride	1.0E-02	4.5E-03	3.3E+03	5.0E-07	1.6E-07	6.7E+00	1.4E+00
Naphthalene	1.3E-01	6.9E-02	6.4E+04	5.0E-05	1.6E-05	4.6E-01	9.4E-02
Pyrene	1.3E-01	3.2E-01	--	2.0E-03	6.3E-04	5.5E-02	1.1E-02
Tetrachloroethene	1.0E-02	4.8E-02	2.5E+03	1.0E-05	3.1E-06	1.2E+00	2.4E-01

Table L-5. Chemical-specific Exposure Parameters for Ramsdell Quarry Landfill COPCs (continued)

[a] Chemical-specific absorption factor values from EPA Region V (EPA 2000). When chemical-specific values are not available, the following default values are used for soil and sediment only:
SVOCs = 0.1, VOCs = 0.01, inorganics = 0.001, per EPA Region 4 Supplemental Guidance to RAGS.

[b] From Risk Assessment Information System (RAIS) *http://risk.lsd.ornl.gov/tox/tox_values.shtml* for groundwater and surface water.
[c] Volatilization factors (VFs) calculated using the 1996 EPA Soil Screening Guidance Methodology, using site-specific parameter values for Cleveland, Ohio. Only used for soil and sediment VOCs.
[d] Parameter used to evaluate food pathways.
COPC = Chemical of potential concern.
RAGS = Risk Assessment Guidance for Superfund.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.
-- = No value available.

Table L-6. Non-carcinogenic Reference Doses for Ramsdell Quarry Landfill COPCs

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Inorganics								
Aluminum	1.0E+00	NA	1	1.0E+00	1.4E-03	NA	NA	(O) UF=10
Antimony	4.0E-04	Low	0.15	6.0E-05	--	Oral, oral-water	Gastrointestinal, liver, cardiovascular, and developmental toxicity	(O) UF=1000
Arsenic	3.0E-04	Medium (O)	0.95	3.0E-04	--	Oral, oral-water	Hyperpigmentation and keritosis and possible vascular complication	(O) UF=3
Cadmium (diet)	1.0E-03	High	0.025	2.5E-05	--	Oral, oral-water	Renal toxicity, osteomalacia, osteoporosis, and significant proteinuria	(O) UF=1000
Chromium (as Cr VI)	3.0E-03	Low (O)	0.025	7.5E-05	2.9E-05	Oral (rat)	Reduced liver/spleen weight	(O) UF=100
Copper	4.0E-02	NA	1	4.0E-02	--	NA	NA	
Manganese (water)	4.6E-02	NA	0.04	1.8E-03	1.4E-05	Oral: water, inhalation	(O) lethargy, tremors, mental disturbance, muscle tonus, and central nervous system effects	(O) UF=1 (O) MF=3 (I) UF=1000
Manganese (diet)	1.4E-01	NA	0.04	5.63E-03	1.4E-05	Oral: water, inhalation	(O) lethargy, tremors, mental disturbance, muscle tonus, and central nervous system effects	(O) UF=1 (O) MF=3 (I) UF=1000
Thallium	8.0E-05	Low	1	8.0E-05	--	Oral (rat)	Increased levels of SGOT and LDH	UF = 3,000
Vanadium	7.0E-03		0.026	1.8E-04	--			
Organics								
1,3-Dinitrobenzene	1.0E-04	Low	1	1.0E-04	--	Oral (rat)	Increased splenic weight	(O) UF = 3,000
2,4,6-Trinitrotoluene	5.0E-04	Medium	1	5.0E-04	--	Oral (dog)	Liver effects	UF = 1,000
2,6-Dinitrotoluene	1.0E-03	Medium	1	1.0E-03	--	Oral (dog)	Neurological, hematological, and liver histopathology	UF = 3,000
2-Methylnaphthalene	4.0E-03	Low	1	4.0E-03	--	Oral (mice)	Pulmonary alveolar proteinosis	(O) UF = 1,000
Aldrin	3.0E-05	Medium	1	3.0E-05	--	Oral (rat)	Liver toxicity (rat)	UF = 1,000
Dibenzofuran	4.0E-03	Low	1	4.0E-03	--	Oral (rat)	Lesion	UF = 3,000
Fluoranthene	4.0E-02	Low	0.58	4.0E-02	--	Oral (mice)	Nephropathy, increased weight, alterations and clinical effects	UF = 3,000

Table L-6. Non-carcinogenic Reference Doses for Ramsdell Quarry Landfill COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Fluorene	4.0E-02	Low	1	4.0E-02	--	Oral (mice)	Decreased RBC, packed cell volume and hemoglobin	UF = 3,000
Methylene Chloride	6.0E-02	Medium	1	6.0E-02	8.6E-01	Oral (mice), inhalation (mice)	Adenomas, carcinomas, nodules	UF = 100
Naphthalene	2.0E-02	Low	0.58	2.0E-02	8.6E-04	Oral (rat)	Decreased mean terminal body weights in males	UF = 3,000
Pyrene	3.0E-02	Low	0.58	3.0E-02	--	Oral (mice)	Renal effects	UF = 3,000
Tetrachloroethene	1.0E-02	Medium	1	1.0E-02	1.7E-01	Oral (mice, rat)	Hepatotoxicity, weight gain	UF = 1,000

[a] % Gastrointestinal (GI) absorption values from EPA 2000.
(O) indicates oral, (I) indicates inhalation.
COPC = Constituent of potential concern.
MF = Modifying factor (the default modifying factor is 1).
NA = Not available.
RfD = Refenernce dose.
UF = Uncertainty factor.
-- = No value available.

Table L-7. Cancer Slope Factors for Ramsdell Quarry Landfill COPCs

COPC	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	% GI Absorption[a]	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	EPA Class	TEF	Type of Cancer
Inorganics							
Arsenic	1.5E+00	0.95	1.5E+00	1.5E+01	A	--	Respiratory system tumors
Cadmium (diet)	--	0.025	--	6.3E+00	B1	--	Respiratory tract and lung tumors
Chromium (as Cr VI)	--	0.025	--	4.2E+01	A	--	Lung tumors
Organics							
2,4,6-Trinitrotoluene	3.0E-02	1	3.0E-02	--	C	--	Bladder transitional cell papilloma
2,6-Dinitrotoluene	6.8E-01	1	6.8E-01	--	B2	--	Liver carcinoma, mammary adenomas, fibromas (mouse)
Aldrin	1.7E+01	1	1.7E+01	1.7E+01	B2	--	Tumor induction (mouse)
Benz(a)anthracene	7.3E-01	0.58	7.3E-01	3.1E-01	B2	0.1	Stomach tumors (mouse)
Benzo(a)pyrene	7.3E+00	0.58	7.3E+00	3.1E+00	B2	1	Stomach, nasal cavity, larynx, tracheak, and pharnyx
Benzo(b)fluoranthene	7.3E-01	0.58	7.3E-01	3.1E-01	B2	0.1	Tumors
Benzo(k)fluoranthene	7.3E-02	0.58	7.3E-02	3.1E-02	B2	0.01	Tumors (mouse)
Carbazole	2.0E-02	1	2.0E-02	--	B2	--	Liver tumors (mouse)
Chrysene	7.3E-03	0.58	7.3E-03	3.1E-03	B2	0.001	Carcinomas and malignant lymphoma (mouse)
Dibenz(a,h)anthracene	7.3E+00	0.58	7.3E+00	3.1E+00	B2	1	Immunodepressive effects (mouse)
Indeno(1,2,3-cd)pyrene	7.3E-01	0.58	7.3E-01	3.1E-01	B2	0.1	Tumors
Methylene Chloride	7.5E-03	1	7.5E-03	1.7E-03	B2	--	Hepatocellular carcinoma, adinomas (mouse)
Tetrachloroethene	5.2E-02	1	5.2E-02	2.0E-03	NA	--	Liver, kidney and bladder cancer

[a] % Gastrointestinal (GI) absorption values from EPA 2000.
COPC = Constituent of potential concern.
EPA = U. S. Environmental Protection Agency.
NA = Not available.
TEF = Toxicity equivalency factor is based on the relative potency of each carcinogenic polycyclic aromatic hydrocarbon relative to that of benzo(a)pyrene.
-- = No value available.

Table L-8. Ramsdell Quarry Landfill Surface Soil Calculations of Blood Lead Concentrations for Security Guard/Maintenance Worker

Exposure Variable	PbB Equation[1] 1*	PbB Equation[1] 2*	Description of Exposure Variable	Units	Security Guard/ Maintenance Worker GSDi = 1.8	Security Guard/ Maintenance Worker GSDi = 2.1
PbS	X	X	Soil lead concentration	ug/g or mg/kg	733	733
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	X	X	Baseline PbB	ug/dL	2.2	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.1	0.1
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	0.1	0.1
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}		X	Mass fraction of soil in dust	--	--	--
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/year	250	250
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/year	365	365
PbB_{adult}	**PbB of adult receptor, geometric mean**			**ug/dL**	**4.6**	**4.1**
$PbB_{fetal,0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**10.9**	**12.5**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**
P(PbB > PbB_t)	**Probability that PbB > PbB_t, assuming lognormal distribution**			**%**	**6.7%**	**9.0%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}). When IRS = IR_{S+D} and WS = 1.0, the equations yield the same $PbB_{fetal,0.95}$.

* Equation 1, based on Eq. 1, 2 in EPA (1996). U. S. EPA Technical Review Workgroup for Lead, Adult Lead Committee.

$PbB_{adult} = (PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_{S,D}/AT_{S,D}) + PbB_0$

$PbB_{fetal,0.95} = PbB_{adult} * (GSD_i^{1.645} * R)$

PbB = Blood lead concentration.

Table L-9. Ramsdell Quarry Landfill Surface Soil Calculations of Blood Lead Concentrations for Adult Resident Subsistence Farmer

Exposure Variable	PbB Equation[1]		Description of Exposure Variable	Units	Adult Resident Subsistence Farmer	
	1*	2*			GSDi = 1.8	GSDi = 2.1
PbS	X	X	Soil lead concentration	ug/g or mg/kg	733	733
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	X	X	Baseline PbB	ug/dL	2.2	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.1	0.1
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	0.1	0.1
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}		X	Mass fraction of soil in dust	--	--	--
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/year	350	350
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/year	365	365
PbB_{adult}	**PbB of adult receptor, geometric mean**			**ug/dL**	**5.6**	**5.1**
$PbB_{fetal,0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**13.2**	**15.5**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**
$P(PbB > PbB_t)$	**Probability that PbB > PbB_t, assuming lognormal distribution**			**%**	**12.0%**	**14.5%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}). When IRS = IR_{S+D} and WS = 1.0, the equations yield the same $PbB_{fetal,0.95}$.

* Equation 1, based on Eq. 1, 2 in EPA (1996). U. S. EPA Technical Review Workgroup for Lead, Adult Lead Committee.

$PbB_{adult} = (PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_{S,D}/AT_{S,D}) + PbB_0$

$PbB_{fetal,0.95} = PbB_{adult} * (GSD_i^{1.645} * R)$

PbB = Blood lead concentration.

Table L-10. Ramsdell Quarry Landfill Surface Soil Calculations Blood Lead Concentrations for Child Resident Subsistence Farmer

Exposure Variable	Description of Exposure Variable	Units	Child Resident Subsistence Farmer
PbS	Soil lead concentration	mg/kg	733
GSD_i	Geometric standard deviation PbB	--	1.6
PbB	**PbB geometric mean**	**ug/dL**	**13.0**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**	**ug/dL**	**10.0**
P(PbB > PbB_t)	**Probability that PbB > PbB_t, assuming lognormal distribution**	**%**	**71.2%**

Child receptor uses the IEUBK win 32 Lead Model Version 1.0 (Build 252) to calculate the blood lead concentration (PbB) and the probability that PbB > PbB_t, assuming a soil/dust ingestion weighting factor of 100%.

Table L-11. Ramsdell Quarry Landfill Surface Soil Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Maintained Industrial/Managed Recreational - Security Guard/Maintenance Worker									
Aluminum	1.5E+04	5.9E-04	3.3E-04	1.3E-07	5.9E-04	3.3E-04	9.0E-05	1.0E-03	
Antimony	4.1E+00	1.7E-07	9.3E-08	3.6E-11	4.2E-04	1.6E-03		2.0E-03	
Arsenic	1.5E+01	6.2E-07	1.0E-05	1.4E-10	2.1E-03	3.5E-02		3.7E-02	
Cadmium	2.1E+00	8.5E-08	4.7E-08	1.8E-11	8.5E-05	1.9E-03		2.0E-03	
Chromium	5.2E+01	2.1E-06	1.2E-06	4.6E-10	7.1E-04	1.6E-02	1.6E-05	1.6E-02	
Copper	9.4E+01	3.8E-06	2.1E-06	8.3E-10	9.6E-05	5.3E-05		1.5E-04	
Thallium	4.0E-01	1.6E-08	9.0E-09	3.5E-12	2.0E-04	1.1E-04		3.2E-04	
Vanadium	2.5E+01	1.0E-06	5.7E-07	2.2E-10	1.5E-04	3.2E-03		3.3E-03	
Inorganics Pathway Total					4.3E-03	5.7E-02	1.1E-04	6.2E-02	
1,3-Dinitrobenzene	7.8E-01	3.2E-08	1.8E-06	6.9E-12	3.2E-04	1.8E-02		1.8E-02	
2,4,6-Trinitrotoluene	8.0E-01	3.2E-08	1.8E-06	7.0E-12	6.5E-05	3.6E-03		3.7E-03	
2,6-Dinitrotoluene	1.6E+00	6.4E-08	3.5E-06	1.4E-11	6.4E-05	3.5E-03		3.6E-03	
2-Methylnaphthalene	1.2E+01	4.7E-07	2.6E-05	1.0E-10	1.2E-04	6.6E-03		6.7E-03	
Benz(a)anthracene	2.6E+02	1.1E-05	7.6E-04	2.3E-09					
Benzo(a)pyrene	1.8E+02	7.2E-06	5.2E-04	1.6E-09					
Benzo(b)fluoranthene	2.2E+02	9.1E-06	6.5E-04	2.0E-09					
Benzo(k)fluoranthene	1.1E+02	4.4E-06	3.1E-04	9.4E-10					
Carbazole	8.5E+01	3.5E-06	1.9E-04	7.5E-10					
Chrysene	1.9E+02	7.5E-06	5.4E-04	1.6E-09					
Dibenz(a,h)anthracene	3.3E+01	1.4E-06	9.8E-05	2.9E-10					
Dibenzofuran	5.0E+01	2.0E-06	1.1E-04	4.4E-10	5.1E-04	2.8E-02		2.9E-02	
Fluoranthene	5.7E+02	2.3E-05	1.7E-03	5.1E-09	5.8E-04	4.2E-02		4.3E-02	
Fluorene	8.3E+01	3.4E-06	1.9E-04	7.3E-10	8.5E-05	4.7E-03		4.8E-03	
Indeno(1,2,3-cd)pyrene	1.2E+02	4.7E-06	3.4E-04	1.0E-09					

Table L-11. Ramsdell Quarry Landfill Surface Soil Non-carcinogenic Hazards - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Naphthalene	1.9E+01	7.6E-07	5.5E-05	1.7E-10	3.8E-05	2.7E-03	1.9E-07	2.8E-03	
Pyrene	5.5E+02	2.3E-05	1.6E-03	4.9E-09	7.5E-04	5.4E-02		5.5E-02	
Organics Pathway Total					2.5E-03	1.6E-01	1.9E-07	1.7E-01	
Pathway Total - Chemicals					6.9E-03	2.2E-01	1.1E-04	2.3E-01	
National Guard - National Guard Fire Suppression Worker									
Aluminum	1.5E+04	1.4E-04	8.4E-06	6.8E-08	1.4E-04	8.4E-06	4.8E-05	2.0E-04	
Antimony	4.1E+00	4.0E-08	2.4E-09	1.9E-11	1.0E-04	4.0E-05		1.4E-04	
Arsenic	1.5E+01	1.5E-07	2.7E-07	7.2E-11	5.0E-04	8.9E-04		1.4E-03	
Cadmium	2.1E+00	2.0E-08	1.2E-09	9.8E-12	2.0E-05	4.8E-05		6.9E-05	
Chromium	5.2E+01	5.1E-07	3.0E-08	2.5E-10	1.7E-04	4.0E-04	8.6E-06	5.8E-04	
Copper	9.4E+01	9.2E-07	5.4E-08	4.4E-10	2.3E-05	1.4E-06		2.4E-05	
Thallium	4.0E-01	3.9E-09	2.3E-10	1.9E-12	4.9E-05	2.9E-06		5.2E-05	
Vanadium	2.5E+01	2.5E-07	1.5E-08	1.2E-10	3.6E-05	8.1E-05		1.2E-04	
Inorganics Pathway Total					1.0E-03	1.5E-03	5.6E-05	2.6E-03	
1,3-Dinitrobenzene	7.8E-01	7.6E-09	4.5E-08	3.7E-12	7.6E-05	4.5E-04		5.3E-04	
2,4,6-Trinitrotoluene	8.0E-01	7.8E-09	4.6E-08	3.7E-12	1.6E-05	9.2E-05		1.1E-04	
2,6-Dinitrotoluene	1.6E+00	1.5E-08	9.1E-08	7.4E-12	1.5E-05	9.1E-05		1.1E-04	
2-Methylnaphthalene	1.2E+01	1.1E-07	6.7E-07	5.5E-11	2.8E-05	1.7E-04		2.0E-04	
Benz(a)anthracene	2.6E+02	2.5E-06	2.0E-05	1.2E-09					
Benzo(a)pyrene	1.8E+02	1.7E-06	1.3E-05	8.3E-10					
Benzo(b)fluoranthene	2.2E+02	2.2E-06	1.7E-05	1.0E-09					
Benzo(k)fluoranthene	1.1E+02	1.0E-06	8.1E-06	5.0E-10					
Carbazole	8.5E+01	8.3E-07	4.9E-06	4.0E-10					
Chrysene	1.9E+02	1.8E-06	1.4E-05	8.7E-10					
Dibenz(a,h)anthracene	3.3E+01	3.3E-07	2.5E-06	1.6E-10					
Dibenzofuran	5.0E+01	4.9E-07	2.9E-06	2.4E-10	1.2E-04	7.3E-04		8.5E-04	
Fluoranthene	5.7E+02	5.6E-06	4.3E-05	2.7E-09	1.4E-04	1.1E-03		1.2E-03	
Fluorene	8.3E+01	8.1E-07	4.8E-06	3.9E-10	2.0E-05	1.2E-04		1.4E-04	
Indeno(1,2,3-cd)pyrene	1.2E+02	1.1E-06	8.8E-06	5.5E-10					
Naphthalene	1.9E+01	1.8E-07	1.4E-06	8.8E-11	9.1E-06	7.1E-05	1.0E-07	8.0E-05	
Pyrene	5.5E+02	5.4E-06	4.2E-05	2.6E-09	1.8E-04	1.4E-03		1.6E-03	
Organics Pathway Total					6.1E-04	4.2E-03	1.0E-07	4.8E-03	
Pathway Total - Chemicals					1.6E-03	5.7E-03	5.6E-05	7.4E-03	
National Guard - National Guard Trainee									
Aluminum	1.5E+04	2.2E-03	2.2E-05	5.9E-04	2.2E-03	2.2E-05	4.1E-01	4.1E-01	
Antimony	4.1E+00	6.3E-07	6.2E-09	1.7E-07	1.6E-03	1.0E-04		1.7E-03	
Arsenic	1.5E+01	2.3E-06	6.9E-07	6.2E-07	7.8E-03	2.3E-03		1.0E-02	
Cadmium	2.1E+00	3.2E-07	3.1E-09	8.5E-08	3.2E-04	1.3E-04		4.4E-04	
Chromium	5.2E+01	8.0E-06	7.9E-08	2.1E-06	2.7E-03	1.0E-03	7.4E-02	7.8E-02	
Copper	9.4E+01	1.4E-05	1.4E-07	3.8E-06	3.6E-04	3.5E-06		3.6E-04	
Thallium	4.0E-01	6.1E-08	6.0E-10	1.6E-08	7.6E-04	7.5E-06		7.7E-04	
Vanadium	2.5E+01	3.9E-06	3.8E-08	1.0E-06	5.5E-04	2.1E-04		7.6E-04	
Inorganics Pathway Total					1.6E-02	3.8E-03	4.9E-01	5.1E-01	
1,3-Dinitrobenzene	7.8E-01	1.2E-07	1.2E-07	3.2E-08	1.2E-03	1.2E-03		2.4E-03	
2,4,6-Trinitrotoluene	8.0E-01	1.2E-07	1.2E-07	3.2E-08	2.4E-04	2.4E-04		4.8E-04	
2,6-Dinitrotoluene	1.6E+00	2.4E-07	2.4E-07	6.4E-08	2.4E-04	2.4E-04		4.8E-04	
2-Methylnaphthalene	1.2E+01	1.8E-06	1.8E-06	4.7E-07	4.4E-04	4.4E-04		8.8E-04	
Benz(a)anthracene	2.6E+02	4.0E-05	5.1E-05	1.1E-05					
Benzo(a)pyrene	1.8E+02	2.7E-05	3.5E-05	7.2E-06					
Benzo(b)fluoranthene	2.2E+02	3.4E-05	4.4E-05	9.0E-06					
Benzo(k)fluoranthene	1.1E+02	1.6E-05	2.1E-05	4.4E-06					
Carbazole	8.5E+01	1.3E-05	1.3E-05	3.5E-06					
Chrysene	1.9E+02	2.8E-05	3.6E-05	7.5E-06					

Table L-11. Ramsdell Quarry Landfill Surface Soil Non-carcinogenic Hazards - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Dibenz(a,h)anthracene	3.3E+01	5.1E-06	6.6E-06	1.4E-06					
Dibenzofuran	5.0E+01	7.6E-06	7.6E-06	2.0E-06	1.9E-03	1.9E-03		3.8E-03	
Fluoranthene	5.7E+02	8.7E-05	1.1E-04	2.3E-05	2.2E-03	2.8E-03		5.0E-03	
Fluorene	8.3E+01	1.3E-05	1.3E-05	3.4E-06	3.2E-04	3.1E-04		6.3E-04	
Indeno(1,2,3-cd)pyrene	1.2E+02	1.8E-05	2.3E-05	4.7E-06					
Naphthalene	1.9E+01	2.9E-06	3.7E-06	7.6E-07	1.4E-04	1.8E-04	8.9E-04	1.2E-03	
Pyrene	5.5E+02	8.5E-05	1.1E-04	2.3E-05	2.8E-03	3.6E-03		6.4E-03	
Organics Pathway Total					9.5E-03	1.1E-02	8.9E-04	2.1E-02	
Pathway Total - Chemicals					2.6E-02	1.5E-02	4.9E-01	5.3E-01	
Open Residential - Resident Farmer Adult									
Aluminum	1.5E+04	2.0E-02	4.5E-04	4.3E-06	2.0E-02	4.5E-04	3.0E-03	2.3E-02	
Antimony	4.1E+00	5.7E-06	1.3E-07	1.2E-09	1.4E-02	2.1E-03		1.6E-02	
Arsenic	1.5E+01	2.1E-05	1.4E-05	4.5E-09	7.0E-02	4.8E-02		1.2E-01	
Cadmium	2.1E+00	2.8E-06	6.5E-08	6.2E-10	2.8E-03	2.6E-03		5.4E-03	
Chromium	5.2E+01	7.1E-05	1.6E-06	1.5E-08	2.4E-02	2.2E-02	5.4E-04	4.6E-02	
Copper	9.4E+01	1.3E-04	2.9E-06	2.8E-08	3.2E-03	7.3E-05		3.3E-03	
Thallium	4.0E-01	5.5E-07	1.2E-08	1.2E-10	6.8E-03	1.6E-04		7.0E-03	
Vanadium	2.5E+01	3.5E-05	7.9E-07	7.5E-09	5.0E-03	4.4E-03		9.3E-03	
Inorganics Pathway Total					1.5E-01	7.9E-02	3.6E-03	2.3E-01	
1,3-Dinitrobenzene	7.8E-01	1.1E-06	2.4E-06	2.3E-10	1.1E-02	2.4E-02		3.5E-02	
2,4,6-Trinitrotoluene	8.0E-01	1.1E-06	2.5E-06	2.4E-10	2.2E-03	5.0E-03		7.1E-03	
2,6-Dinitrotoluene	1.6E+00	2.2E-06	4.9E-06	4.7E-10	2.2E-03	4.9E-03		7.1E-03	
2-Methylnaphthalene	1.2E+01	1.6E-05	3.6E-05	3.4E-09	4.0E-03	9.1E-03		1.3E-02	
Benz(a)anthracene	2.6E+02	3.5E-04	1.1E-03	7.7E-08					
Benzo(a)pyrene	1.8E+02	2.4E-04	7.2E-04	5.3E-08					
Benzo(b)fluoranthene	2.2E+02	3.0E-04	9.0E-04	6.6E-08					
Benzo(k)fluoranthene	1.1E+02	1.5E-04	4.3E-04	3.2E-08					
Carbazole	8.5E+01	1.2E-04	2.7E-04	2.5E-08					
Chrysene	1.9E+02	2.5E-04	7.5E-04	5.5E-08					
Dibenz(a,h)anthracene	3.3E+01	4.6E-05	1.4E-04	9.9E-09					
Dibenzofuran	5.0E+01	6.8E-05	1.6E-04	1.5E-08	1.7E-02	3.9E-02		5.6E-02	
Fluoranthene	5.7E+02	7.8E-04	2.3E-03	1.7E-07	2.0E-02	5.8E-02		7.8E-02	
Fluorene	8.3E+01	1.1E-04	2.6E-04	2.5E-08	2.8E-03	6.5E-03		9.3E-03	
Indeno(1,2,3-cd)pyrene	1.2E+02	1.6E-04	4.7E-04	3.4E-08					
Naphthalene	1.9E+01	2.6E-05	7.6E-05	5.5E-09	1.3E-03	3.8E-03	6.5E-06	5.1E-03	
Pyrene	5.5E+02	7.6E-04	2.2E-03	1.6E-07	2.5E-02	7.5E-02		1.0E-01	
Organics Pathway Total					8.5E-02	2.3E-01	6.5E-06	3.1E-01	
Pathway Total - Chemicals					2.3E-01	3.0E-01	3.6E-03	5.4E-01	
Open Residential - Resident Farmer Child									
Aluminum	1.5E+04	1.9E-01	4.1E-04	1.0E-05	1.9E-01	4.1E-04	7.0E-03	1.9E-01	
Antimony	4.1E+00	5.3E-05	1.2E-07	2.9E-09	1.3E-01	1.9E-03		1.3E-01	
Arsenic	1.5E+01	2.0E-04	1.3E-05	1.1E-08	6.5E-01	4.3E-02		7.0E-01	
Cadmium	2.1E+00	2.7E-05	5.9E-08	1.4E-09	2.7E-02	2.3E-03		2.9E-02	
Chromium	5.2E+01	6.7E-04	1.5E-06	3.6E-08	2.2E-01	2.0E-02	1.3E-03	2.4E-01	
Copper	9.4E+01	1.2E-03	2.6E-06	6.5E-08	3.0E-02	6.6E-05		3.0E-02	
Thallium	4.0E-01	5.1E-06	1.1E-08	2.8E-10	6.4E-02	1.4E-04		6.4E-02	
Vanadium	2.5E+01	3.2E-04	7.1E-07	1.8E-08	4.6E-02	3.9E-03		5.0E-02	
Inorganics Pathway Total					1.4E+00	7.1E-02	8.3E-03	1.4E+00	H
1,3-Dinitrobenzene	7.8E-01	1.0E-05	2.2E-06	5.4E-10	1.0E-01	2.2E-02		1.2E-01	
2,4,6-Trinitrotoluene	8.0E-01	1.0E-05	2.2E-06	5.5E-10	2.0E-02	4.5E-03		2.5E-02	
2,6-Dinitrotoluene	1.6E+00	2.0E-05	4.4E-06	1.1E-09	2.0E-02	4.4E-03		2.4E-02	
2-Methylnaphthalene	1.2E+01	1.5E-04	3.3E-05	8.0E-09	3.7E-02	8.2E-03		4.5E-02	
Benz(a)anthracene	2.6E+02	3.3E-03	9.5E-04	1.8E-07					
Benzo(a)pyrene	1.8E+02	2.3E-03	6.5E-04	1.2E-07					

Table L-11. Ramsdell Quarry Landfill Surface Soil Non-carcinogenic Hazards - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Benzo(b)fluoranthene	2.2E+02	2.8E-03	8.1E-04	1.5E-07					
Benzo(*k*)fluoranthene	1.1E+02	1.4E-03	3.9E-04	7.4E-08					
Carbazole	8.5E+01	1.1E-03	2.4E-04	5.9E-08					
Chrysene	1.9E+02	2.4E-03	6.8E-04	1.3E-07					
Dibenz(*a,h*)anthracene	3.3E+01	4.3E-04	1.2E-04	2.3E-08					
Dibenzofuran	5.0E+01	6.4E-04	1.4E-04	3.5E-08	1.6E-01	3.5E-02		1.9E-01	
Fluoranthene	5.7E+02	7.3E-03	2.1E-03	4.0E-07	1.8E-01	5.2E-02		2.4E-01	
Fluorene	8.3E+01	1.1E-03	2.3E-04	5.8E-08	2.7E-02	5.8E-03		3.2E-02	
Indeno(*1,2,3-cd*)pyrene	1.2E+02	1.5E-03	4.2E-04	8.0E-08					
Naphthalene	1.9E+01	2.4E-04	6.8E-05	1.3E-08	1.2E-02	3.4E-03	1.5E-05	1.5E-02	
Pyrene	5.5E+02	7.1E-03	2.0E-03	3.8E-07	2.4E-01	6.8E-02		3.0E-01	
Organics Pathway Total					7.9E-01	2.0E-01	1.5E-05	1.0E+00	
Pathway Total - Chemicals					2.2E+00	2.7E-01	8.3E-03	2.4E+00	H
Recreational - Hunter/Fisher									
Aluminum	1.5E+04	2.8E-05	1.8E-06	6.1E-09	2.8E-05	1.8E-06	4.3E-06	3.4E-05	
Antimony	4.1E+00	8.1E-09	5.0E-10	1.8E-12	2.0E-05	8.4E-06		2.9E-05	
Arsenic	1.5E+01	3.0E-08	5.6E-08	6.5E-12	1.0E-04	1.9E-04		2.9E-04	
Cadmium	2.1E+00	4.1E-09	2.5E-10	8.8E-13	4.1E-06	1.0E-05		1.4E-05	
Chromium	5.2E+01	1.0E-07	6.4E-09	2.2E-11	3.4E-05	8.5E-05	7.7E-07	1.2E-04	
Copper	9.4E+01	1.8E-07	1.1E-08	4.0E-11	4.6E-06	2.9E-07		4.9E-06	
Thallium	4.0E-01	7.8E-10	4.9E-11	1.7E-13	9.7E-06	6.1E-07		1.0E-05	
Vanadium	2.5E+01	5.0E-08	3.1E-09	1.1E-11	7.1E-06	1.7E-05		2.4E-05	
Inorganics Pathway Total					2.1E-04	3.1E-04	5.1E-06	5.2E-04	
1,3-Dinitrobenzene	7.8E-01	1.5E-09	9.5E-09	3.3E-13	1.5E-05	9.5E-05		1.1E-04	
2,4,6-Trinitrotoluene	8.0E-01	1.6E-09	9.7E-09	3.4E-13	3.1E-06	1.9E-05		2.3E-05	
2,6-Dinitrotoluene	1.6E+00	3.1E-09	1.9E-08	6.7E-13	3.1E-06	1.9E-05		2.2E-05	
2-Methylnaphthalene	1.2E+01	2.3E-08	1.4E-07	4.9E-12	5.7E-06	3.5E-05		4.1E-05	
Benz(*a*)anthracene	2.6E+02	5.1E-07	4.1E-06	1.1E-10					
Benzo(*a*)pyrene	1.8E+02	3.5E-07	2.8E-06	7.5E-11					
Benzo(*b*)fluoranthene	2.2E+02	4.3E-07	3.5E-06	9.4E-11					
Benzo(*k*)fluoranthene	1.1E+02	2.1E-07	1.7E-06	4.5E-11					
Carbazole	8.5E+01	1.7E-07	1.0E-06	3.6E-11					
Chrysene	1.9E+02	3.6E-07	2.9E-06	7.8E-11					
Dibenz(*a,h*)anthracene	3.3E+01	6.5E-08	5.3E-07	1.4E-11					
Dibenzofuran	5.0E+01	9.8E-08	6.1E-07	2.1E-11	2.4E-05	1.5E-04		1.8E-04	
Fluoranthene	5.7E+02	1.1E-06	9.1E-06	2.4E-10	2.8E-05	2.3E-04		2.5E-04	
Fluorene	8.3E+01	1.6E-07	1.0E-06	3.5E-11	4.1E-06	2.5E-05		2.9E-05	
Indeno(*1,2,3-cd*)pyrene	1.2E+02	2.3E-07	1.8E-06	4.9E-11					
Naphthalene	1.9E+01	3.7E-08	3.0E-07	7.9E-12	1.8E-06	1.5E-05	9.2E-09	1.7E-05	
Pyrene	5.5E+02	1.1E-06	8.8E-06	2.3E-10	3.6E-05	2.9E-04		3.3E-04	
Organics Pathway Total					1.2E-04	8.8E-04	9.2E-09	1.0E-03	
Pathway Total - Chemicals					3.3E-04	1.2E-03	5.1E-06	1.5E-03	

[a] COPCs are identified as COCs if the total HI across all pathways is > 1 (H).
COC =Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HI = Hazard index.
HQ = Hazard quotient.

Table L-12. Ramsdell Quarry Landfill Surface Soil Carcinogenic Risks - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Maintained Industrial/Managed Recreational - Security Guard/Maintenance Worker									
Aluminum	1.5E+04	2.1E-04	1.2E-04	4.6E-08					
Antimony	4.1E+00	6.0E-08	3.3E-08	1.3E-11					
Arsenic	1.5E+01	2.2E-07	3.7E-06	4.8E-11	3.3E-07	5.6E-06	7.3E-10	5.9E-06	R
Cadmium	2.1E+00	3.0E-08	1.7E-08	6.6E-12			4.1E-11	4.1E-11	
Chromium	5.2E+01	7.6E-07	4.2E-07	1.6E-10			6.9E-09	6.9E-09	
Copper	9.4E+01	1.4E-06	7.6E-07	3.0E-10					
Thallium	4.0E-01	5.8E-09	3.2E-09	1.3E-12					
Vanadium	2.5E+01	3.7E-07	2.1E-07	8.0E-11					
Inorganics Pathway Total					3.3E-07	5.6E-06	7.7E-09	5.9E-06	R
1,3-Dinitrobenzene	7.8E-01	1.1E-08	6.3E-07	2.5E-12					
2,4,6-Trinitrotoluene	8.0E-01	1.2E-08	6.4E-07	2.5E-12	3.5E-10	1.9E-08		2.0E-08	
2,6-Dinitrotoluene	1.6E+00	2.3E-08	1.3E-06	5.0E-12	1.6E-08	8.6E-07		8.8E-07	
2-Methylnaphthalene	1.2E+01	1.7E-07	9.4E-06	3.7E-11					
Benz(a)anthracene	2.6E+02	3.8E-06	2.7E-04	8.2E-10	2.8E-06	2.0E-04	2.5E-10	2.0E-04	R
Benzo(a)pyrene	1.8E+02	2.6E-06	1.9E-04	5.6E-10	1.9E-05	1.4E-03	1.7E-09	1.4E-03	R
Benzo(b)fluoranthene	2.2E+02	3.2E-06	2.3E-04	7.0E-10	2.4E-06	1.7E-04	2.2E-10	1.7E-04	R
Benzo(k)fluoranthene	1.1E+02	1.6E-06	1.1E-04	3.4E-10	1.1E-07	8.2E-06	1.0E-11	8.3E-06	R
Carbazole	8.5E+01	1.2E-06	6.9E-05	2.7E-10	2.5E-08	1.4E-06		1.4E-06	R
Chrysene	1.9E+02	2.7E-06	1.9E-04	5.8E-10	2.0E-08	1.4E-06	1.8E-12	1.4E-06	R
Dibenz(a,h)anthracene	3.3E+01	4.9E-07	3.5E-05	1.1E-10	3.6E-06	2.6E-04	3.3E-10	2.6E-04	R
Dibenzofuran	5.0E+01	7.3E-07	4.0E-05	1.6E-10					
Fluoranthene	5.7E+02	8.3E-06	6.0E-04	1.8E-09					
Fluorene	8.3E+01	1.2E-06	6.7E-05	2.6E-10					
Indeno(1,2,3-cd)pyrene	1.2E+02	1.7E-06	1.2E-04	3.7E-10	1.2E-06	8.9E-05	1.1E-10	9.0E-05	R

Table L-12. Ramsdell Quarry Landfill Surface Soil Carcinogenic Risks - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Naphthalene	1.9E+01	2.7E-07	2.0E-05	5.9E-11					
Pyrene	5.5E+02	8.1E-06	5.8E-04	1.7E-09					
Organics Pathway Total					2.9E-05	2.1E-03	2.7E-09	2.1E-03	R
Pathway Total - Chemicals					2.9E-05	2.1E-03	1.0E-08	2.1E-03	R
National Guard - National Guard Fire Suppression Worker									
Aluminum	1.5E+04	5.1E-05	3.0E-06	2.4E-08					
Antimony	4.1E+00	1.4E-08	8.6E-10	6.9E-12					
Arsenic	1.5E+01	5.3E-08	9.5E-08	2.6E-11	8.0E-08	1.4E-07	3.9E-10	2.2E-07	
Cadmium	2.1E+00	7.3E-09	4.3E-10	3.5E-12			2.2E-11	2.2E-11	
Chromium	5.2E+01	1.8E-07	1.1E-08	8.8E-11			3.7E-09	3.7E-09	
Copper	9.4E+01	3.3E-07	1.9E-08	1.6E-10					
Thallium	4.0E-01	1.4E-09	8.3E-11	6.7E-13					
Vanadium	2.5E+01	8.9E-08	5.3E-09	4.3E-11					
Inorganics Pathway Total					8.0E-08	1.4E-07	4.1E-09	2.3E-07	
1,3-Dinitrobenzene	7.8E-01	2.7E-09	1.6E-08	1.3E-12					
2,4,6-Trinitrotoluene	8.0E-01	2.8E-09	1.7E-08	1.3E-12	8.3E-11	5.0E-10		5.8E-10	
2,6-Dinitrotoluene	1.6E+00	5.5E-09	3.3E-08	2.6E-12	3.7E-09	2.2E-08		2.6E-08	
2-Methylnaphthalene	1.2E+01	4.1E-08	2.4E-07	1.9E-11					
Benz(a)anthracene	2.6E+02	9.1E-07	7.0E-06	4.4E-10	6.6E-07	5.1E-06	1.3E-10	5.8E-06	R
Benzo(a)pyrene	1.8E+02	6.2E-07	4.8E-06	3.0E-10	4.5E-06	3.5E-05	9.2E-10	3.9E-05	R
Benzo(b)fluoranthene	2.2E+02	7.8E-07	6.0E-06	3.7E-10	5.7E-07	4.4E-06	1.2E-10	4.9E-06	R
Benzo(k)fluoranthene	1.1E+02	3.7E-07	2.9E-06	1.8E-10	2.7E-08	2.1E-07	5.6E-12	2.4E-07	
Carbazole	8.5E+01	3.0E-07	1.8E-06	1.4E-10	5.9E-09	3.5E-08		4.1E-08	
Chrysene	1.9E+02	6.5E-07	5.0E-06	3.1E-10	4.7E-09	3.6E-08	9.6E-13	4.1E-08	
Dibenz(a,h)anthracene	3.3E+01	1.2E-07	9.0E-07	5.6E-11	8.5E-07	6.6E-06	1.7E-10	7.4E-06	R
Dibenzofuran	5.0E+01	1.7E-07	1.0E-06	8.4E-11					
Fluoranthene	5.7E+02	2.0E-06	1.5E-05	9.6E-10					
Fluorene	8.3E+01	2.9E-07	1.7E-06	1.4E-10					
Indeno(1,2,3-cd)pyrene	1.2E+02	4.1E-07	3.1E-06	1.9E-10	3.0E-07	2.3E-06	6.0E-11	2.6E-06	R
Naphthalene	1.9E+01	6.5E-08	5.0E-07	3.1E-11					
Pyrene	5.5E+02	1.9E-06	1.5E-05	9.3E-10					
Organics Pathway Total					6.9E-06	5.4E-05	1.4E-09	6.0E-05	R
Pathway Total - Chemicals					7.0E-06	5.4E-05	5.5E-09	6.1E-05	R
National Guard - National Guard Trainee									
Aluminum	1.5E+04	7.9E-04	7.8E-06	2.1E-04					
Antimony	4.1E+00	2.3E-07	2.2E-09	6.0E-08					
Arsenic	1.5E+01	8.3E-07	2.5E-07	2.2E-07	1.3E-06	3.7E-07	3.3E-06	5.0E-06	R
Cadmium	2.1E+00	1.1E-07	1.1E-09	3.0E-08			1.9E-07	1.9E-07	
Chromium	5.2E+01	2.8E-06	2.8E-08	7.6E-07			3.2E-05	3.2E-05	R
Copper	9.4E+01	5.1E-06	5.1E-08	1.4E-06					
Thallium	4.0E-01	2.2E-08	2.1E-10	5.8E-09					
Vanadium	2.5E+01	1.4E-06	1.4E-08	3.7E-07					
Inorganics Pathway Total					1.3E-06	3.7E-07	3.5E-05	3.7E-05	R
1,3-Dinitrobenzene	7.8E-01	4.3E-08	4.2E-08	1.1E-08					
2,4,6-Trinitrotoluene	8.0E-01	4.3E-08	4.3E-08	1.2E-08	1.3E-09	1.3E-09		2.6E-09	
2,6-Dinitrotoluene	1.6E+00	8.6E-08	8.5E-08	2.3E-08	5.8E-08	5.8E-08		1.2E-07	
2-Methylnaphthalene	1.2E+01	6.3E-07	6.3E-07	1.7E-07					
Benz(a)anthracene	2.6E+02	1.4E-05	1.8E-05	3.8E-06	1.0E-05	1.3E-05	1.2E-06	2.5E-05	R
Benzo(a)pyrene	1.8E+02	9.6E-06	1.2E-05	2.6E-06	7.0E-05	9.1E-05	8.0E-06	1.7E-04	R
Benzo(b)fluoranthene	2.2E+02	1.2E-05	1.6E-05	3.2E-06	8.8E-06	1.1E-05	1.0E-06	2.1E-05	R
Benzo(k)fluoranthene	1.1E+02	5.8E-06	7.5E-06	1.6E-06	4.3E-07	5.5E-07	4.8E-08	1.0E-06	R
Carbazole	8.5E+01	4.6E-06	4.6E-06	1.2E-06	9.3E-08	9.2E-08		1.8E-07	
Chrysene	1.9E+02	1.0E-05	1.3E-05	2.7E-06	7.4E-08	9.5E-08	8.3E-09	1.8E-07	
Dibenz(a,h)anthracene	3.3E+01	1.8E-06	2.3E-06	4.9E-07	1.3E-05	1.7E-05	1.5E-06	3.2E-05	R

Table L-12. Ramsdell Quarry Landfill Surface Soil Carcinogenic Risks - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Dibenzofuran	5.0E+01	2.7E-06	2.7E-06	7.3E-07					
Fluoranthene	5.7E+02	3.1E-05	4.0E-05	8.3E-06					
Fluorene	8.3E+01	4.5E-06	4.5E-06	1.2E-06					
Indeno(1,2,3-cd)pyrene	1.2E+02	6.3E-06	8.1E-06	1.7E-06	4.6E-06	5.9E-06	5.2E-07	1.1E-05	R
Naphthalene	1.9E+01	1.0E-06	1.3E-06	2.7E-07					
Pyrene	5.5E+02	3.0E-05	3.9E-05	8.0E-06					
Organics Pathway Total					1.1E-04	1.4E-04	1.2E-05	2.6E-04	R
Pathway Total - Chemicals					1.1E-04	1.4E-04	4.8E-05	3.0E-04	R
Open Residential - Resident Farmer Adult									
Aluminum	1.5E+04	8.5E-03	1.9E-04	1.8E-06					
Antimony	4.1E+00	2.4E-06	5.5E-08	5.3E-10					
Arsenic	1.5E+01	9.0E-06	6.1E-06	1.9E-09	1.3E-05	9.2E-06	2.9E-08	2.3E-05	R
Cadmium	2.1E+00	1.2E-06	2.8E-08	2.6E-10			1.7E-09	1.7E-09	
Chromium	5.2E+01	3.1E-05	7.0E-07	6.6E-09			2.8E-07	2.8E-07	
Copper	9.4E+01	5.5E-05	1.3E-06	1.2E-08					
Thallium	4.0E-01	2.3E-07	5.3E-09	5.1E-11					
Vanadium	2.5E+01	1.5E-05	3.4E-07	3.2E-09					
Inorganics Pathway Total					1.3E-05	9.2E-06	3.1E-07	2.3E-05	R
1,3-Dinitrobenzene	7.8E-01	4.6E-07	1.0E-06	9.9E-11					
2,4,6-Trinitrotoluene	8.0E-01	4.7E-07	1.1E-06	1.0E-10	1.4E-08	3.2E-08		4.6E-08	
2,6-Dinitrotoluene	1.6E+00	9.2E-07	2.1E-06	2.0E-10	6.3E-07	1.4E-06		2.1E-06	R
2-Methylnaphthalene	1.2E+01	6.8E-06	1.6E-05	1.5E-09					
Benz(a)anthracene	2.6E+02	1.5E-04	4.5E-04	3.3E-08	1.1E-04	3.3E-04	1.0E-08	4.4E-04	R
Benzo(a)pyrene	1.8E+02	1.0E-04	3.1E-04	2.3E-08	7.6E-04	2.2E-03	7.0E-08	3.0E-03	R
Benzo(b)fluoranthene	2.2E+02	1.3E-04	3.9E-04	2.8E-08	9.5E-05	2.8E-04	8.7E-09	3.8E-04	R
Benzo(k)fluoranthene	1.1E+02	6.3E-05	1.9E-04	1.4E-08	4.6E-06	1.4E-05	4.2E-10	1.8E-05	R
Carbazole	8.5E+01	5.0E-05	1.1E-04	1.1E-08	1.0E-06	2.3E-06		3.3E-06	R
Chrysene	1.9E+02	1.1E-04	3.2E-04	2.4E-08	7.9E-07	2.4E-06	7.3E-11	3.1E-06	R
Dibenz(a,h)anthracene	3.3E+01	2.0E-05	5.8E-05	4.2E-09	1.4E-04	4.2E-04	1.3E-08	5.7E-04	R
Dibenzofuran	5.0E+01	2.9E-05	6.7E-05	6.4E-09					
Fluoranthene	5.7E+02	3.4E-04	1.0E-03	7.3E-08					
Fluorene	8.3E+01	4.9E-05	1.1E-04	1.1E-08					
Indeno(1,2,3-cd)pyrene	1.2E+02	6.8E-05	2.0E-04	1.5E-08	5.0E-05	1.5E-04	4.6E-09	2.0E-04	R
Naphthalene	1.9E+01	1.1E-05	3.3E-05	2.4E-09					
Pyrene	5.5E+02	3.3E-04	9.6E-04	7.0E-08					
Organics Pathway Total					1.2E-03	3.5E-03	1.1E-07	4.6E-03	R
Pathway Total - Chemicals					1.2E-03	3.5E-03	4.2E-07	4.6E-03	R
Open Residential - Resident Farmer Child									
Aluminum	1.5E+04	1.6E-02	3.5E-05	8.6E-07					
Antimony	4.1E+00	4.5E-06	1.0E-08	2.5E-10					
Arsenic	1.5E+01	1.7E-05	1.1E-06	9.1E-10	2.5E-05	1.7E-06	1.4E-08	2.7E-05	R
Cadmium	2.1E+00	2.3E-06	5.0E-09	1.2E-10			7.8E-10	7.8E-10	
Chromium	5.2E+01	5.7E-05	1.3E-07	3.1E-09			1.3E-07	1.3E-07	
Copper	9.4E+01	1.0E-04	2.3E-07	5.6E-09					
Thallium	4.0E-01	4.4E-07	9.6E-10	2.4E-11					
Vanadium	2.5E+01	2.8E-05	6.1E-08	1.5E-09					
Inorganics Pathway Total					2.5E-05	1.7E-06	1.4E-07	2.7E-05	R
1,3-Dinitrobenzene	7.8E-01	8.6E-07	1.9E-07	4.6E-11					
2,4,6-Trinitrotoluene	8.0E-01	8.7E-07	1.9E-07	4.7E-11	2.6E-08	5.8E-09		3.2E-08	
2,6-Dinitrotoluene	1.6E+00	1.7E-06	3.8E-07	9.3E-11	1.2E-06	2.6E-07		1.4E-06	R
2-Methylnaphthalene	1.2E+01	1.3E-05	2.8E-06	6.9E-10					
Benz(a)anthracene	2.6E+02	2.8E-04	8.1E-05	1.5E-08	2.1E-04	5.9E-05	4.8E-09	2.7E-04	R
Benzo(a)pyrene	1.8E+02	1.9E-04	5.5E-05	1.1E-08	1.4E-03	4.0E-04	3.3E-08	1.8E-03	R
Benzo(b)fluoranthene	2.2E+02	2.4E-04	7.0E-05	1.3E-08	1.8E-04	5.1E-05	4.1E-09	2.3E-04	R

Table L-12. Ramsdell Quarry Landfill Surface Soil Carcinogenic Risks - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Benzo(*k*)fluoranthene	1.1E+02	1.2E-04	3.4E-05	6.3E-09	8.6E-06	2.4E-06	2.0E-10	1.1E-05	R
Carbazole	8.5E+01	9.3E-05	2.0E-05	5.0E-09	1.9E-06	4.1E-07		2.3E-06	R
Chrysene	1.9E+02	2.0E-04	5.8E-05	1.1E-08	1.5E-06	4.2E-07	3.4E-11	1.9E-06	R
Dibenz(*a,h*)anthracene	3.3E+01	3.7E-05	1.0E-05	2.0E-09	2.7E-04	7.6E-05	6.1E-09	3.4E-04	R
Dibenzofuran	5.0E+01	5.5E-05	1.2E-05	3.0E-09					
Fluoranthene	5.7E+02	6.3E-04	1.8E-04	3.4E-08					
Fluorene	8.3E+01	9.1E-05	2.0E-05	4.9E-09					
Indeno(*1,2,3-cd*)pyrene	1.2E+02	1.3E-04	3.6E-05	6.9E-09	9.3E-05	2.7E-05	2.1E-09	1.2E-04	R
Naphthalene	1.9E+01	2.0E-05	5.9E-06	1.1E-09					
Pyrene	5.5E+02	6.1E-04	1.7E-04	3.3E-08					
Organics Pathway Total					2.2E-03	6.2E-04	5.0E-08	2.8E-03	R
Pathway Total - Chemicals					2.2E-03	6.2E-04	1.9E-07	2.8E-03	R
Recreational - Hunter/Fisher									
Aluminum	1.5E+04	1.2E-05	7.6E-07	2.6E-09					
Antimony	4.1E+00	3.5E-09	2.2E-10	7.5E-13					
Arsenic	1.5E+01	1.3E-08	2.4E-08	2.8E-12	1.9E-08	3.6E-08	4.2E-11	5.5E-08	
Cadmium	2.1E+00	1.7E-09	1.1E-10	3.8E-13			2.4E-12	2.4E-12	
Chromium	5.2E+01	4.4E-08	2.7E-09	9.5E-12			4.0E-10	4.0E-10	
Copper	9.4E+01	7.9E-08	4.9E-09	1.7E-11					
Thallium	4.0E-01	3.3E-10	2.1E-11	7.2E-14					
Vanadium	2.5E+01	2.1E-08	1.3E-09	4.6E-12					
Inorganics Pathway Total					1.9E-08	3.6E-08	4.4E-10	5.6E-08	
1,3-Dinitrobenzene	7.8E-01	6.6E-10	4.1E-09	1.4E-13					
2,4,6-Trinitrotoluene	8.0E-01	6.7E-10	4.2E-09	1.4E-13	2.0E-11	1.2E-10		1.4E-10	
2,6-Dinitrotoluene	1.6E+00	1.3E-09	8.2E-09	2.9E-13	9.0E-10	5.6E-09		6.5E-09	
2-Methylnaphthalene	1.2E+01	9.7E-09	6.1E-08	2.1E-12					
Benz(*a*)anthracene	2.6E+02	2.2E-07	1.8E-06	4.7E-11	1.6E-07	1.3E-06	1.5E-11	1.4E-06	R
Benzo(*a*)pyrene	1.8E+02	1.5E-07	1.2E-06	3.2E-11	1.1E-06	8.8E-06	1.0E-10	9.9E-06	R
Benzo(*b*)fluoranthene	2.2E+02	1.9E-07	1.5E-06	4.0E-11	1.4E-07	1.1E-06	1.2E-11	1.2E-06	R
Benzo(*k*)fluoranthene	1.1E+02	9.0E-08	7.3E-07	1.9E-11	6.6E-09	5.3E-08	6.0E-13	6.0E-08	
Carbazole	8.5E+01	7.1E-08	4.4E-07	1.5E-11	1.4E-09	8.9E-09		1.0E-08	
Chrysene	1.9E+02	1.6E-07	1.3E-06	3.4E-11	1.1E-09	9.2E-09	1.0E-13	1.0E-08	
Dibenz(*a,h*)anthracene	3.3E+01	2.8E-08	2.3E-07	6.1E-12	2.0E-07	1.7E-06	1.9E-11	1.9E-06	R
Dibenzofuran	5.0E+01	4.2E-08	2.6E-07	9.1E-12					
Fluoranthene	5.7E+02	4.8E-07	3.9E-06	1.0E-10					
Fluorene	8.3E+01	7.0E-08	4.3E-07	1.5E-11					
Indeno(*1,2,3-cd*)pyrene	1.2E+02	9.7E-08	7.9E-07	2.1E-11	7.1E-08	5.8E-07	6.5E-12	6.5E-07	
Naphthalene	1.9E+01	1.6E-08	1.3E-07	3.4E-12					
Pyrene	5.5E+02	4.6E-07	3.8E-06	1.0E-10					
Organics Pathway Total					1.7E-06	1.3E-05	1.5E-10	1.5E-05	R
Pathway Total - Chemicals					1.7E-06	1.4E-05	5.9E-10	1.5E-05	R

[a] COPCs are identified as COCs if the total ILCR across all pathways is > 1E-06 (R).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
ILCR = Incremental lifetime cancer risk.

Table L-13. Ramsdell Quarry Landfill Surface Soil Non-carcinogenic Hazards - Ingestion of Foodstuffs

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)				HQ				Total HI Across all Pathways	COC[a]
		Milk	Beef	Vegetables	Venison	Milk	Beef	Vegetables	Venison		
Open Residential - Resident Farmer Adult											
Aluminum	1.5E+04	4.4E-02	3.6E-02	4.3E+00	1.3E-06	4.4E-02	3.6E-02	4.3E+00	1.3E-06	4.4E+00	H
Antimony	4.1E+00	1.8E-06	3.1E-07	1.3E-03	1.2E-10	4.4E-03	7.6E-04	3.2E+00	3.1E-07	3.2E+00	H
Arsenic	1.5E+01	1.5E-05	5.5E-05	4.7E-03	1.8E-08	5.1E-02	1.8E-01	1.6E+01	6.2E-05	1.6E+01	H
Cadmium	2.1E+00	7.9E-05	3.2E-06	9.5E-04	6.9E-09	7.9E-02	3.2E-03	9.5E-01	6.9E-06	1.0E+00	H
Chromium	5.2E+01	8.6E-06	8.5E-04	1.5E-02	2.8E-07	2.9E-03	2.8E-01	5.2E+00	9.4E-05	5.4E+00	H
Copper	9.4E+01	6.8E-03	4.1E-03	3.6E-02	1.0E-05	1.7E-01	1.0E-01	9.1E-01	2.5E-04	1.2E+00	H
Thallium	4.0E-01	1.2E-05	2.6E-05	1.2E-04	9.6E-10	1.5E-01	3.3E-01	1.5E+00	1.2E-05	2.0E+00	H
Vanadium	2.5E+01	7.7E-06	1.1E-04	7.6E-03	5.3E-09	1.1E-03	1.5E-02	1.1E+00	7.5E-07	1.1E+00	H
Inorganics Pathway Total						5.0E-01	9.6E-01	3.3E+01	4.3E-04	3.4E+01	H
1,3-Dinitrobenzene	7.8E-01	4.9E-08	1.6E-08	1.0E-03	1.1E-11	4.9E-04	1.6E-04	1.0E+01	1.1E-07	1.0E+01	H
2,4,6-Trinitrotoluene	8.0E-01	1.2E-07	3.6E-08	5.6E-04	2.2E-11	2.3E-04	7.1E-05	1.1E+00	4.4E-08	1.1E+00	H
2,6-Dinitrotoluene	1.6E+00	1.1E-07	3.6E-08	1.9E-03	2.4E-11	1.1E-04	3.6E-05	1.9E+00	2.4E-08	1.9E+00	H
2-Methylnaphthalene	1.2E+01	1.7E-05	5.8E-06	4.0E-03	1.5E-09	4.3E-03	1.5E-03	1.0E+00	3.7E-07	1.0E+00	H
Benz(*a*)anthracene	2.6E+02	1.6E-02	5.8E-03	7.8E-02	1.9E-07						
Benzo(*a*)pyrene	1.8E+02	2.7E-02	9.3E-03	5.3E-02	1.8E-07						
Benzo(*b*)fluoranthene	2.2E+02	3.4E-02	1.2E-02	6.7E-02	2.3E-07						
Benzo(*k*)fluoranthene	1.1E+02	8.1E-02	2.8E-02	3.2E-02	2.2E-07						
Carbazole	8.5E+01	1.1E-04	3.6E-05	3.0E-02	9.9E-09						
Chrysene	1.9E+02	1.2E-02	4.1E-03	5.6E-02	1.4E-07						
Dibenz(*a,h*)anthracene	3.3E+01	2.5E-02	8.9E-03	1.0E-02	7.0E-08						
Dibenzofuran	5.0E+01	1.1E-04	3.7E-05	1.7E-02	7.5E-09	2.6E-02	9.3E-03	4.2E+00	1.9E-06	4.2E+00	H
Fluoranthene	5.7E+02	6.2E-03	2.1E-03	1.8E-01	1.9E-07	1.5E-01	5.4E-02	4.4E+00	4.8E-06	4.6E+00	H
Fluorene	8.3E+01	3.2E-04	1.1E-04	2.7E-02	1.8E-08	8.1E-03	2.7E-03	6.7E-01	4.4E-07	6.8E-01	
Indeno(*1,2,3-cd*)pyrene	1.2E+02	5.4E-02	1.9E-02	3.5E-02	2.0E-07						
Naphthalene	1.9E+01	1.0E-05	3.3E-06	7.6E-03	1.3E-09	5.1E-04	1.6E-04	3.8E-01	6.5E-08	3.8E-01	
Pyrene	5.5E+02	6.0E-03	2.1E-03	1.7E-01	1.9E-07	2.0E-01	6.9E-02	5.7E+00	6.2E-06	6.0E+00	H
Organics Pathway Total						4.0E-01	1.4E-01	3.0E+01	1.4E-05	3.0E+01	H
Pathway Total						9.0E-01	1.1E+00	6.3E+01	4.5E-04	6.5E+01	H
Open Residential - Resident Farmer Child											
Aluminum	1.5E+04	3.4E-01	1.7E-01	2.0E+01	6.1E-06	3.4E-01	1.7E-01	2.0E+01	6.1E-06	2.1E+01	H
Antimony	4.1E+00	1.4E-05	1.4E-06	5.9E-03	5.8E-10	3.4E-02	3.6E-03	1.5E+01	1.5E-06	1.5E+01	H
Arsenic	1.5E+01	1.2E-04	2.6E-04	2.2E-02	8.6E-08	3.9E-01	8.6E-01	7.3E+01	2.9E-04	7.5E+01	H

Table L-13. Ramsdell Quarry Landfill Surface Soil Non-carcinogenic Hazards - Ingestion of Foodstuffs (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)				HQ				Total HI Across all Pathways	COC[a]
		Milk	Beef	Vegetables	Venison	Milk	Beef	Vegetables	Venison		
Cadmium	2.1E+00	6.2E-04	1.5E-05	4.4E-03	3.2E-08	6.2E-01	1.5E-02	4.4E+00	3.2E-05	5.1E+00	H
Chromium	5.2E+01	6.7E-05	4.0E-03	7.2E-02	1.3E-06	2.2E-02	1.3E+00	2.4E+01	4.4E-04	2.5E+01	H
Copper	9.4E+01	5.3E-02	1.9E-02	1.7E-01	4.8E-05	1.3E+00	4.8E-01	4.2E+00	1.2E-03	6.1E+00	H
Thallium	4.0E-01	9.3E-05	1.2E-04	5.5E-04	4.5E-09	1.2E+00	1.5E+00	6.9E+00	5.6E-05	9.6E+00	H
Vanadium	2.5E+01	6.0E-05	4.9E-04	3.5E-02	2.5E-08	8.5E-03	7.1E-02	5.1E+00	3.5E-06	5.1E+00	H
Inorganics Pathway Total						3.9E+00	4.5E+00	1.5E+02	2.0E-03	1.6E+02	H
1,3-Dinitrobenzene	7.8E-01	3.9E-07	7.3E-08	4.9E-03	5.0E-11	3.9E-03	7.3E-04	4.9E+01	5.0E-07	4.9E+01	H
2,4,6-Trinitrotoluene	8.0E-01	9.0E-07	1.7E-07	2.6E-03	1.0E-10	1.8E-03	3.3E-04	5.3E+00	2.0E-07	5.3E+00	H
2,6-Dinitrotoluene	1.6E+00	8.8E-07	1.7E-07	8.9E-03	1.1E-10	8.8E-04	1.7E-04	8.9E+00	1.1E-07	8.9E+00	H
2-Methylnaphthalene	1.2E+01	1.3E-04	2.7E-05	1.9E-02	6.9E-09	3.4E-02	6.8E-03	4.7E+00	1.7E-06	4.7E+00	H
Benz(*a*)anthracene	2.6E+02	1.3E-01	2.7E-02	3.6E-01	9.1E-07						
Benzo(*a*)pyrene	1.8E+02	2.1E-01	4.3E-02	2.5E-01	8.6E-07						
Benzo(*b*)fluoranthene	2.2E+02	2.6E-01	5.4E-02	3.1E-01	1.1E-06						
Benzo(*k*)fluoranthene	1.1E+02	6.3E-01	1.3E-01	1.5E-01	1.0E-06						
Carbazole	8.5E+01	8.3E-04	1.7E-04	1.4E-01	4.6E-08						
Chrysene	1.9E+02	9.0E-02	1.9E-02	2.6E-01	6.5E-07						
Dibenz(*a,h*)anthracene	3.3E+01	2.0E-01	4.2E-02	4.6E-02	3.3E-07						
Dibenzofuran	5.0E+01	8.3E-04	1.7E-04	7.8E-02	3.5E-08	2.1E-01	4.3E-02	1.9E+01	8.8E-06	2.0E+01	H
Fluoranthene	5.7E+02	4.8E-02	1.0E-02	8.3E-01	8.9E-07	1.2E+00	2.5E-01	2.1E+01	2.2E-05	2.2E+01	H
Fluorene	8.3E+01	2.5E-03	5.1E-04	1.2E-01	8.2E-08	6.3E-02	1.3E-02	3.1E+00	2.0E-06	3.2E+00	H
Indeno(*1,2,3-cd*)pyrene	1.2E+02	4.2E-01	9.0E-02	1.6E-01	9.2E-07						
Naphthalene	1.9E+01	8.0E-05	1.5E-05	3.5E-02	6.1E-09	4.0E-03	7.7E-04	1.8E+00	3.1E-07	1.8E+00	H
Pyrene	5.5E+02	4.7E-02	9.7E-03	8.0E-01	8.6E-07	1.6E+00	3.2E-01	2.7E+01	2.9E-05	2.9E+01	H
Organics Pathway Total						3.1E+00	6.4E-01	1.4E+02	6.5E-05	1.4E+02	H
Pathway Total						7.0E+00	5.1E+00	2.9E+02	2.1E-03	3.0E+02	H

[a] COPCs are identified as COCs if the total HI across all pathways is > 1 (H).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HI = Hazard index.
HQ = Hazard quotient.

Table L-14. Ramsdell Quarry Landfill Surface Soil Carcinogenic Risks - Ingestion of Foodstuffs

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)				Risk				Total Risk Across all Pathways	COC[a]
		Milk	Beef	Vegetables	Venison	Milk	Beef	Vegetables	Venison		
Open Residential - Resident Farmer Adult											
Aluminum	1.5E+04	1.9E-02	1.6E-02	1.9E+00	5.6E-07						
Antimony	4.1E+00	7.5E-07	1.3E-07	5.5E-04	5.3E-11						
Arsenic	1.5E+01	6.5E-06	2.4E-05	2.0E-03	7.9E-09	9.8E-06	3.6E-05	3.0E-03	1.2E-08	3.1E-03	R
Cadmium	2.1E+00	3.4E-05	1.4E-06	4.1E-04	3.0E-09						
Chromium	5.2E+01	3.7E-06	3.6E-04	6.6E-03	1.2E-07						
Copper	9.4E+01	2.9E-03	1.8E-03	1.6E-02	4.4E-06						
Thallium	4.0E-01	5.1E-06	1.1E-05	5.1E-05	4.1E-10						
Vanadium	2.5E+01	3.3E-06	4.5E-05	3.3E-03	2.3E-09						
Inorganics Pathway Total						9.8E-06	3.6E-05	3.0E-03	1.2E-08	3.1E-03	R
1,3-Dinitrobenzene	7.8E-01	2.1E-08	6.7E-09	4.5E-04	4.6E-12						
2,4,6-Trinitrotoluene	8.0E-01	4.9E-08	1.5E-08	2.4E-04	9.3E-12	1.5E-09	4.6E-10	7.2E-06	2.8E-13	7.2E-06	R
2,6-Dinitrotoluene	1.6E+00	4.8E-08	1.5E-08	8.2E-04	1.0E-11	3.3E-08	1.0E-08	5.5E-04	7.1E-12	5.5E-04	R
2-Methylnaphthalene	1.2E+01	7.4E-06	2.5E-06	1.7E-03	6.3E-10						
Benz(*a*)anthracene	2.6E+02	7.0E-03	2.5E-03	3.3E-02	8.3E-08	5.1E-03	1.8E-03	2.4E-02	6.1E-08	3.1E-02	R
Benzo(*a*)pyrene	1.8E+02	1.2E-02	4.0E-03	2.3E-02	7.9E-08	8.4E-02	2.9E-02	1.7E-01	5.7E-07	2.4E-01	R
Benzo(*b*)fluoranthene	2.2E+02	1.4E-02	5.0E-03	2.9E-02	9.9E-08	1.1E-02	3.6E-03	2.1E-02	7.2E-08	3.4E-02	R
Benzo(*k*)fluoranthene	1.1E+02	3.5E-02	1.2E-02	1.4E-02	9.6E-08	2.5E-03	8.9E-04	1.0E-03	7.0E-09	4.4E-03	R
Carbazole	8.5E+01	4.5E-05	1.5E-05	1.3E-02	4.2E-09	9.1E-07	3.1E-07	2.6E-04	8.5E-11	2.6E-04	R
Chrysene	1.9E+02	5.0E-03	1.8E-03	2.4E-02	6.0E-08	3.6E-05	1.3E-05	1.7E-04	4.3E-10	2.2E-04	R
Dibenz(*a,h*)anthracene	3.3E+01	1.1E-02	3.8E-03	4.3E-03	3.0E-08	7.9E-02	2.8E-02	3.1E-02	2.2E-07	1.3E-01	R
Dibenzofuran	5.0E+01	4.5E-05	1.6E-05	7.1E-03	3.2E-09						
Fluoranthene	5.7E+02	2.7E-03	9.2E-04	7.6E-02	8.2E-08						
Fluorene	8.3E+01	1.4E-04	4.7E-05	1.1E-02	7.5E-09						
Indeno(*1,2,3-cd*)pyrene	1.2E+02	2.3E-02	8.3E-03	1.5E-02	8.5E-08	1.7E-02	6.1E-03	1.1E-02	6.2E-08	3.3E-02	R
Naphthalene	1.9E+01	4.4E-06	1.4E-06	3.2E-03	5.6E-10						
Pyrene	5.5E+02	2.6E-03	8.9E-04	7.4E-02	7.9E-08						
Organics Pathway Total						2.0E-01	6.9E-02	2.6E-01	9.9E-07	4.1E-01	R
Pathway Total						2.0E-01	6.9E-02	2.6E-01	1.0E-06	4.1E-01	R
Open Residential - Resident Farmer Child											
Aluminum	1.5E+04	2.9E-02	1.4E-02	1.7E+00	5.3E-07						
Antimony	4.1E+00	1.2E-06	1.2E-07	5.1E-04	5.0E-11						
Arsenic	1.5E+01	1.0E-05	2.2E-05	1.9E-03	7.4E-09	1.5E-05	3.3E-05	2.8E-03	1.1E-08	2.9E-03	R

Table L-14. Ramsdell Quarry Landfill Surface Soil Carcinogenic Risks - Ingestion of Foodstuffs (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)				Risk				Total Risk Across all Pathways	COC[a]
		Milk	Beef	Vegetables	Venison	Milk	Beef	Vegetables	Venison		
Cadmium	2.1E+00	5.3E-05	1.3E-06	3.8E-04	2.8E-09						
Chromium	5.2E+01	5.8E-06	3.4E-04	6.2E-03	1.1E-07						
Copper	9.4E+01	4.6E-03	1.7E-03	1.5E-02	4.1E-06						
Thallium	4.0E-01	8.0E-06	1.1E-05	4.7E-05	3.8E-10						
Vanadium	2.5E+01	5.1E-06	4.2E-05	3.0E-03	2.1E-09						
Inorganics Pathway Total						1.5E-05	3.3E-05	2.8E-03	1.1E-08	2.9E-03	R
1,3-Dinitrobenzene	7.8E-01	3.3E-08	6.2E-09	4.2E-04	4.3E-12						
2,4,6-Trinitrotoluene	8.0E-01	7.7E-08	1.4E-08	2.3E-04	8.7E-12	2.3E-09	4.3E-10	6.8E-06	2.6E-13	6.8E-06	R
2,6-Dinitrotoluene	1.6E+00	7.5E-08	1.4E-08	7.6E-04	9.7E-12	5.1E-08	9.7E-09	5.2E-04	6.6E-12	5.2E-04	R
2-Methylnaphthalene	1.2E+01	1.2E-05	2.3E-06	1.6E-03	5.9E-10						
Benz(*a*)anthracene	2.6E+02	1.1E-02	2.3E-03	3.1E-02	7.8E-08	7.9E-03	1.7E-03	2.3E-02	5.7E-08	3.2E-02	R
Benzo(*a*)pyrene	1.8E+02	1.8E-02	3.7E-03	2.1E-02	7.3E-08	1.3E-01	2.7E-02	1.5E-01	5.4E-07	2.7E-01	R
Benzo(*b*)fluoranthene	2.2E+02	2.3E-02	4.7E-03	2.7E-02	9.2E-08	1.6E-02	3.4E-03	1.9E-02	6.7E-08	3.8E-02	R
Benzo(*k*)fluoranthene	1.1E+02	5.4E-02	1.1E-02	1.3E-02	9.0E-08	3.9E-03	8.3E-04	9.3E-04	6.5E-09	5.7E-03	R
Carbazole	8.5E+01	7.1E-05	1.4E-05	1.2E-02	4.0E-09	1.4E-06	2.9E-07	2.4E-04	7.9E-11	2.4E-04	R
Chrysene	1.9E+02	7.7E-03	1.7E-03	2.2E-02	5.6E-08	5.7E-05	1.2E-05	1.6E-04	4.1E-10	2.3E-04	R
Dibenz(*a,h*)anthracene	3.3E+01	1.7E-02	3.6E-03	4.0E-03	2.8E-08	1.2E-01	2.6E-02	2.9E-02	2.0E-07	1.6E-01	R
Dibenzofuran	5.0E+01	7.1E-05	1.5E-05	6.7E-03	3.0E-09						
Fluoranthene	5.7E+02	4.1E-03	8.6E-04	7.1E-02	7.7E-08						
Fluorene	8.3E+01	2.2E-04	4.4E-05	1.1E-02	7.0E-09						
Indeno(*1,2,3-cd*)pyrene	1.2E+02	3.6E-02	7.7E-03	1.4E-02	7.9E-08	2.6E-02	5.7E-03	1.0E-02	5.8E-08	4.1E-02	R
Naphthalene	1.9E+01	6.8E-06	1.3E-06	3.0E-03	5.2E-10						
Pyrene	5.5E+02	4.0E-03	8.3E-04	6.9E-02	7.4E-08						
Organics Pathway Total						3.1E-01	6.5E-02	2.4E-01	9.3E-07	4.6E-01	R
Pathway Total						3.1E-01	6.5E-02	2.4E-01	9.4E-07	4.6E-01	R

[a] COPCs are identified as COCs if the total ILCR across all pathways is > 1E-06 (R).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
ILCR = Incrementallifetime cancer risk.

Table L-15. Ramsdell Quarry Landfill Groundwater Non-carcinogenic Hazards

COPC	EPC (mg/L)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
National Guard - National Guard Trainee									
Arsenic	6.8E-03	2.1E-05	9.7E-08		6.9E-02	3.2E-04		7.0E-02	
Manganese	6.2E+00	1.9E-02	5.8E-05		4.1E-01	3.2E-02		4.4E-01	
Inorganics Pathway Total					4.8E-01	3.2E-02		5.1E-01	
Pathway Total - Chemicals					4.8E-01	3.2E-02		5.1E-01	
Open Residential - Resident Farmer Adult									
Arsenic	6.8E-03	1.9E-04	8.7E-07		6.2E-01	2.9E-03		6.2E-01	
Manganese	6.2E+00	1.7E-01	5.2E-04		3.7E+00	2.9E-01		4.0E+00	H
Inorganics Pathway Total					4.3E+00	2.9E-01		4.6E+00	H
Pathway Total - Chemicals					4.3E+00	2.9E-01		4.6E+00	H
Open Residential - Resident Farmer Child									
Arsenic	6.8E-03	6.5E-04	1.8E-06		2.2E+00	6.1E-03		2.2E+00	H
Manganese	6.2E+00	5.9E-01	1.1E-03		1.3E+01	5.9E-01		1.3E+01	H
Inorganics Pathway Total					1.5E+01	6.0E-01		1.6E+01	H
Pathway Total - Chemicals					1.5E+01	6.0E-01		1.6E+01	H

[a] COPCs are identified as COCs if the total HI across all pathways is > 1 (H).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HI = Hazard index.
HQ = Hazard qoutient.

Table L-16. Ramsdell Quarry Landfill Groundwater Carcinogenic Risks

COPC	EPC (mg/L)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
National Guard - National Guard Trainee									
Arsenic	6.8E-03	7.4E-06	3.5E-08		1.1E-05	5.2E-08		1.1E-05	R
Manganese	6.2E+00	6.7E-03	2.1E-05						
Inorganics Pathway Total					1.1E-05	5.2E-08		1.1E-05	R
Pathway Total - Chemicals					1.1E-05	5.2E-08		1.1E-05	R
Open Residential - Resident Farmer Adult									
Arsenic	6.8E-03	8.0E-05	3.7E-07		1.2E-04	5.6E-07		1.2E-04	R
Manganese	6.2E+00	7.2E-02	2.2E-04						
Inorganics Pathway Total					1.2E-04	5.6E-07		1.2E-04	R
Pathway Total - Chemicals					1.2E-04	5.6E-07		1.2E-04	R
Open Residential - Resident Farmer Child									
Arsenic	6.8E-03	5.6E-05	1.6E-07		8.4E-05	2.3E-07		8.4E-05	R
Manganese	6.2E+00	5.1E-02	9.4E-05						
Inorganics Pathway Total					8.4E-05	2.3E-07		8.4E-05	R
Pathway Total - Chemicals					8.4E-05	2.3E-07		8.4E-05	R

[a] COPCs are identified as COCs if the total ILCR across all pathways is > 1E-06 (R).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
ILCR = Incremental lifetime cancer risk.

Table L-17. Ramsdell Quarry Landfill Sediment Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
National Guard - National Guard Trainee									
Aluminum	1.9E+04	2.9E-03	2.9E-05	7.7E-04	2.9E-03	2.9E-05	5.4E-01	5.4E-01	
Arsenic	3.3E+01	5.0E-06	1.5E-06	1.3E-06	1.7E-02	4.9E-03		2.1E-02	
Cadmium	6.4E+00	9.8E-07	9.7E-09	2.6E-07	9.8E-04	3.9E-04		1.4E-03	
Chromium	3.1E+01	4.7E-06	4.7E-08	1.3E-06	1.6E-03	6.2E-04	4.4E-02	4.6E-02	
Manganese	2.2E+03	3.4E-04	3.3E-06	8.9E-05	7.3E-03	1.8E-03	6.3E+00	6.3E+00	H
Thallium	1.5E+00	2.3E-07	2.3E-09	6.2E-08	2.9E-03	2.9E-05		2.9E-03	
Vanadium	3.5E+01	5.3E-06	5.3E-08	1.4E-06	7.6E-04	2.9E-04		1.1E-03	
Inorganics Pathway Total					3.3E-02	8.1E-03	6.8E+00	6.9E+00	H
Benzo(a)pyrene	3.4E-01	5.2E-08	6.7E-08	1.4E-08					
Organics Pathway Total									
Pathway Total - Chemicals					3.3E-02	8.1E-03	6.8E+00	6.9E+00	H
Open Residential - Resident Farmer Adult									
Aluminum	1.9E+04	2.6E-02	5.9E-04	5.6E-06	2.6E-02	5.9E-04	3.9E-03	3.1E-02	
Arsenic	3.3E+01	4.5E-05	3.0E-05	9.6E-09	1.5E-01	1.0E-01		2.5E-01	
Cadmium	6.4E+00	8.8E-06	2.0E-07	1.9E-09	8.8E-03	8.0E-03		1.7E-02	
Chromium	3.1E+01	4.2E-05	9.7E-07	9.2E-09	1.4E-02	1.3E-02	3.2E-04	2.7E-02	
Manganese	2.2E+03	3.0E-03	6.9E-05	6.5E-07	6.6E-02	3.7E-02	4.6E-02	1.5E-01	
Thallium	1.5E+00	2.1E-06	4.7E-08	4.5E-10	2.6E-02	5.9E-04		2.7E-02	
Vanadium	3.5E+01	4.8E-05	1.1E-06	1.0E-08	6.8E-03	6.0E-03		1.3E-02	
Inorganics Pathway Total					3.0E-01	1.7E-01	5.0E-02	5.1E-01	
Benzo(a)pyrene	3.4E-01	4.7E-07	1.4E-06	1.0E-10					
Organics Pathway Total									
Pathway Total - Chemicals					3.0E-01	1.7E-01	5.0E-02	5.1E-01	
Open Residential - Resident Farmer Child									
Aluminum	1.9E+04	2.4E-01	5.3E-04	1.3E-05	2.4E-01	5.3E-04	9.2E-03	2.5E-01	
Arsenic	3.3E+01	4.2E-04	2.7E-05	2.2E-08	1.4E+00	9.1E-02		1.5E+00	H
Cadmium	6.4E+00	8.2E-05	1.8E-07	4.4E-09	8.2E-02	7.2E-03		8.9E-02	
Chromium	3.1E+01	4.0E-04	8.7E-07	2.1E-08	1.3E-01	1.2E-02	7.5E-04	1.4E-01	
Manganese	2.2E+03	2.8E-02	6.2E-05	1.5E-06	6.1E-01	3.4E-02	1.1E-01	7.5E-01	

Table L-17. Ramsdell Quarry Landfill Sediment Non-carcinogenic Hazards - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Thallium	1.5E+00	1.9E-05	4.3E-08	1.1E-09	2.4E-01	5.3E-04		2.4E-01	
Vanadium	3.5E+01	4.5E-04	9.8E-07	2.4E-08	6.4E-02	5.4E-03		6.9E-02	
Inorganics Pathway Total					2.8E+00	1.5E-01	1.2E-01	3.0E+00	H
Benzo(*a*)pyrene	3.4E-01	4.3E-06	1.2E-06	2.4E-10					
Organics Pathway Total									
Pathway Total - Chemicals					2.8E+00	1.5E-01	1.2E-01	3.0E+00	H
Recreational - Hunter/Fisher									
Aluminum	1.9E+04	3.7E-05	2.3E-06	8.1E-09	3.7E-05	2.3E-06	5.6E-06	4.5E-05	
Arsenic	3.3E+01	6.4E-08	1.2E-07	1.4E-11	2.1E-04	4.0E-04		6.1E-04	
Cadmium	6.4E+00	1.3E-08	7.8E-10	2.7E-12	1.3E-05	3.1E-05		4.4E-05	
Chromium	3.1E+01	6.0E-08	3.8E-09	1.3E-11	2.0E-05	5.0E-05	4.6E-07	7.1E-05	
Manganese	2.2E+03	4.3E-06	2.7E-07	9.3E-10	9.4E-05	1.5E-04	6.5E-05	3.0E-04	
Thallium	1.5E+00	3.0E-09	1.9E-10	6.4E-13	3.7E-05	2.3E-06		4.0E-05	
Vanadium	3.5E+01	6.8E-08	4.3E-09	1.5E-11	9.8E-06	2.3E-05		3.3E-05	
Inorganics Pathway Total					4.2E-04	6.5E-04	7.1E-05	1.1E-03	
Benzo(*a*)pyrene	3.4E-01	6.7E-10	5.4E-09	1.4E-13					
Organics Pathway Total									
Pathway Total - Chemicals					4.2E-04	6.5E-04	7.1E-05	1.1E-03	

[a] COPCs are identified as COCs if the total HI across all pathways is > 1 (H).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HI = Hazard index.
HQ = Hazard quotient.

Table L-18. Ramsdell Quarry Landfill Sediment Carcinogenic Risks - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
National Guard - National Guard Fire Suppression Worker									
Aluminum	1.9E+04	6.6E-05	3.9E-06	3.2E-08					
Arsenic	3.3E+01	1.1E-07	2.0E-07	5.5E-11	1.7E-07	3.0E-07	8.2E-10	4.7E-07	
Cadmium	6.4E+00	2.2E-08	1.3E-09	1.1E-11			6.8E-11	6.8E-11	
Chromium	3.1E+01	1.1E-07	6.4E-09	5.2E-11			2.2E-09	2.2E-09	
Manganese	2.2E+03	7.7E-06	4.6E-07	3.7E-09					
Thallium	1.5E+00	5.3E-09	3.2E-10	2.6E-12					
Vanadium	3.5E+01	1.2E-07	7.3E-09	5.9E-11					
Inorganics Pathway Total					1.7E-07	3.0E-07	3.1E-09	4.8E-07	
Benzo(a)pyrene	3.4E-01	1.2E-09	9.2E-09	5.7E-13	8.7E-09	6.7E-08	1.8E-12	7.6E-08	
Organics Pathway Total					8.7E-09	6.7E-08	1.8E-12	7.6E-08	
Pathway Total - Chemicals					1.8E-07	3.7E-07	3.1E-09	5.5E-07	
National Guard - National Guard Trainee									
Aluminum	1.9E+04	1.0E-03	1.0E-05	2.8E-04					
Arsenic	3.3E+01	1.8E-06	5.3E-07	4.7E-07	2.7E-06	7.9E-07	7.1E-06	1.1E-05	R
Cadmium	6.4E+00	3.5E-07	3.5E-09	9.3E-08			5.9E-07	5.9E-07	
Chromium	3.1E+01	1.7E-06	1.7E-08	4.5E-07			1.9E-05	1.9E-05	R
Manganese	2.2E+03	1.2E-04	1.2E-06	3.2E-05					
Thallium	1.5E+00	8.3E-08	8.2E-10	2.2E-08					
Vanadium	3.5E+01	1.9E-06	1.9E-08	5.1E-07					
Inorganics Pathway Total					2.7E-06	7.9E-07	2.7E-05	3.0E-05	R
Benzo(a)pyrene	3.4E-01	1.9E-08	2.4E-08	4.9E-09	1.4E-07	1.7E-07	1.5E-08	3.2E-07	
Organics Pathway Total					1.4E-07	1.7E-07	1.5E-08	3.2E-07	
Pathway Total - Chemicals					2.8E-06	9.6E-07	2.7E-05	3.0E-05	R
Open Residential - Resident Farmer Adult									
Aluminum	1.9E+04	1.1E-02	2.5E-04	2.4E-06					
Arsenic	3.3E+01	1.9E-05	1.3E-05	4.1E-09	2.9E-05	2.0E-05	6.2E-08	4.8E-05	R
Cadmium	6.4E+00	3.8E-06	8.6E-08	8.1E-10			5.1E-09	5.1E-09	
Chromium	3.1E+01	1.8E-05	4.1E-07	3.9E-09			1.6E-07	1.6E-07	
Manganese	2.2E+03	1.3E-03	2.9E-05	2.8E-07					
Thallium	1.5E+00	8.9E-07	2.0E-08	1.9E-10					
Vanadium	3.5E+01	2.1E-05	4.7E-07	4.4E-09					
Inorganics Pathway Total					2.9E-05	2.0E-05	2.3E-07	4.8E-05	R
Benzo(a)pyrene	3.4E-01	2.0E-07	5.9E-07	4.3E-11	1.5E-06	4.3E-06	1.3E-10	5.8E-06	R
Organics Pathway Total					1.5E-06	4.3E-06	1.3E-10	5.8E-06	R
Pathway Total - Chemicals					3.0E-05	2.4E-05	2.3E-07	5.4E-05	R
Open Residential - Resident Farmer Child									
Aluminum	1.9E+04	2.1E-02	4.6E-05	1.1E-06					
Arsenic	3.3E+01	3.6E-05	2.4E-06	1.9E-09	5.3E-05	3.5E-06	2.9E-08	5.7E-05	R
Cadmium	6.4E+00	7.0E-06	1.5E-08	3.8E-10			2.4E-09	2.4E-09	
Chromium	3.1E+01	3.4E-05	7.4E-08	1.8E-09			7.7E-08	7.7E-08	
Manganese	2.2E+03	2.4E-03	5.3E-06	1.3E-07					

Table L-18. Ramsdell Quarry Landfill Sediment Carcinogenic Risks - Direct Contact (continued)

COPC	EPC (mg/kg)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Thallium	1.5E+00	1.7E-06	3.7E-09	9.0E-11					
Vanadium	3.5E+01	3.8E-05	8.4E-08	2.1E-09					
Inorganics Pathway Total					5.3E-05	3.5E-06	1.1E-07	5.7E-05	R
Benzo(*a*)pyrene	3.4E-01	3.7E-07	1.1E-07	2.0E-11	2.7E-06	7.8E-07	6.3E-11	3.5E-06	R
Organics Pathway Total					2.7E-06	7.8E-07	6.3E-11	3.5E-06	R
Pathway Total - Chemicals					5.6E-05	4.3E-06	1.1E-07	6.1E-05	R
Recreational - Hunter/Fisher									
Aluminum	1.9E+04	1.6E-05	9.9E-07	3.5E-09					
Arsenic	3.3E+01	2.7E-08	5.1E-08	5.9E-12	4.1E-08	7.7E-08	8.9E-11	1.2E-07	
Cadmium	6.4E+00	5.4E-09	3.3E-10	1.2E-12			7.3E-12	7.3E-12	
Chromium	3.1E+01	2.6E-08	1.6E-09	5.6E-12			2.4E-10	2.4E-10	
Manganese	2.2E+03	1.8E-06	1.2E-07	4.0E-10					
Thallium	1.5E+00	1.3E-09	8.0E-11	2.8E-13					
Vanadium	3.5E+01	2.9E-08	1.8E-09	6.4E-12					
Inorganics Pathway Total					4.1E-08	7.7E-08	3.3E-10	1.2E-07	
Benzo(*a*)pyrene	3.4E-01	2.9E-10	2.3E-09	6.2E-14	2.1E-09	1.7E-08	1.9E-13	1.9E-08	
Organics Pathway Total					2.1E-09	1.7E-08	1.9E-13	1.9E-08	
Pathway Total - Chemicals					4.3E-08	9.3E-08	3.3E-10	1.4E-07	

[a] COPCs are identified as COCs if the total ILCR across all pathways is > 1E-06 (R).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
ILCR = Incremental lifetime cancer risk.

Table L-19. Ramsdell Quarry Landfill Surface Water Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/L)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
National Guard - National Guard Fire Suppression Worker									
Aluminum	5.0E+01	2.9E-03	8.2E-04		2.9E-03	8.2E-04		3.7E-04	
Arsenic	2.2E-02	1.3E-06	3.3E-07		4.3E-03	1.1E-03		5.4E-03	
Manganese	5.6E+00	3.3E-04	5.6E-05		7.2E-03	3.0E-02		3.7E-02	
Vanadium	4.7E-02	2.8E-06	4.9E-07		4.0E-04	2.7E-03		3.1E-03	
Inorganics Pathway Total					1.5E-02	3.5E-02		5.0E-02	
Aldrin	1.2E-05	7.0E-10	4.3E-08		2.3E-05	1.4E-03		1.5E-03	
Methylene chloride	5.5E-03	3.2E-07	1.9E-07		5.4E-06	3.2E-06		8.6E-06	
Tetrachloroethene	6.0E-04	3.5E-08	2.2E-07		3.5E-06	2.2E-05		2.6E-05	
Organics Pathway Total					3.2E-05	1.5E-03		1.5E-03	
Pathway Total - Chemicals					1.5E-02	3.6E-02		5.1E-02	
National Guard - National Guard Trainee									
Aluminum	5.0E+01	7.6E-03	1.3E-02		7.6E-03	1.3E-02		2.0E-02	
Arsenic	2.2E-02	3.4E-06	5.2E-06		1.1E-02	1.7E-02		2.8E-02	
Manganese	5.6E+00	8.6E-04	8.7E-04		1.9E-02	4.7E-01		4.9E-01	
Vanadium	4.7E-02	7.2E-06	7.7E-06		1.0E-03	4.2E-02		4.3E-02	
Inorganics Pathway Total					3.8E-02	5.4E-01		5.8E-01	
Aldrin	1.2E-05	1.8E-09	6.8E-07		6.1E-05	2.3E-02		2.3E-02	
Methylene chloride	5.5E-03	8.4E-07	3.0E-06		1.4E-05	5.0E-05		6.4E-05	
Tetrachloroethene	6.0E-04	9.2E-08	3.5E-06		9.2E-06	3.5E-04		3.6E-04	
Organics Pathway Total					8.4E-05	2.3E-02		2.3E-02	
Pathway Total - Chemicals					3.9E-02	5.7E-01		6.1E-01	
Open Residential - Resident Farmer Adult									
Aluminum	5.0E+01	6.8E-02	2.1E-02		6.8E-02	2.1E-02		8.9E-02	
Arsenic	2.2E-02	3.0E-05	8.3E-06		1.0E-01	2.8E-02		1.3E-01	
Manganese	5.6E+00	7.7E-03	1.4E-03		1.7E-01	7.6E-01		9.3E-01	
Vanadium	4.7E-02	6.5E-05	1.2E-05		9.2E-03	6.8E-02		7.8E-02	
Inorganics Pathway Total					3.5E-01	8.8E-01		1.2E+00	H
Aldrin	1.2E-05	1.6E-08	1.1E-06		5.5E-04	3.6E-02		3.7E-02	
Methylene chloride	5.5E-03	7.6E-06	4.8E-06		1.3E-04	8.0E-05		2.1E-04	
Tetrachloroethene	6.0E-04	8.2E-07	5.6E-06		8.2E-05	5.6E-04		6.5E-04	
Organics Pathway Total					7.6E-04	3.7E-02		3.8E-02	
Pathway Total - Chemicals					3.5E-01	9.2E-01		1.3E+00	H
Open Residential - Resident Farmer Child									
Aluminum	5.0E+01	3.2E-01	3.7E-02		3.2E-01	3.7E-02		3.5E-01	
Arsenic	2.2E-02	1.4E-04	1.5E-05		4.7E-01	5.0E-02		5.2E-01	
Manganese	5.6E+00	3.6E-02	2.5E-03		7.8E-01	1.4E+00		2.2E+00	H
Vanadium	4.7E-02	3.0E-04	2.2E-05		4.3E-02	1.2E-01		1.7E-01	
Inorganics Pathway Total					1.6E+00	1.6E+00		3.2E+00	H
Aldrin	1.2E-05	7.7E-08	2.0E-06		2.6E-03	6.6E-02		6.8E-02	
Methylene Chloride	5.5E-03	3.5E-05	8.7E-06		5.9E-04	1.4E-04		7.3E-04	
Tetrachloroethene	6.0E-04	3.8E-06	1.0E-05		3.8E-04	1.0E-03		1.4E-03	

Table L-19. Ramsdell Quarry Landfill Surface Water Non-carcinogenic Hazards - Direct Contact (continued)

COPC	EPC (mg/L)	Daily Intake (mg/kg-day)			HQ			Total HI Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Organics Pathway Total					3.5E-03	6.7E-02		7.0E-02	
Pathway Total - Chemicals					1.6E+00	1.7E+00		3.3E+00	H
Recreational - Hunter/Fisher									
Aluminum	5.0E+01	1.9E-04	2.6E-04		1.9E-04	2.6E-04		4.5E-04	
Arsenic	2.2E-02	8.6E-08	1.0E-07		2.9E-04	3.5E-04		6.4E-04	
Manganese	5.6E+00	2.2E-05	1.8E-05		4.8E-04	9.5E-03		1.0E-02	
Vanadium	4.7E-02	1.8E-07	1.6E-07		2.6E-05	8.6E-04		8.8E-04	
Inorganics Pathway Total					9.9E-04	1.1E-02		1.2E-02	
Aldrin	1.2E-05	4.7E-11	1.4E-08		1.6E-06	4.6E-04		4.6E-04	
Methylene Chloride	5.5E-03	2.2E-08	6.0E-08		3.6E-07	1.0E-06		1.4E-06	
Tetrachloroethene	6.0E-04	2.3E-09	7.0E-08		2.3E-07	7.0E-06		7.3E-06	
Organics Pathway Total					2.2E-06	4.6E-04		4.7E-04	
Pathway Total - Chemicals					9.9E-04	1.1E-02		1.2E-02	

[a] COPCs are identified as COCs if the total HI across all pathways is > 1 (H).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HI = Hazard index.
HQ = Hazard quotient.

Table L-20. Ramsdell Quarry Landfill Surface Water Carcinogenic Risks - Direct Contact

COPC	EPC (mg/L)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
National Guard - National Guard Fire Suppression Worker									
Aluminum	5.0E+01	1.0E-03	2.9E-04						
Arsenic	2.2E-02	4.6E-07	1.2E-07		7.0E-07	1.8E-07		8.7E-07	
Manganese	5.6E+00	1.2E-04	2.0E-05						
Vanadium	4.7E-02	9.9E-07	1.8E-07						
Inorganics Pathway Total					7.0E-07	1.8E-07		8.7E-07	
Aldrin	1.2E-05	2.5E-10	1.6E-08		4.3E-09	2.6E-07		2.7E-07	
Methylene chloride	5.5E-03	1.2E-07	6.8E-08		8.7E-10	5.1E-10		1.4E-09	
Tetrachloroethene	6.0E-04	1.3E-08	8.0E-08		6.5E-10	4.2E-09		4.8E-09	
Organics Pathway Total					5.8E-09	2.7E-07		2.7E-07	
Pathway Total - Chemicals					7.0E-07	4.5E-07		1.1E-06	R
National Guard - National Guard Trainee									
Aluminum	5.0E+01	2.7E-03	4.6E-03						
Arsenic	2.2E-02	1.2E-06	1.8E-06		1.8E-06	2.8E-06		4.6E-06	R
Manganese	5.6E+00	3.1E-04	3.1E-04						
Vanadium	4.7E-02	2.6E-06	2.8E-06						
Inorganics Pathway Total					1.8E-06	2.8E-06		4.6E-06	R
Aldrin	1.2E-05	6.5E-10	2.4E-07		1.1E-08	4.1E-06		4.1E-06	R
Methylene chloride	5.5E-03	3.0E-07	1.1E-06		2.3E-09	8.0E-09		1.0E-08	
Tetrachloroethene	6.0E-04	3.3E-08	1.2E-06		1.7E-09	6.5E-08		6.6E-08	
Organics Pathway Total					1.5E-08	4.2E-06		4.2E-06	R
Pathway Total - Chemicals					1.8E-06	6.9E-06		8.8E-06	R
Open Residential - Resident Farmer Adult									
Aluminum	5.0E+01	2.9E-02	8.9E-03						
Arsenic	2.2E-02	1.3E-05	3.6E-06		1.9E-05	5.4E-06		2.5E-05	R
Manganese	5.6E+00	3.3E-03	6.0E-04						
Vanadium	4.7E-02	2.8E-05	5.3E-06						
Inorganics Pathway Total					1.9E-05	5.4E-06		2.5E-05	R
Aldrin	1.2E-05	7.0E-09	4.7E-07		1.2E-07	8.0E-06		8.1E-06	R
Methylene chloride	5.5E-03	3.2E-06	2.1E-06		2.4E-08	1.5E-08		4.0E-08	
Tetrachloroethene	6.0E-04	3.5E-07	2.4E-06		1.8E-08	1.3E-07		1.4E-07	
Organics Pathway Total					1.6E-07	8.1E-06		8.3E-06	R
Pathway Total - Chemicals					2.0E-05	1.3E-05		3.3E-05	R
Open Residential - Resident Farmer Child									
Aluminum	5.0E+01	2.7E-02	3.2E-03						
Arsenic	2.2E-02	1.2E-05	1.3E-06		1.8E-05	1.9E-06		2.0E-05	R
Manganese	5.6E+00	3.1E-03	2.2E-04						
Vanadium	4.7E-02	2.6E-05	1.9E-06						
Inorganics Pathway Total					1.8E-05	1.9E-06		2.0E-05	R
Aldrin	1.2E-05	6.6E-09	1.7E-07		1.1E-07	2.9E-06		3.0E-06	R
Methylene Chloride	5.5E-03	3.0E-06	7.4E-07		2.3E-08	5.6E-09		2.8E-08	
Tetrachloroethene	6.0E-04	3.3E-07	8.7E-07		1.7E-08	4.5E-08		6.2E-08	

Table L-20. Ramsdell Quarry Landfill Surface Water Carcinogenic Risks - Direct Contact (continued)

COPC	EPC (mg/L)	Daily Intake (mg/kg-day)			Risk			Total Risk Across all Pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
Organics Pathway Total					1.5E-07	2.9E-06		3.1E-06	R
Pathway Total - Chemicals					1.8E-05	4.9E-06		2.3E-05	R
Recreational - Hunter/Fisher									
Aluminum	5.0E+01	8.3E-05	1.1E-04						
Arsenic	2.2E-02	3.7E-08	4.5E-08		5.6E-08	6.7E-08		1.2E-07	
Manganese	5.6E+00	9.4E-06	7.5E-06						
Vanadium	4.7E-02	7.9E-08	6.7E-08						
Inorganics Pathway Total					5.6E-08	6.7E-08		1.2E-07	
Aldrin	1.2E-05	2.0E-11	5.9E-09		3.4E-10	1.0E-07		1.0E-07	
Methylene Chloride	5.5E-03	9.3E-09	2.6E-08		6.9E-11	1.9E-10		2.6E-10	
Tetrachloroethene	6.0E-04	1.0E-09	3.0E-08		5.2E-11	1.6E-09		1.6E-09	
Organics Pathway Total					4.6E-10	1.0E-07		1.0E-07	
Pathway Total - Chemicals					5.6E-08	1.7E-07		2.2E-07	

[a] COPCs are identified as COCs if the total ILCR across all pathways is > 1E-06 (R).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
ILCR = Incremental lifetime cancer risk.

Table L-21. Ramsdell Quarry Landfill Risks and Hazards for the Ingestion of Waterfowl Pathway

COPC	EPC (mg/kg)	Non-carcinogenic		Carcinogenic		COC[a]
		Daily Intake (mg/kg-day)	Total HI	Daily Intake (mg/kg-day)	Total Risk	
Recreational - Hunter/Fisher						
Aluminum	1.3E+03	2.4E-01	2.4E-01	1.0E-01		H
Arsenic	2.9E+00	5.5E-04	1.8E+00	2.4E-04	3.5E-04	R,H
Cadmium	5.9E-01	1.1E-04	1.1E-01	4.7E-05		H
Chromium	3.8E+00	7.1E-04	2.4E-01	3.0E-04		H
Manganese	3.8E+01	7.1E-03	5.1E-02	3.1E-03		
Thallium	2.7E+00	5.2E-04	6.5E+00	2.2E-04		H
Vanadium	3.9E+00	7.4E-04	1.1E-01	3.2E-04		H
Inorganics Pathway Total			9.0E+00		3.5E-04	R,H
Aldrin	2.3E-05	4.3E-09	1.4E-04	1.8E-09	3.1E-08	
Benzo(*a*)pyrene	9.1E-01	1.7E-04		7.3E-05	5.3E-04	R
Methylene Chloride	7.9E-07	1.5E-10	2.5E-09	6.4E-11	4.8E-13	
Tetrachloroethene	3.1E-07	5.8E-11	5.8E-09	2.5E-11	1.3E-12	
Organics Pathway Total			1.4E-04		5.3E-04	R
Pathway Total			9.0E+00		8.9E-04	R,H

[a] COPCs are identified as COCs if the total ILCR is > 1E-06 (R) or total HI is > 1 (H).
COC = Chemical of concern.
COPC = Chemical of potential concern.
EPC = Exposure point concentration.
HI = Hazard index.
ILCR = Incremental lifetime cancer risk.

- ingestion of surface water; and
- incidental ingestion of sediment.

The values and sources of all biouptake and concentration factors used in the calculation of duck tissue concentrations are given in Table L-22.

L3.1.1 Estimating Aquatic Plant Tissue Concentrations

The exposure concentrations (ECs) of inorganic COPCs (metals) in aquatic plant tissues eaten by dabbling ducks are assumed to result primarily from uptake from sediment by rooted aquatic plants. The resulting concentrations are estimated using soil-to-plant uptake factors (soil-to-plant Bv) reported by Hazardous Waste Remedial Actions Program (HAZWRAP) (1994), because it is assumed that the root uptake into plants of inorganics in sediment and soil is similar. That is, for inorganic COPCs in sediment,

$$\text{Aquatic Plant EC} = \text{soil-to-plant Bv} \times \text{Sediment EC}.$$

For organic COPCs, plant tissue concentrations are estimated from water-to-algae uptake factors (water-to-algae Bv) recommended in U. S. Environmental Protection Agency (EPA) guidance for screening-level risk assessments at hazardous waste combustion facilities (EPA 1999). For organic COPCs, the Bv is multiplied by the larger of the measured surface water EC and estimated sediment porewater ECs, representing floating plants and rooted plants, respectively. That is, for organic COPCs,

$$\text{Aquatic Plant EC} = \text{water-to-algae Bv} \times \text{Surface Water EC}$$

or

$$\text{Aquatic Plant EC} = \text{water-to-algae Bv} \times \text{Sediment Porewater EC}.$$

The method of estimating sediment porewater ECs is described in Section L3.1.3, following the method for estimating sediment invertebrate tissue ECs.

L3.1.2 Estimating Sediment Invertebrate Tissue Concentrations

Water-to-tissue bioconcentration factors (BCF_{inv}) and sediment-to-tissue bioaccumulation factors (BSAFs) are required to predict the tissue concentration in sediment invertebrates exposed to COPCs in sediment. The values used are those recommended in EPA (1999). For organic COPCs with log octanol-water partitioning coefficient (K_{ow}) ≤ 5 (i.e., nitrocellulose and phenanthrene), the sediment porewater EC and BCF_{inv} are used to estimate the tissue concentration in sediment invertebrates. For inorganic COPCs and organic COPCs with log $K_{ow} > 5$ [i.e., 2,4,6-trinitrotoluene and benzo(*b*)fluoranthene], the sediment EC and BSAF are used. That is, for inorganic COPCs and organic COPCs with log $K_{ow} > 5$,

$$\text{Sediment Invertebrate EC} = \text{BSAF} \times \text{Sediment EC},$$

and for organic COPCs with log $K_{ow} \leq 5$,

$$\text{Sediment Invertebrate EC} = BCF_{inv} \times \text{Sediment Porewater EC}.$$

Table L-22. Bioaccumulation Factors for Estimating Dabbling Duck Tissue Concentrations for COPCs in Sediment and Surface Water at the Ramsdell Quarry Landfill

COPC	Koc (L/kg)		log Kow		BCFinv		Bv		BSAF		BAFv	
	Value	Source	Value	Source	Value	Source	Value	Source	Value	Source	Value	Source
Inorganics												
Aluminum	NA		NA		4.07E+03	EPA (1999)[a]	8.00E-04	Baes et al. (1984)[b]	9.00E-01	Average[c]	7.50E-02	Baes et al. (1984)[d]
Arsenic	NA		NA		7.30E+01	EPA (1999)[a]	8.00E-03	Baes et al. (1984)[b]	9.00E-01	EPA (1999)[e]	1.00E-01	Baes et al. (1984)[d]
Cadmium	NA		NA		3.46E+03	EPA (1999)[a]	1.10E-01	Baes et al. (1984)[b]	3.40E+00	EPA (1999)[e]	2.80E-02	Baes et al. (1984)[d]
Chromium	NA		NA		3.00E+03	EPA (1999)[a]	1.50E-03	Baes et al. (1984)[b]	3.90E-01	EPA (1999)[e]	2.75E-01	Baes et al. (1984)[d]
Lead	NA		NA		5.06E+03	EPA (1999)[a]	9.00E-03	Baes et al. (1984)[b]	6.30E-01	EPA (1999)[e]	1.50E-02	Baes et al. (1984)[d]
Manganese	NA		NA		4.07E+03	Average[f]	5.00E-02	Baes et al. (1984)[b]	9.00E-01	Average[c]	2.00E-02	Baes et al. (1984)[d]
Thallium	NA		NA		1.50E+04	EPA (1999)[a]	8.00E-04	Baes et al. (1984)[b]	9.00E-01	Average[c]	2.00E+00	Baes et al. (1984)[d]
Vanadium	NA		NA		4.07E+03	Average[f]	1.10E-03	Baes et al. (1984)[b]	9.00E-01	Average[c]	1.25E-01	Baes et al. (1984)[d]
Sulfate	NA		NA		4.07E+03	Average[f]	3.00E-01	Baes et al. (1984)[b]	9.00E-01	Average[c]	5.00E+00	Baes et al. (1984)[d]
Organics-Explosives												
Nitrocellulose	0.00E+00	Estimated[g]	0.00	Estimated[g]	0.00E+00	Estimated[h]	0.00E+00	Estimated[h]	0.00E+00	Estimated[h]	0.00E+00	Estimated[h]
Organics-Semivolatiles												
Aldrin	4.87E+04	EPA (1998)[i]	6.18	EPA (1998)[i]	8.21E+03	Equation 1[j]	1.04E-02	Equation 2[k]	1.35E+01	Equation 3[l]	1.90E+00	Equation 4[m]
Benzo(*a*)pyrene	9.69E+05	EPA (1998)[i]	6.13	EPA (1998)[i]	4.70E+03	EPA (1999)[a]	1.01E-02	EPA (1999)[a]	1.59E+00	EPA (1999)[e]	1.69E+00	EPA (1998)[i]
Benzo(*g,h,i*)perylene	2.68E+06	EPI Suite[n]	6.70	EPI Suite[n]	4.70E+03	Surrogate[o]	5.19E-03	Equation 2[k]	1.59E+00	Surrogate[o]	6.29E+00	Equation 4[m]
Phenanthrene	5.01E+04	EPA (1998)[i]	4.55	EPA (1998)[i]	4.70E+03	Surrogate[o]	9.08E-02	Equation 2[k]	1.59E+00	Surrogate[o]	4.46E-02	Equation 4[m]
Organics-Volatiles												
Methylene Chloride	1.00E+01	EPA (1998)[i]	1.26	EPA (1998)[i]	7.62E-01	Equation 1[j]	7.29E+00	Equation 2[k]	6.10E+00	Equation 3[l]	2.26E-05	Equation 4[m]
Tetrachloroethene	2.65E+02	EPA (1998)[i]	2.55	EPA (1998)[i]	8.68E+00	Equation 1[j]	1.31E+00	Equation 2[k]	2.62E+00	Equation 3[l]	4.41E-04	Equation 4[m]

[a] EPA 1999a. *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft*, EPA 530 D 99 001A, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at http://www.epa.gov/epaoswer/hazwaste/combust/ecorisk.htm. Table C-3.

[b] Baes, C.F., III, Sharp, R.D., Sjoreen, A.L., and Shor, R.W. 1984. *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture*, ORNL 5786, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Figure 2.1 multiplied by 0.2 to adjust from dry weight to 80% moisture wet weight.

[c] Arithmetic mean of recommended values in Table C-6 in EPA (1999a) for 14 inorganics with measured values.

[d] Baes et al. 1984, Figure 2.25 (Ff) multiplied by cattle ingestion rate of 50 kg/day.

[e] EPA 1999a, Table C-6.

[f] Arithmetic mean of recommended values in Table C-3 in EPA (1999a) for 6 inorganics with measured values.

[g] Based on the assumption that nitrocellulose, which is used to make filters to purify biological materials, does not bind to organic carbon or non-polar organics.

[h] Based on the assumption that nitrocellulose, as a polymeric biochemical, will not cross cell membranes.

[i] EPA 1998. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft,* EPA/530/D 98/001B, U. S. Environmental Protection Agency, Washington, D.C., available at http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm, Appendix A-3.

[j] Empirically developed equation for uptake of organics by aquatic invertebrates: BCFinv = 10^[0.819 x Log(Kow)-1.146] (Southworth, G.R., Beauchamp, J.J., and Schmieder, P.K. 1978. "Bioaccumulation Potential of Polycyclic Aromatic Hydrocarbons in Daphnia pulex," *Water Res*. 12:973–977).

[k] Empirically developed equation for uptake of organics by plants: Bv =10^[1.588-0.578 x log(Kow)] (Travis, C.C., and Arms, A.D. 1988. "Bioconcentration of Organics in Beef, Milk, and Vegetation," *Environ. Sci. Technol*. 22:271-274)

[l] Calculated by equilibrium partitioning (EPA 1999a). BSAF = BCFinv/(foc x Koc) = 10^[0.819 x Log(Kow)-1.146]/(foc x Koc). foc is assumed to be 0.0125.
[m] Empirically developed equation for uptake of organics into animal tissue: BTF =10^[log(Kow)-7.6)] (Travis and Arms 1988). BAFv = BTF multiplied by cattle ingestion rate of 50 kg/day.
[n] Software to calculate chemical properties by quantitative structure-activity relationships. EPI Suite was developed by the EPA's Office of Pollution, Prevention and Toxics and Syracuse Research Corporation. URL http://www.epa.gov/oppt/exposure/docs/episuitedl.htm.
[o] Values for benzo(*a*)pyrene used by SAIC as surrogates.
BAFv = Ingestion-to-tissue uptake factor for ducks.
BCFinv = Water-to-aquatic invertebrate bioconcentration factor.
BSAF = Sediment-to-benthic invertebrate bioaccumulation factor.
Bv = Soil-to-plant bioconcentration factor.
COPC = Constituent of potential concern.
Koc = Organic carbon partitioning coefficient.
Kow = Octanol-water partitioning coefficient.
NA = Not applicable.

This approach, modeled after the method of calculating fish tissue concentrations for an HHRA (EPA 1998), assumes that sediment invertebrates primarily take up COPCs either from bulk sediment or sediment porewater as a function of the COPCs' different affinities for sediment. Inorganic COPCs (metals) and organic COPCs with log $K_{ow} > 5$ are assumed to be strongly associated with sediment. The BSAF is assumed to capture the relationship between sediment invertebrate tissue concentration and bulk sediment concentration of these COPCs resulting primarily from ingestion of sediment. The organic COPCs with log $K_{ow} \leq 5$ are assumed to be less strongly associated with sediment and, thus, reach an equilibrium with sediment porewater. The BCF_{inv} for these COPCs is assumed to capture the relationship between the concentration in sediment porewater and sediment invertebrate tissue concentration resulting from direct contact and ingestion of sediment porewater.

L3.1.3 Estimating Sediment Porewater Concentrations

Sediment porewater concentrations for organic COPCs are estimated from sediment concentrations using the product of the K_{oc} and fraction organic carbon (foc) assuming equilibrium partitioning (EPA 1993b), that is,

$$\text{Sediment Porewater EC} = \text{Sediment EC}/(K_{oc} \times \text{foc}).$$

The foc is assumed to be 0.0125. The K_{oc} values for organic COPCs are from the EPA's *Estimation Program Interface (EPI) Suite* software (EPA 2003).

L3.1.4 Estimating Duck Whole-body Tissue Concentrations

Bioaccumulation in the duck from the plant and animal food, water, and sediment it ingests is estimated using the bioaccumulation factors (BAF_vs) for small birds reported in HAZWRAP (1994). The small bird BAF_vs come from Baes et al. (1984) biotransfer factors (BTFs) [i.e., ingestion-to-beef transfer (Ff) values] for cattle for inorganics and BTFs for cattle for organics, calculated from log K_{ow}, using equations in Travis and Arms (1988).

A diet of 50% plant matter and 50% animal matter is used in the calculation of dabbling ducks' (as represented by the mallard) whole-body tissue concentrations. According to EPA (1993a), female mallards, during the breeding season, consume large amounts of animals dwelling in or on the sediment of lakes and streams, while the information for males in the Louisiana coastal marsh-prairie indicates they are primarily herbivorous during the winter. Thus, the ratio of animal-to-plant food differs by sex and by time of year. The 1:1 ratio is assumed to be representative of the diet of harvested ducks. Mallards and other dabbling ducks drink water and are likely to ingest small amounts of sediment incidentally while feeding; the calculations use a conservative value of 2% of food eaten daily for the amount of sediment ingested (EPA 1993a). The food and water ingestion rates for the mallard are given in Table L-23.

For the purposes of estimating duck tissue concentrations for human health COPCs, it is assumed that ducks spend enough time at RQL prior to harvesting to achieve the predicted tissue concentration of COPCs via the different pathways.

Chemical-specific parameters used to calculate duck tissue concentration are provided in Table L-24. The calculation of duck tissue concentrations for human health COPCs at the RQL exposure unit is shown in Table L-25.

Table L-23. Receptor Parameters for Mallard Ducks[a]

Parameter	Definition	Receptor: Mallard Duck *(Anas platyrhynchos)* Value	Reference/Notes
BW	Body weight (kg)	1.134	Arithmetic mean adult males and females, throughout North America (EPA 1993)
HR	Home range (ha)	111	Adult females, spring, laying, North Dakota prairie potholes (EPA 1993)
TUF	Temporal use factor	1	Assumes ducks are present continuously at Ramsdell Quarry and do not migrate
IR_F	Food ingestion rate (g/g-day = kg/kgBW/day)[a]	0.09	Estimated by dividing free-living metabolic rate (203 kcal/kgBW/day) by the product of the energy composition of seeds (4.26 kcal/g wet wt.) and leaves/stems (0.64 kcal/g wet wt.) times their assimilation efficiencies (0.59 and 0.23, respectively), per Table 4 in EPA 1993
PF	Plant fraction	0.5	Assumed by SAIC to be average for harvested ducks based on interpretation of diets for males and females at different seasons
AF	Animal fraction	0.5	Assumed by SAIC to be average for harvested ducks based on interpretation of diets for males and females at different seasons
SF	Sediment fraction	0.02	Less than 2% (EPA 1993), assume 2%
IR_w	Water ingestion rate (g/g-day = L/kgBW/day)	0.057	Adult, arithmetic mean, both sexes (EPA 1993)

[a] Food ingestion rate (g/g-day) re-expressed as kg/kgBW/day is assumed not to include ingested soil; therefore, PF + AF = 1.0.

EPA = U. S. Environmental Protection Agency.

SAIC = Science Applications International Corporation.

Table L-24. Exposure Parameters, Measurements, and Abiotic Media Concentrations Used to Calculate Dabbling Duck Tissue Concentrations for Human Health COPCs at the Ramsdell Quarry Landfill

COPC	Koc (L/kg)	log (Kow)	Aquatic Plant Bv (kg/kg)	Sediment Invertebrate BCFinv (L/kg)	Sediment Invertebrate BSAF (kg/kg)	Bird BAFv (kg/kg)	Sediment EC (mg/kg)	Surface Water EC (ug/L)	Sediment Pore Water EC (ug/L)	Aquatic Plant EC (mg/kg)	Sediment Invertebrate EC (mg/kg)
Inorganics											
Aluminum	NA	NA	8.00E-04	4.07E+03	9.00E-01	7.50E-02	1.90E+04	4.96E+04	NA	1.52E+01	1.71E+04
Arsenic	NA	NA	8.00E-03	7.30E+01	9.00E-01	1.00E-01	3.25E+01	2.21E+01	NA	2.60E-01	2.93E+01
Cadmium	NA	NA	1.10E-01	3.46E+03	3.40E+00	2.80E-02	6.40E+00	2.97E+00	NA	7.04E-01	2.18E+01
Chromium	NA	NA	1.50E-03	3.00E+03	3.90E-01	2.75E-01	3.09E+01	2.97E+01	NA	4.64E-02	1.21E+01
Lead	NA	NA	9.00E-03	5.06E+03	6.30E-01	1.50E-02	8.11E+01	6.56E+01	NA	7.30E-01	5.11E+01
Manganese	NA	NA	5.00E-02	4.07E+03	9.00E-01	2.00E-02	2.20E+03	5.62E+03	NA	1.10E+02	1.98E+03
Thallium	NA	NA	8.00E-04	1.50E+04	9.00E-01	2.00E+00	1.52E+00	1.40E+00	NA	1.22E-03	1.37E+00
Vanadium	NA	NA	1.10E-03	4.07E+03	9.00E-01	1.25E-01	3.50E+01	4.72E+01	NA	3.85E-02	3.15E+01
Sulfate	NA	NA	3.00E-01	4.07E+03	9.00E-01	5.00E+00	0.00E+00	2.86E+05	NA	0.00E+00	0.00E+00
Organics-Explosives											
Nitrocellulose	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.07E+00	0.00E+00	NA	0.00E+00	0.00E+00
Organics-Semivolatiles											
Aldrin	4.87E+04	6.18E+00	1.04E-02	8.21E+03	1.35E+01	1.90E+00	0.00E+00	1.20E-02	0.00E+00	1.25E-07	0.00E+00
Benzo(*a*)pyrene	9.69E+05	6.13E+00	1.01E-02	4.70E+03	1.59E+00	1.69E+00	3.40E-01	0.00E+00	2.81E-02	2.84E-07	5.41E-01
Benzo(*g,h,i*)perylene	2.68E+06	6.70E+00	5.19E-03	4.70E+03	1.59E+00	6.29E+00	1.70E-01	0.00E+00	5.07E-03	2.64E-08	2.70E-01
Phenanthrene	5.01E+04	4.55E+00	9.08E-02	4.70E+03	1.59E+00	4.46E-02	5.71E-01	0.00E+00	9.12E-01	8.28E-05	4.29E+00
Organics-Volatiles											
Methylene Chloride	1.00E+01	1.26E+00	7.29E+00	7.62E-01	6.10E+00	2.26E-05	0.00E+00	5.52E+00	0.00E+00	4.02E-02	0.00E+00
Tetrachloroethene	2.65E+02	2.55E+00	1.31E+00	8.68E+00	2.62E+00	4.41E-04	0.00E+00	6.00E-01	0.00E+00	7.85E-04	0.00E+00

BAFv = Ingested material-to-bird bioconcentration factor (kg-ingest/kg-tissue) (Table L-22).
BCFinv = Water-to-invertebrate bioconcentration factor (L/kg) from EPA (1999) (Table L-22).
BSAF = Sediment-to-invertebrate bioconcentration factor (kg-sediment/kg-tissue) from EPA (1999) (Table L-22).
Bv = Aquatic plant uptake factor; soil-to-plant uptake factor (kg-sediment/kg tissue) (Table L-22).
COPC = Chemical of potential concern (for human health).
EC = Eposure concentration. Sediment EC and Surface Water EC are measured values; sediment pore water EC = Sediment EC x 1000/(Koc x f_{oc}).
f_{oc} = Fraction organic carbon in sediment (assumed to be 0.0125).
Koc = Organic carbon partitioning coefficient.
Kow = Octanol-water partitioning coefficient (for organic compounds) (Table L-22).
NA = Not applicable.
Aquatic Plant EC = larger of Surface Water EC x Bv and Sediment Pore Water EC x Bv for organic COPCs; = Sediment EC x Bv for metals.
Sediment Invertebrate EC = Sediment EC x BSAF for metals and organic COPCs with log Kow > 5; = Sediment Pore Water EC x BCFinv for organic COPCs with log(Kow)<=5.

Table L-25. Calculation of Dabbling Duck Tissue Concentrations for Human Health COPCs in Sediment and Surface Water at the Ramsdell Quarry Landfill

COPC	Sediment Intake (mg/kg/day)	Water Intake (mg/kg/day)	Aquatic Plant Intake (mg/kg/day)	Sediment Invertebrate Intake (mg/kg/day)	Duck Tissue Concentration (mg/kg)
Inorganics					
Aluminum	3.42E+01	2.83E+00	6.84E-01	7.70E+02	1.28E+03
Arsenic	5.85E-02	1.26E-03	1.17E-02	1.32E+00	2.91E+00
Cadmium	1.15E-02	1.69E-04	3.17E-02	9.79E-01	5.86E-01
Chromium	5.56E-02	1.69E-03	2.09E-03	5.42E-01	3.77E+00
Lead	1.46E-01	3.74E-03	3.28E-02	2.30E+00	7.82E-01
Manganese	3.96E+00	3.20E-01	4.95E+00	8.91E+01	3.78E+01
Thallium	2.74E-03	7.98E-05	5.47E-05	6.16E-02	2.74E+00
Vanadium	6.30E-02	2.69E-03	1.73E-03	1.42E+00	3.94E+00
Sulfate	0.00E+00	1.63E+01	0.00E+00	0.00E+00	1.43E+03
Organics-Explosives					
Nitrocellulose	5.53E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Organics-Semivolatiles					
Aldrin	0.00E+00	6.84E-07	5.61E-09	0.00E+00	2.26E-05
Benzo(*a*)pyrene	6.12E-04	0.00E+00	1.28E-08	2.43E-02	9.05E-01
Benzo(*g,h,i*)perylene	3.06E-04	0.00E+00	1.19E-09	1.22E-02	1.69E+00
Phenanthrene	1.03E-03	0.00E+00	3.73E-06	1.93E-01	1.90E-01
Organics-Volatiles					
Methylene Chloride	0.00E+00	3.15E-04	1.81E-03	0.00E+00	7.93E-07
Tetrachloroethene	0.00E+00	3.42E-05	3.53E-05	0.00E+00	3.06E-07

COPC = Chemical of potential concern (for human health).
Sediment Intake (mg/kg/day) = Sediment EC x IR_S.
Water Intake = Surface Water EC x 0.001 mg/ug x IR_W.
Aquatic Plant Intake (mg/kg/day) = Aquatic Plant EC x IR_P.
Sediment Invertebrate Intake (mg/kg/day) = Sediment Invertebrate EC x IR_A.
IR_F = Food ingestion rate (kg/kg/day) = 0.09 (Table L-23).
PF = Plant fraction of diet = 0.5 (Table L-23).
AF = Animal fraction of diet = 0.5 (Table L-23).
SF = Incidental ingested sediment as fraction of food diet = 0.02 (Table L-23).
IR_S = Sediment ingestion rate (kg/kg/day) = IR_F x SF = 0.0018.
IR_W = Water ingestion rate (L/kg/day) = 0.057 (Table L-23).
IR_P = Plant ingestion rate (kg/kg/day) = IR_F x PF = 0.045.
IR_A = Animal food ingestion rate (kg/kg/day) = IR_F x AF = 0.045.
Duck Tissue Concentration (mg/kg) = BAFv x (Sediment EC x FS + Surface Water EC x FW + Aquatic Plant EC x FP + Sediment Invertebrate EC x FA).
FS = Sediment EC x IR_S/(Sediment EC x IR_S + Surface Water EC x IR_W + Aquatic Plant EC x IR_P + Sediment Invertebrate EC x IR_A).
FW = Surface Water EC x IR_W/(Sediment EC x IR_S + Surface Water EC x IR_W + Aquatic Plant EC x IR_P + Sediment Invertebrate EC x IR_A).
FP = Aquatic Plant EC x IR_P/(Sediment EC x IR_S + Surface Water EC x IR_W + Aquatic Plant EC x IR_P + Sediment Invertebrate EC x IR_A).
FA = Sediment Invertebrate EC x IR_A/(Sediment EC x IR_S + Surface Water EC x IR_W + Aquatic Plant EC x IR_P + Sediment Invertebrate EC x IR_A).

L3.2 EXPOSURE POINT CONCENTRATIONS IN WATERFOWL TISSUE

The estimated concentrations in ducks of human health COPCs in sediment and surface water at RQL are presented in Table L-26.

Table L-26. Dabbling Duck Tissue Concentrations for COPCs in Sediment and Surface Water at the Ramsdell Quarry Landfill

COPC	Duck Tissue Concentration (mg/kg)
Inorganics	
Aluminum	1.3E+03
Arsenic	2.9E+00
Cadmium	5.9E-01
Chromium	3.8E+00
Lead	7.8E-01
Manganese	3.8E+01
Thallium	2.7E+00
Vanadium	3.9E+00
Sulfate	1.4E+03
Organics-Explosives	
Nitrocellulose	0.0E+00
Organics-Semivolatiles	
Aldrin	2.3E-05
Benzo(*a*)pyrene	9.1E-01
Benzo(*g,h,i*)perylene	1.7E+00
Phenanthrene	1.9E-01
Organics-Volatiles	
Methylene Chloride	7.9E-07
Tetrachloroethene	3.1E-07

COPC = Constituent of potential concern.

L3.3 UNCERTAINTIES IN ESTIMATING WATERFOWL CONCENTRATIONS

Published data on whole-body tissue concentrations for ducks are not available – published data are for organs – so it is difficult to compare estimated duck tissue concentrations to published measurement data. Duck BAFv values are not for specific organs. Duck-tissue concentrations of metals, e.g., chromium, lead, zinc, may be overestimated due to the use of conservative sediment-to-sediment invertebrate bioaccumulation factors, duck biouptake factors (BAFv), and duck diet (50% sediment invertebrate, 50% plant). Comparisons of other COPCs are fraught with similar limitations. The predicted values are assumed to be conservative.

L3.4 REFERENCES

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