ATTACHMENT 1 – HYPOTHETICAL FUTURE RESIDENT SCREENING ASSESSMENT

The hypothetical future resident screening assessment scenario was created in response to US Environmental Protection Agency (EPA) comments, which stated that an assessment of risks associated with residential living is necessary to determine if Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions are needed to restrict future residential land use (EPA 2007). As discussed in the remedial investigation/feasibility study work plan (Bridgewater et al. 2008), the wetlands are currently zoned as open space, and the Facility and other surrounding areas are currently zoned for industrial use. City of Portland planning documents indicate that these designations are not likely to change in the future, especially given the "Industrial Sanctuary" designation for the property where the Facility is located and the fact that the non-Facility portions of the Study Area are in a natural resource management planning area established under the City of Portland planning code. Based on this information, residential development in this area is unlikely.

Because no residential areas are currently located near the Facility and no residential developments are planned, the hypothetical future resident scenario was assessed using a screening approach, as requested by EPA. The screening assessment was based on exposure through the following routes:

- **Wetland soil and Facility soil:** dermal absorption and incidental ingestion (e.g., gardening or child play)
- **Groundwater:** dermal absorption, incidental ingestion (e.g., showering) or water ingestion (e.g., drinking water)

Because this scenario was evaluated as a screening assessment, no contaminant of potential concern (COPC) list was generated, but rather all contaminants of interest (COIs) were evaluated. Facility soil data, wetland soil data, and groundwater data were compared (separately) with cancer and non-cancer residential regional screening levels (RSLs), and groundwater data were compared with relevant drinking water criteria. In addition, groundwater data were compared with EPA maximum contaminant levels (MCLs) and non-zero MCL goals (MCLGs).

Published screening levels were used to screen data for risks to hypothetical future residents. The published screening levels consider the difference in child and adult exposure and are protective of both. An integrated lifetime approach was used to calculate residential RSLs based on carcinogenic risks. For residential RSLs based on non-cancer risks, child-specific parameters were generally used to account for the higher sensitivity of this population.

In this screening assessment, maximum concentrations were compared with cancer and non-cancer RSLs. Cancer risks were estimated by dividing the maximum concentration by the cancer RSL, and then multiplying by 1×10^{-6}, the excess cancer risk upon which the RSLs were based. Chemical-specific cancer risks were then summed to derive a total excess cancer risk estimate for all

chemicals. Non-cancer HQs were estimated by dividing the maximum concentration by the non-cancer RSL. No multiplication was needed to estimate the HQ because an HQ of 1 was used to develop the RSLs. Chemical-specific HQs were then summed, regardless of the endpoint on which the non-cancer RSL was based. It should be noted that these risk estimates likely overestimate risk because they are based on maximum concentrations rather than exposure point concentrations that reflect integrated exposure over an area. Furthermore, the sum of HQs that does not consider endpoint is not directly interpretable for risk assessment purposes. For the MCLs and non-zero MCLGs, risk estimates could not be calculated because these screening levels are not risk-based. Instead, exceedance factors (EFs), equal to the maximum concentrations divided by the MCL or non-zero MCLG, were calculated. The results of the hypothetical future resident screening assessment are summarized in Table 1.

Table 1. Summary of the Hypothetical Future Resident Screening Assessment

Exposure Medium	Criteria Source	Data	Total Risks (Detects)	
			Excess Cancer Risks	Sum of HQs
Soil	EPA residential RSLs	**Facility soil**: maximum concentration for each chemical in surface soil samples and soil berm samples (soil stockpile samples were not included, as indicated in the work plan (Bridgewater et al. 2008))	6×10^{-4}	39
		Wetland soil: maximum concentration for each chemical in surface samples (0 to 6 inches) and the top layer of subsurface cores (6 to 12 inches); residents would be unlikely to contact deeper soils	5×10^{-4}	13
Ground-water	EPA residential RSLs	**Groundwater:** maximum concentration for each chemical in shallow groundwater samples[a]	1×10^{-3}	23
	EPA MCL or non-zero MCLGs		Total EF = 35 (criteria are not risk-based, and thus risks could not be calculated)	

[a] Groundwater is addressed as a potential source of drinking water because the concentration of total dissolved solids is less than 10,000 mg/L. This criterion is based on the standards for underground sources of drinking water as defined by the Safe Drinking Water Act and underground injection control regulations.

EF – exceedance factor
EPA – US Environmental Protection Agency
MCL – maximum contaminant level
MCLG – maximum contaminant level goal
RSL – regional screening level

As presented in Table 1, total excess cancer risks were greater than EPA's target risk range of 10^{-4} to 10^{-6} and the sum of HQs was greater than 1 for all exposure media. The results of this conservative screening assessment, which used maximum concentrations, are further discussed below:

- **Facility soil:** Maximum concentrations in surface soil samples (with the exception of the soil stockpile samples[1]) were compared with cancer and non-cancer RSLs, as presented in Table 2. Table 2 also presents summary statistics, including the detection frequency, concentration range, and mean concentration. Of the 120 chemicals or chemical groups detected in Facility soil, 8 (arsenic, carcinogenic polycyclic aromatic hydrocarbon [cPAH] toxic equivalent [TEQ], naphthalene, total polychlorinated biphenyls [PCBs], total dichlorodiphenyltrichloroethanes [DDTs], benzene, ethylbenzene, and vinyl chloride) had detected concentrations greater than the cancer RSLs, and 3 (cobalt, total PCBs, and total DDTs) had detected concentrations greater than the non-cancer RSLs. Based on maximum detected concentrations, the total excess cancer risk was equal to 6×10^{-4}, and the sum of non-cancer HQs was equal to 39.
- **Wetland soil:** Maximum concentrations in surface and intermediate soil samples were compared with cancer and non-cancer RSLs, as presented in Table 3. Table 3 also presents summary statistics, including the detection frequency, concentration range, and mean concentration. Of the 100 chemicals or chemical groups detected in wetland soil, 5 (arsenic, cPAH TEQ, naphthalene, total PCBs, total DDTs) had detected concentrations greater than the cancer RSLs, and 5 (arsenic, cobalt, iron, total PCBs, and total DDTs) had detected concentrations greater than the non-cancer RSLs. Based on maximum detected concentrations, the total excess cancer risk was equal to 5×10^{-4}, and the sum of non-cancer HQs was equal to 13.
- **Groundwater:** Maximum concentrations in shallow groundwater samples were compared with cancer and non-cancer RSLs as well as with EPA MCLs and non-zero MCLGs, as presented in Table 4. Table 4 also presents summary statistics, including the detection frequency, concentration range, and mean concentration. A total of 7 chemicals or chemical groups (arsenic, naphthalene, 1,4-dichlorobenzene, total DDTs, benzene, tert-butyl methyl ether, and vinyl chloride) had detected concentrations greater than the cancer RSLs, 6 (arsenic, cobalt, iron, manganese, benzene, and chlorobenzene) had detected concentrations greater than the non-cancer RSLs, and 4 (arsenic, lead, benzene, and chlorobenzene) had detected concentrations greater than their respective MCLs or non-zero MCLGs. Based on maximum detected concentrations, the total excess cancer risk was equal to 1×10^{-3}, and the total non-cancer HI was equal to 23. Because MCLs and non-zero MCLGs are not risk-based screening levels, a total EF was calculated. This number cannot be directly interpreted as a risk estimate.

Based on the risks calculated using maximum concentrations, total excess cancer risks would be greater than 1×10^{-4} (the upper end of EPA's target risk range), and non-cancer HQs for some chemicals would be above EPA's threshold of 1 (which would result in endpoint-specific HIs greater than 1).

[1] Soil stockpile samples were excluded from this analysis because the storage of soil at the Facility was intended to be temporary (Bridgewater et al. 2008; Windward and Bridgewater 2008). Note that concentrations in soil stockpile samples are within the range of Facility soil samples.

Because risks were calculated based on maximum concentrations (rather than an upper confidence limit on the mean [UCL]) they represent an overestimation of risks. However, because excess cancer risk estimates were greater than 1×10^{-4} and HQs for some contaminants were greater than 1 using the UCLs presented in the HHRA for select contaminants, risks would likely be greater than the target risk range if the land use designation for this area were to change and the area was developed for residential use. However, as discussed previously, current land zoning and future planning documents indicate that residential development in this area is unlikely.

Table 2. Comparison of Facility Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Metals												
Aluminum	mg/kg dw	13/13	5,280 – 11,200	na	8,400	8,400				77,000	0.15	
Antimony	mg/kg dw	0/62	nd	0.2 – 4.5	nd	0.6				31		0.07
Arsenic	mg/kg dw	62/62	0.7 – 20.6 J	na	4	4	0.39	**5×10^{-5}**		22	0.9	
Barium	mg/kg dw	62/62	36.5 – 1,170 J	na	200	200				15,000	0.08	
Beryllium	mg/kg dw	13/13	0.29 – 0.601	na	0.4	0.4	1,400	4×10^{-10}		160	0.004	
Cadmium	mg/kg dw	39/62	0.2 – 3.76	0.2 – 0.3	0.6	0.4	1,800	2×10^{-9}		70	0.05	
Calcium	mg/kg dw	13/13	3,040 – 18,500	na	8,700	8,700						
Chromium	mg/kg dw	62/62	4.0 – 76	na	20	20						
Cobalt	mg/kg dw	62/62	4.1 J – 32	na	10	10	370	9×10^{-8}		23	**1.4**	
Copper	mg/kg dw	62/62	9.23 – 1,240 J	na	100	100				3,100	0.4	
Iron	mg/kg dw	13/13	1,400 – 46,200	na	28,000	28,000				55,000	0.8	
Lead	mg/kg dw	62/62	3 – 337	na	50	50				400	0.8	
Magnesium	mg/kg dw	13/13	2,880 – 5,370	na	3,800	3,800						
Manganese	mg/kg dw	13/13	158 – 977	na	470	470				1,800	0.5	
Mercury	mg/kg dw	31/62	0.03 – 6.69	0.04 – 0.06	0.4	0.2				23	0.3	
Nickel	mg/kg dw	62/62	4 – 50 J	na	20	20	13,000	4×10^{-9}		1,500	0.03	
Selenium	mg/kg dw	4/62	0.1 – 0.7 J	0.1 – 0.7	0.3	0.3				390	0.002	
Silver	mg/kg dw	12/13	0.42 – 3.16	0.4	1	1				390	0.008	
Sodium	mg/kg dw	13/13	286 – 625	na	451	451						
Thallium	mg/kg dw	0/13	nd	0.3 – 0.75	nd	0.3						
Vanadium	mg/kg dw	62/62	29.4 J – 165	na	84	84				390	0.4	
Zinc	mg/kg dw	62/62	35 – 718 J	na	200	200				23000	0.03	
PAHs												
2-Chloronaphthalene	µg/kg dw	0/30	nd	20 – 440	nd	72				6,300,000		0.00003
2-Methylnaphthalene	µg/kg dw	53/66	13 – 29,000	5 – 131	2,000	2,000				310,000	0.09	
Acenaphthene	µg/kg dw	33/66	5.3 – 28,000	4.6 – 134	1,500	760				3,400,000	0.008	
Acenaphthylene	µg/kg dw	9/66	5.3 – 597	4.6 – 390	120	47						
Anthracene	µg/kg dw	55/66	7.9 – 110,000	5 – 131	2,600	2,200				17,000,000	0.006	
Benzo(g,h,i)perylene	µg/kg dw	58/66	5.7 – 1,400 J	14 – 665	260	240						
Dibenzofuran	µg/kg dw	42/66	5.1 – 18,000	5 – 131	720	470						
Fluoranthene	µg/kg dw	60/66	9.7 – 35,000	15 – 131	1,600	1,500				2,300,000	0.02	

Table 2. Comparison of Facility Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Fluorene	µg/kg dw	35/66	7.2 – 40,000	4.6 – 134	1,900	990				2,300,000	0.02	
Naphthalene	µg/kg dw	45/66	5.8 – 19,000	5 – 242	1,100	740	3,600	**5×10^{-6}**		140,000	0.14	
Phenanthrene	µg/kg dw	60/66	7.9 – 77,000	9.7 – 131	2,600	2,400						
Pyrene	µg/kg dw	63/66	16 – 31,000	20 – 120	1,600	1,600				1,700,000	0.02	
cPAH TEQ	µg/kg dw	62/66	14.0 – 5,200	33 – 450	611	581	15	**3×10^{-4}**				
Phthalates												
Bis(2-ethylhexyl) phthalate	µg/kg dw	24/30	11 J – 5,730	56 – 133	1,300	1,000	35,000	2×10^{-7}		1,200,000	0.005	
Butyl benzyl phthalate	µg/kg dw	6/30	190 – 1,700	20 – 1,440	790	300	260,000	7×10^{-9}		12,000,000	0.00014	
Diethyl phthalate	µg/kg dw	1/30	184 J	20 – 440	184	75				49,000,000	4E-06	
Dimethyl phthalate	µg/kg dw	0/30	nd	20 – 577	nd	100						
Di-n-butyl phthalate	µg/kg dw	1/30	194	20 – 440	194	76				6,100,000	0.00003	
Di-n-octyl phthalate	µg/kg dw	0/30	nd	20 – 1,440	nd	200						
Other SVOCs												
1,2,4-Trichlorobenzene	µg/kg dw	2/62	7.2 J – 24 J	2.2 – 4,000	16	50	22,000	1×10^{-9}		62,000	0.0004	
1,2-Dichlorobenzene	µg/kg dw	11/61	1.3 JN – 980	0.9 – 440	110	30				1,900,000	0.0005	
1,3-Dichlorobenzene	µg/kg dw	4/60	1.4 J – 2.7 J	0.9 – 810	2.1	10						
1,4-Dichlorobenzene	µg/kg dw	13/61	2.2 – 99	0.9 – 810	19	20	2,400	4×10^{-8}		3,500,000	0.00003	
2,4,5-Trichlorophenol	µg/kg dw	0/30	nd	98 – 2,200	nd	360				6,100,000		0.0002
2,4,6-Trichlorophenol	µg/kg dw	0/30	nd	98 – 2,200	nd	270	44,000		3×10^{-8}	61,000		0.02
2,4-Dichlorophenol	µg/kg dw	0/30	nd	98 – 2,200	nd	230				180,000		0.006
2,4-Dimethylphenol	µg/kg dw	3/30	70 – 480	20 – 440	260	93				1,200,000	0.0004	
2,4-Dinitrophenol	µg/kg dw	0/28	nd	200 – 5,770	nd	1,100				120,000		0.02
2,4-Dinitrotoluene	µg/kg dw	0/30	nd	98 – 2,200	nd	270	1,600		7×10^{-7}	120,000		0.009
2,6-Dinitrotoluene	µg/kg dw	0/30	nd	98 – 2,880	nd	520				61,000		0.02
2-Chlorophenol	µg/kg dw	0/30	nd	20 – 440	nd	72				390,000		0.0006
2-Methylphenol	µg/kg dw	2/30	163 – 518	20 – 440	341	90				3,100,000	0.0002	
2-Nitroaniline	µg/kg dw	0/30	nd	98 – 2,200	nd	270				610,000		0.002
2-Nitrophenol	µg/kg dw	0/30	nd	98 – 2,200	nd	360						
3,3'-Dichlorobenzidine	µg/kg dw	0/29	nd	98 – 2,200	nd	370	1,100		**1×10^{-6}**			
3-Nitroaniline	µg/kg dw	0/30	nd	98 – 2,200	nd	360						
4,6-Dinitro-o-cresol	µg/kg dw	0/30	nd	200 – 4,400	nd	720				4,900		0.4
4-Bromophenyl phenyl ether	µg/kg dw	0/30	nd	20 – 440	nd	72						
4-Chloro-3-methylphenol	µg/kg dw	0/30	nd	98 – 2,200	nd	360						

Table 2. Comparison of Facility Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

							Cancer Residential RSL			Non-Cancer Residential RSL		
Chemical	**Unit**	**Detect Ratio**	**Detect or Range of Detects**	**RL or Range of RLs**	**Mean Detect**	**Mean Value**	**RSL[a]**	**Excess Cancer Risk (Max Detect)**	**Excess Cancer Risk (Half Max RL)[b]**	**RSL[a]**	**HQ (Max Detect)**	**HQ (Half Max RL)[b]**
4-Chloroaniline	µg/kg dw	0/30	nd	98 – 2,200	nd	270	2,400		5×10^{-7}	240,000		0.005
4-Chlorophenyl phenyl ether	µg/kg dw	0/30	nd	20 – 440	nd	72						
4-Methylphenol	µg/kg dw	4/30	58 – 1,240	20 – 440	600	140				310,000	0.004	
4-Nitroaniline	µg/kg dw	0/30	nd	98 – 2,200	nd	360	24,000		5×10^{-8}	240,000		0.005
4-Nitrophenol	µg/kg dw	0/30	nd	98 – 2,880	nd	520						
Acetophenone	µg/kg dw	2/13	68.2 J – 307	119 – 1,730	188	180				7,800,000	0.00004	
Aniline	µg/kg dw	0/16	nd	20 – 440	nd	72	85,000		3×10^{-9}	430,000		0.0005
Atrazine	µg/kg dw	0/13	nd	596 – 1,440	nd	375	2,100		3×10^{-7}	2,100,000		0.0003
Benzaldehyde	µg/kg dw	1/12	37.2 J	119 – 288	37.2	73.6				7,800,000	0.000005	
Benzoic acid	µg/kg dw	0/17	nd	200 – 4,400	nd	700				240,000,000		0.000009
Benzyl alcohol	µg/kg dw	0/17	nd	20 – 440	nd	70				6,100,000		0.00004
Biphenyl	µg/kg dw	5/13	44.7 J – 1,000	119 – 254	300	200				3,900,000	0.0003	
bis(2-chloroethoxy)methane	µg/kg dw	0/30	nd	20 – 440	nd	72				180,000		0.001
bis(2-chloroethyl)ether	µg/kg dw	0/30	nd	20 – 440	nd	72	210		**1×10^{-6}**			
bis(2-chloroisopropyl)ether	µg/kg dw	0/30	nd	20 – 440	nd	72	4,600		5×10^{-8}	3,100,000		0.00007
Caprolactam	µg/kg dw	0/13	nd	596 – 1,440	nd	375				31,000,000		0.00002
Carbazole	µg/kg dw	6/30	40 – 940	20 – 440	270	110						
Hexachlorobenzene	µg/kg dw	2/65	42 – 230	0.97 – 4,800	140	89	300	8×10^{-7}		49,000	0.005	
Hexachlorobutadiene	µg/kg dw	0/65	nd	0.97 – 4,000	nd	50	6,200		3×10^{-7}	61,000		0.03
Hexachlorocyclopentadiene	µg/kg dw	0/29	nd	98 – 2,200	nd	370				370,000		0.003
Hexachloroethane	µg/kg dw	0/30	nd	20 – 440	nd	72	35,000		6×10^{-9}	61,000		0.004
Isophorone	µg/kg dw	0/30	nd	20 – 440	nd	72	510,000		4×10^{-10}	12,000,000		0.00002
Nitrobenzene	µg/kg dw	0/30	nd	20 – 2,000	nd	120	4,800		2×10^{-7}	130,000		0.008
n-Nitroso-di-n-propylamine	µg/kg dw	0/30	nd	98 – 2,200	nd	230	69		**2×10^{-5}**			
n-Nitrosodiphenylamine	µg/kg dw	0/30	nd	20 – 2,500	nd	150	99,000		1×10^{-8}			
Pentachlorophenol	µg/kg dw	0/30	nd	98 – 2,200	nd	360	3,000		4×10^{-7}	1,400,000		0.0008
Phenol	µg/kg dw	2/30	156 – 825	20 – 440	491	100				18,000,000	0.00005	
PCBs												
Total PCBs	µg/kg dw	52/64	4.9 J – 32,000	32 – 160	2,000	2,000	220	**1×10^{-4}**		1,100	**29**	
Pesticides												
Total DDTs	µg/kg dw	62/65	5.0 – 78,000 J	0.6 – 2	7,000	7,000	1700	**5×10^{-5}**		36,000	**2.2**	
Aldrin	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70	29		**8×10^{-5}**	1,800		**1.3**
Dieldrin	µg/kg dw	0/65	nd	0.6 – 9,600	nd	100	30		**2×10^{-4}**	3,100		**1.5**

Table 2. Comparison of Facility Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
alpha-BHC	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70	77		**3×10^{-5}**	490,000		0.005
beta-BHC	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70	270		**9×10^{-6}**			
gamma-BHC	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70	520		**5×10^{-6}**	21,000		0.1
delta-BHC	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70						
alpha-Chlordane	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70						
gamma-Chlordane	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70						
Total chlordane	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70	1,600		**2×10^{-6}**	35,000		0.07
alpha-Endosulfan	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70				370,000		0.006
beta-Endosulfan	µg/kg dw	0/65	nd	0.6 – 9,600	nd	100						
Endosulfan sulfate	µg/kg dw	0/65	nd	0.6 – 9,600	nd	200						
Endrin	µg/kg dw	1/65	2.6	0.6 – 9,600	2.6	100				18,000	0.0001	
Endrin aldehyde	µg/kg dw	0/65	nd	0.6 – 9,600	nd	100						
Endrin ketone	µg/kg dw	0/65	nd	0.6 – 9,600	nd	100						
Heptachlor	µg/kg dw	0/65	nd	0.6 – 4,800	nd	70	110		**2×10^{-5}**	31,000		0.08
Heptachlor epoxide	µg/kg dw	0/65	nd	0.6 – 4,800	nd	80	53		**5×10^{-5}**	790		**3.0**
Methoxychlor	µg/kg dw	0/65	nd	0.6 – 48,000	nd	700				310,000		0.08
Toxaphene	µg/kg dw	0/65	nd	97 – 480,000	nd	13,000	440		**5×10^{-4}**			
VOCs												
1,1,1,2-Tetrachloroethane	µg/kg dw	0/49	nd	0.9 – 1,100	nd	20	1,900		3×10^{-7}	2,300,000		0.0002
1,1,1-Trichloroethane	µg/kg dw	1/62	170	0.9 – 1,100	170	20				8,700,000	0.00002	
1,1,2,2-Tetrachloroethane	µg/kg dw	0/60	nd	0.9 – 1,100	nd	20	560		1×10^{-6}	310,000		0.002
1,1,2-Trichloroethane	µg/kg dw	2/62	1.5 J – 41	0.9 – 1,100	21	20	1,100	4×10^{-8}		310,000	0.00013	
1,1,2-Trichlorotrifluoroethane	µg/kg dw	0/62	nd	1.8 – 2,200	nd	36				43,000,000		0.00003
1,1-Dichloroethane	µg/kg dw	3/62	1.1 – 680	0.9 – 1,100	230	30	3,300	2×10^{-7}		16,000,000	0.00004	
1,1-Dichloroethene	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20				240,000		0.002
1,1-Dichloropropene	µg/kg dw	0/49	nd	0.9 – 1,100	nd	20						
1,2,3-Trichlorobenzene	µg/kg dw	0/47	nd	4.4 – 5,600	nd	100						
1,2,3-Trichloropropane	µg/kg dw	0/47	nd	1.8 – 2,200	nd	48	5		**2×10^{-4}**	5,200		0.2
1,2,4-Trimethylbenzene	µg/kg dw	23/49	1.9 J – 40,000	0.9 – 7.1	5,000	2,000				62,000	0.6	
1,2-Dibromo-3-chloropropane	µg/kg dw	0/62	nd	4.4 – 5,600	nd	90	5.4		**5×10^{-4}**	4,900		0.6
1,2-Dibromoethane (EDB)	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	34		**2×10^{-5}**	78,000		0.007
1,2-Dichloroethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	430		**1×10^{-6}**	1,400,000		0.0004
1,2-Dichloroethene (total)	µg/kg dw	0/13	nd	2.2 – 4.7	nd	1.4				150,000		0.00002

Table 2. Comparison of Facility Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

							Cancer Residential RSL			Non-Cancer Residential RSL		
Chemical	**Unit**	**Detect Ratio**	**Detect or Range of Detects**	**RL or Range of RLs**	**Mean Detect**	**Mean Value**	**RSL[a]**	**Excess Cancer Risk (Max Detect)**	**Excess Cancer Risk (Half Max RL)[b]**	**RSL[a]**	**HQ (Max Detect)**	**HQ (Half Max RL)[b]**
1,2-Dichloropropane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	890		6×10^{-7}	16,000		0.03
1,3,5-Trimethylbenzene	µg/kg dw	18/49	1.5 – 12,000	0.9 – 120	1,000	400				780,000	0.02	
1,3-Dichloropropane	µg/kg dw	0/49	nd	0.9 – 1,100	nd	20				1,600,000		0.0003
2,2-Dichloropropane	µg/kg dw	0/49	nd	0.9 – 1,100	nd	20						
2-Chlorotoluene	µg/kg dw	0/47	nd	0.9 – 1,100	nd	20				1,600,000		0.0003
2-Hexanone	µg/kg dw	0/62	nd	4.4 – 5,600	nd	90						
4-Chlorotoluene	µg/kg dw	0/47	nd	0.9 – 1,100	nd	20				5,500,000		0.0001
Acetone	µg/kg dw	44/62	11 – 800	5.6 – 5,600	140	200				61,000,000	0.00001	
Benzene	µg/kg dw	22/62	1.1 – 6,400	0.9 – 810	310	100	1,100	**6×10^{-6}**		86,000	0.07	
Bromobenzene	µg/kg dw	0/47	nd	0.9 – 1,100	nd	20				300,000		0.002
Bromochloromethane	µg/kg dw	0/49	nd	0.9 – 1,100	nd	20						
Bromodichloromethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	270		**2×10^{-6}**	1600000		0.0003
Bromoform	µg/kg dw	0/60	nd	0.9 – 1,100	nd	20	61,000		9×10^{-9}	1,200,000		0.0005
Bromomethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20				7,300		0.08
Carbon disulfide	µg/kg dw	21/62	1.4 – 460	0.9 – 1,100	25	30				820,000	0.0006	
Carbon tetrachloride	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	610		9×10^{-7}	110,000		0.005
Chlorobenzene	µg/kg dw	7/62	1.2 JN – 320	0.9 – 1,100	110	30				290,000	0.0011	
Chloroethane	µg/kg dw	1/62	2.9	0.9 – 1,100	2.9	20						
Chloroform	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	290		**2×10^{-6}**	210,000		0.003
Chloromethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20				120,000		0.005
cis-1,2-Dichloroethene	µg/kg dw	3/62	1.6 J – 130,000	0.9 – 1,100	43,000	2,000				780,000	0.2	
cis-1,3-Dichloropropene	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	1,700		3×10^{-7}	74,000		0.007
Cyclohexane	µg/kg dw	3/13	1.3 J – 31.6 J	2.2 – 3.5	17	4.9				7,000,000	0.000005	
p-Cymene	µg/kg dw	17/49	1.3 J – 11,000 J	0.9 – 83	1,000	300						
Dibromochloromethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20	680		8×10^{-7}	1,200,000		0.0005
Dibromomethane	µg/kg dw	0/49	nd	0.9 – 1,100	nd	20				25,000		0.02
Dichlorodifluoromethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20				180,000		0.003
Dichloromethane	µg/kg dw	17/62	2.0 – 370	1.9 – 2,200	46	51						
Ethylbenzene	µg/kg dw	18/62	2.0 J – 26,000	0.9 – 120	2,100	600	5,400	**5×10^{-6}**		3,500,000	0.007	
Isopropylbenzene	µg/kg dw	19/60	1.3 – 2,300	0.9 – 120	310	100						
Methyl acetate	µg/kg dw	0/13	nd	11.1 – 23.3	nd	6.94				78,000,000		0.0000001
Methyl ethyl ketone	µg/kg dw	31/62	7.6 – 110 J	4.9 – 5,600	33	100						
Methyl isobutyl ketone	µg/kg dw	2/62	5.2 J – 18	4.4 – 5,600	12	90						

Table 2. Comparison of Facility Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Methylcyclohexane	µg/kg dw	5/13	3.7 – 185 J	2.2 – 3.5	60	20						
n-Butylbenzene	µg/kg dw	19/49	1.4 J – 12,000	0.9 – 83	1,000	400						
n-Propylbenzene	µg/kg dw	19/48	1.3 – 6,700	0.9 – 120	760	300						
sec-Butylbenzene	µg/kg dw	11/47	1.2 – 2,000	0.9 – 1,100	350	100						
Styrene	µg/kg dw	1/62	1.9	0.9 – 1,100	1.9	20				6,300,000	0.0000003	
tert-Butyl methyl ether	µg/kg dw	3/62	2.2 – 6.9	0.9 – 1,100	4.6	20	43,000	2×10^{-10}		17,000,000	0.0000004	
tert-Butylbenzene	µg/kg dw	0/47	nd	0.9 – 1,100	nd	20						
Tetrachloroethene	µg/kg dw	5/62	1.9 – 10.8 J	0.9 – 1,100	4.9	20	550	2×10^{-8}		370,000	0.00003	
Toluene	µg/kg dw	29/62	1.2 – 49,000	0.9 – 810	2,000	900				5,000,000	0.01	
trans-1,2-Dichloroethene	µg/kg dw	1/49	5,500	0.9 – 1,100	5,500	100						
trans-1,3-Dichloropropene	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20						
Trichloroethene	µg/kg dw	6/62	1.5 – 2,400	0.9 – 1,100	400	60	2,800	9×10^{-7}				
Trichlorofluoromethane	µg/kg dw	0/62	nd	0.9 – 1,100	nd	20				790,000		0.0007
Vinyl acetate	µg/kg dw	0/48	nd	4.4 – 5,600	nd	100				970,000		0.003
Vinyl chloride	µg/kg dw	1/62	1,200	0.9 – 1,100	1,200	40	60	2×10^{-5}		74,000	0.02	
o-Xylene	µg/kg dw	25/62	1.6 – 33,000	0.9 – 83	2,000	700				3,800,000	0.009	
m,p-Xylene	µg/kg dw	26/62	1.5 – 120,000 J	0.9 – 83	5,400	2,000				3,400,000	0.04	
Total xylenes	µg/kg dw	28/62	1.8 J – 150,000 J	0.9 – 83	6,000	3,000				630,000	0.2	
Petroleum												
TPH – gasoline range	mg/kg dw	28/51	5.3 – 3,800	5.6 – 12	390	220						
TPH – diesel range	mg/kg dw	60/61	6.3 – 13,000	29	1,500	1,400						
TPH – motor oil range	mg/kg dw	61/61	37 – 12,000	na	1,900	1,900						
Total Risk								**6×10^{-4}**	**2×10^{-3}**		**39**	**8**

[a] Cancer and non-cancer RSLs are from EPA (2009).
[b] Exceedance factors based on half the maximum RL are shown only for chemicals never detected in Facility soil.

BHC – benzene hexachloride
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
EDB – ethylene dibromide
EPA – US Environmental Protection Agency
HQ – hazard quotient
J – estimated concentration
N – tentative identification
na – not applicable
nd – not detected
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RL – reporting limit
RSL – regional screening level
SVOC – semivolatile organic compound
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Bold indicates excess cancer risks greater than 1×10^{-6} or non-cancer HQs greater than 1.

Table 3. Comparison of Wetland Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Metals												
Aluminum	mg/kg dw	5/5	5,990 – 12,100	na	9,500	9,500				77,000	0.2	
Antimony	mg/kg dw	7/62	0.7 J – 8.4 J	0.3 – 4.5	2	0.6				31	0.3	
Arsenic	mg/kg dw	62/62	1.5 – 53.1	na	9	9	0.39	**1×10^{-4}**		22	**2.4**	
Barium	mg/kg dw	62/62	64.5 – 481	na	190	190				15,000	0.03	
Beryllium	mg/kg dw	5/5	0.36 – 0.544	na	0.5	0.5	1,400	4×10^{-10}		160	0.003	
Cadmium	mg/kg dw	57/62	0.3 – 4	0.3 – 0.4	1	1	1,800	2×10^{-9}		70	0.06	
Calcium	mg/kg dw	5/5	3,960 – 18,500	na	9,100	9,100						
Chromium	mg/kg dw	62/62	6.6 – 149	na	30	30						
Cobalt	mg/kg dw	62/62	3.5 – 34.3	na	10	10	370	9×10^{-8}		23	**1.5**	
Copper	mg/kg dw	62/62	10.3 – 162	na	58	58				3,100	0.05	
Iron	mg/kg dw	5/5	17,400 – 56,500	na	29,500	29,500				55,000	**1.0**	
Lead	mg/kg dw	62/62	11.9 J – 320	na	70	70				400	0.8	
Magnesium	mg/kg dw	5/5	2,800 – 4,700	na	3,800	3,800						
Manganese	mg/kg dw	5/5	417 – 1,090	na	724	724				1,800	0.6	
Mercury	mg/kg dw	57/62	0.06 J – 0.4	0.07 – 0.26	0.2	0.2				23	0.02	
Nickel	mg/kg dw	62/62	10 – 48	na	20	20	13,000	4×10^{-9}		1,500	0.03	
Selenium	mg/kg dw	3/62	0.55 – 1.1	0.1 – 3	0.8	0.5				390	0.003	
Silver	mg/kg dw	5/5	0.55 – 1.5	na	0.90	0.90				390	0.004	
Sodium	mg/kg dw	5/5	311 – 850	na	500	500						
Thallium	mg/kg dw	0/5	nd	0.3 – 0.75	nd	0.3						
Vanadium	mg/kg dw	62/62	16.1 – 148	na	70	70				390	0.4	
Zinc	mg/kg dw	62/62	37 – 748	na	200	200				23,000	0.03	
PAHs												
2-Chloronaphthalene	µg/kg dw	0/19	nd	20 – 1000	nd	110				6,300,000		0.00008
2-Methylnaphthalene	µg/kg dw	57/62	5.0 – 2,880	5 – 277	230	220				310,000	0.009	
Acenaphthene	µg/kg dw	11/62	5.4 – 18	4.7 – 883	12	36				3,400,000	0.000005	
Acenaphthylene	µg/kg dw	27/62	4.8 – 836 J	4.7 – 782	73	55						
Anthracene	µg/kg dw	56/62	4.9 – 1,600	5 – 735	130	130				17,000,000	0.00009	
Benzo(g,h,i)perylene	µg/kg dw	58/62	7.6 – 6,000	72 – 3910	310	340						
Total benzofluoranthenes	µg/kg dw	58/62	35 J – 3,200	389 – 1560	410	420						
Dibenzofuran	µg/kg dw	36/62	4.8 – 781 J	4.7 – 782	77	68						

Table 3. Comparison of Wetland Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Fluoranthene	µg/kg dw	61/62	10 J – 2,690	277	300	300				2,300,000	0.0012	
Fluorene	µg/kg dw	19/62	5.4 – 417 J	4.7 – 735	60	38				2,300,000	0.0002	
Naphthalene	µg/kg dw	58/62	5.0 – 4,210	5 – 277	230	210	3,600	**1×10^{-6}**		140,000	0.03	
Phenanthrene	µg/kg dw	61/62	5.4 J – 4,370	277	280	280						
Pyrene	µg/kg dw	61/62	16 J – 4,560	277	400	400				1,700,000	0.003	
cPAHs TEQ	µg/kg dw	60/62	13.7 J – 5,200	625 – 888	387	387	15	**3×10^{-4}**				
Total PAHs	µg/kg dw	61/62	107 J – 28,190 J	2770	3,000	3,000						
Phthalates												
Bis(2-ethylhexyl)phthalate	µg/kg dw	17/19	14 J – 9,100	195 – 277	920	840	35,000	3×10^{-7}		1,200,000	0.008	
Butyl benzyl phthalate	µg/kg dw	2/19	86 – 3,140 J	20 – 3910	1,600	470	260,000	1×10^{-8}		12,000,000	0.0003	
Diethyl phthalate	µg/kg dw	0/19	nd	20 – 1000	nd	110				49,000,000		0.00001
Dimethyl phthalate	µg/kg dw	0/19	nd	20 – 1770	nd	190						
Di-n-butyl phthalate	µg/kg dw	5/19	22 – 2,400	20 – 883	530	220				6,100,000	0.0004	
Di-n-octyl phthalate	µg/kg dw	0/19	nd	20 – 4420	nd	420						
Other SVOCs												
1,2,4-Trichlorobenzene	µg/kg dw	0/49	nd	3 – 39	nd	6	22,000		9×10^{-10}	62,000		0.0003
1,2-Dichlorobenzene	µg/kg dw	0/49	nd	1.5 – 15	nd	2				1,900,000		0.000004
1,3-Dichlorobenzene	µg/kg dw	0/49	nd	1.5 – 15	nd	2						
1,4-Dichlorobenzene	µg/kg dw	2/49	2.3 J – 19 J	1.5 – 15	11	2	2,400	8×10^{-9}		3,500,000	0.000005	
2,4,5-Trichlorophenol	µg/kg dw	0/19	nd	98 – 5200	nd	570				6,100,000		0.0004
2,4,6-Trichlorophenol	µg/kg dw	0/19	nd	98 – 5200	nd	350	44,000		6×10^{-8}	61,000		0.04
2,4-Dichlorophenol	µg/kg dw	0/19	nd	98 – 5200	nd	270				180,000		0.01
2,4-Dimethylphenol	µg/kg dw	0/19	nd	20 – 1000	nd	110				1,200,000		0.0004
2,4-Dinitrophenol	µg/kg dw	0/18	nd	200 – 17700	nd	2,000				120,000		0.07
2,4-Dinitrotoluene	µg/kg dw	0/19	nd	98 – 5200	nd	350	1,600		**2×10^{-6}**	120,000		0.02
2,6-Dinitrotoluene	µg/kg dw	0/19	nd	98 – 8830	nd	950				61,000		0.07
2-Chlorophenol	µg/kg dw	0/19	nd	20 – 1000	nd	110				390,000		0.001
2-Methylphenol	µg/kg dw	0/19	nd	20 – 1000	nd	110				3,100,000		0.0002
2-Nitroaniline	µg/kg dw	0/19	nd	98 – 5200	nd	350				610,000		0.004
2-Nitrophenol	µg/kg dw	0/19	nd	98 – 5200	nd	570						
3,3'-Dichlorobenzidine	µg/kg dw	0/17	nd	98 – 5200	nd	630	1,100		**2×10^{-6}**			
3-Nitroaniline	µg/kg dw	0/19	nd	98 – 5200	nd	570						
4,6-Dinitro-o-cresol	µg/kg dw	0/18	nd	200 – 10000	nd	1,200				4,900		**1.0**

Table 3. Comparison of Wetland Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
4-Bromophenyl phenyl ether	µg/kg dw	0/19	nd	20 – 1000	nd	110						
4-Chloro-3-methylphenol	µg/kg dw	0/19	nd	98 – 5200	nd	570						
4-Chloroaniline	µg/kg dw	0/18	nd	98 – 5200	nd	360	2,400		**1×10^{-6}**	240,000		0.01
4-Chlorophenyl phenyl ether	µg/kg dw	0/19	nd	20 – 1000	nd	110						
4-Methylphenol	µg/kg dw	6/19	17 J – 190	20 – 1000	84	140				310,000	0.0006	
4-Nitroaniline	µg/kg dw	0/19	nd	98 – 5200	nd	570	24,000		1×10^{-7}	240,000		0.01
4-Nitrophenol	µg/kg dw	0/19	nd	98 – 8830	nd	950						
Acetophenone	µg/kg dw	1/5	630 J	195 – 782	630	330				7,800,000	0.00008	
Aniline	µg/kg dw	0/13	nd	20 – 1000	nd	54	85,000		6×10^{-9}	430,000		0.001
Atrazine	µg/kg dw	0/5	nd	973 – 4420	nd	1,440	2,100		**1×10^{-6}**	2,100,000		0.001
Benzaldehyde	µg/kg dw	5/5	59.6 J – 1,080 J	na	470	470				7,800,000	0.00014	
Benzoic acid	µg/kg dw	12/14	120 J – 28,000	590 – 880	2,800	2,400				2.4E+08	0.00012	
Benzyl alcohol	µg/kg dw	7/14	15 J – 2,100	20 – 99	370	190				6,100,000	0.0003	
Biphenyl	µg/kg dw	1/5	836 J	195 – 782	836	366				3,900,000	0.0002	
bis(2-chloroethoxy)methane	µg/kg dw	0/19	nd	20 – 1000	nd	110				180,000		0.003
bis(2-chloroethyl)ether	µg/kg dw	0/19	nd	20 – 1000	nd	110	210		**2×10^{-6}**			
bis(2-chloroisopropyl)ether	µg/kg dw	0/19	nd	20 – 1000	nd	110	4,600		1×10^{-7}	3,100,000		0.0002
Caprolactam	µg/kg dw	0/5	nd	973 – 4420	nd	1,440				31,000,000		0.00007
Carbazole	µg/kg dw	5/19	12 J – 66 J	20 – 1000	36	120						
Hexachlorobenzene	µg/kg dw	0/62	nd	0.96 – 883	nd	40	300		1×10^{-6}	49,000		0.009
Hexachlorobutadiene	µg/kg dw	0/62	nd	0.96 – 883	nd	38	6,200		7×10^{-8}	61,000		0.007
Hexachlorocyclopentadiene	µg/kg dw	0/18	nd	98 – 5200	nd	600				370,000		0.007
Hexachloroethane	µg/kg dw	0/19	nd	20 – 1000	nd	110	35,000		1×10^{-8}	61,000		0.008
Isophorone	µg/kg dw	0/19	nd	20 – 1000	nd	110	510,000		1×10^{-9}	12,000,000		0.00004
Nitrobenzene	µg/kg dw	0/19	nd	20 – 1000	nd	110	4800		1×10^{-7}	130,000		0.004
n-Nitroso-di-n-propylamine	µg/kg dw	0/19	nd	98 – 5200	nd	270	69		**4×10^{-5}**			
n-Nitrosodiphenylamine	µg/kg dw	0/19	nd	20 – 1000	nd	120	99,000		5×10^{-9}			
Pentachlorophenol	µg/kg dw	1/19	80 J	98 – 5200	80	580	3,000	3×10^{-8}		1,400,000	0.00006	
Phenol	µg/kg dw	5/19	53 – 498 J	20 – 1000	200	120				18,000,000	0.00003	
PCBs												
Total PCBs	µg/kg dw	38/62	35 – 4,200	32 – 990	500	300	220	**2×10^{-5}**		1,100	**3.8**	
Pesticides												
Total DDTs	µg/kg dw	61/62	2.7 J – 46,000	130	3,000	3,000	1700	**3×10^{-5}**		36,000	**1.3**	

Table 3. Comparison of Wetland Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Aldrin	µg/kg dw	0/62	nd	0.92 – 490	nd	17	29		**8×10^{-6}**	1,800		0.1
Dieldrin	µg/kg dw	0/62	nd	0.97 – 980	nd	33	30		**2×10^{-5}**	3,100		0.2
alpha-BHC	µg/kg dw	0/62	nd	0.92 – 490	nd	17	77		**3×10^{-6}**	490,000		0.0005
beta-BHC	µg/kg dw	0/62	nd	0.92 – 490	nd	17	270		9×10^{-7}			
gamma-BHC	µg/kg dw	0/62	nd	0.92 – 490	nd	17	520		5×10^{-7}	21,000		0.01
delta-BHC	µg/kg dw	2/62	3.0	0.92 – 490	3.0	17						
alpha-Chlordane	µg/kg dw	0/62	nd	0.96 – 490	nd	17						
gamma-Chlordane	µg/kg dw	0/62	nd	0.96 – 490	nd	17						
Total chlordane	µg/kg dw	0/62	nd	0.96 – 490	nd	17	1,600		2×10^{-7}	35,000		0.007
alpha-Endosulfan	µg/kg dw	0/62	nd	0.92 – 490	nd	17				370,000		0.0007
beta-Endosulfan	µg/kg dw	0/62	nd	0.92 – 980	nd	33						
Endosulfan sulfate	µg/kg dw	0/62	nd	1.9 – 980	nd	40						
Endrin	µg/kg dw	0/62	nd	0.92 – 980	nd	30				18,000		0.03
Endrin aldehyde	µg/kg dw	0/62	nd	0.97 – 980	nd	34						
Endrin ketone	µg/kg dw	0/62	nd	0.97 – 980	nd	34						
Heptachlor	µg/kg dw	0/62	nd	0.92 – 490	nd	20	110		**2×10^{-6}**	31,000		0.008
Heptachlor epoxide	µg/kg dw	0/62	nd	0.92 – 490	nd	18	53		**5×10^{-6}**	790		0.3
Methoxychlor	µg/kg dw	1/62	4.6 J	0.92 – 4900	4.6	200				310,000	0.00001	
Toxaphene	µg/kg dw	0/62	nd	96 – 49000	nd	3,000	440		**6×10^{-5}**			
VOCs												
1,1,1,2-Tetrachloroethane	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4	1,900		2×10^{-9}	2,300,000		0.000002
1,1,1-Trichloroethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2				8,700,000		0.0000009
1,1,2,2-Tetrachloroethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	560		1×10^{-8}	310,000		0.00002
1,1,2-Trichloroethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	1,100		7×10^{-9}	310,000		0.00002
1,1,2-Trichlorotrifluoroethane	µg/kg dw	0/49	nd	3 – 15	nd	3				43,000,000		0.0000002
1,1-Dichloroethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	3,300		2×10^{-9}	16,000,000		0.0000005
1,1-Dichloroethene	µg/kg dw	0/49	nd	1.5 – 15	nd	2				240,000		0.00003
1,1-Dichloropropene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
1,2,3-Trichlorobenzene	µg/kg dw	0/44	nd	7.5 – 39	nd	6.8						
1,2,3-Trichloropropane	µg/kg dw	0/44	nd	3 – 15	nd	2.7	5		**2×10^{-6}**	5,200		0.001
1,2,4-Trimethylbenzene	µg/kg dw	4/44	3.6 J – 9.2	1.5 – 7.7	6.8	1.8				62,000	0.0001	
1,2-Dibromo-3-chloropropane	µg/kg dw	0/49	nd	3 – 150	nd	8	5.4		**1×10^{-5}**	4,900		0.02
1,2-Dibromoethane (EDB)	µg/kg dw	0/49	nd	1.5 – 15	nd	2	34		2×10^{-7}	78,000		0.0001

Table 3. Comparison of Wetland Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
1,2-Dichloroethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	430		2×10^{-8}	1,400,000		0.000005
1,2-Dichloroethene (total)	µg/kg dw	0/5	nd	3 – 15	nd	3				150,000		0.00005
1,2-Dichloropropane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	890		8×10^{-9}	16,000		0.0005
1,3,5-Trimethylbenzene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4				780,000		0.000005
1,3-Dichloropropane	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4				1,600,000		0.000002
2,2-Dichloropropane	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
2-Chlorotoluene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4				1,600,000		0.000002
2-Hexanone	µg/kg dw	0/49	nd	7.5 – 59.8	nd	7.4						
4-Chlorotoluene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4				5,500,000		0.0000007
Acetone	µg/kg dw	44/49	76 – 2,300	61.1 – 299	540	490				61,000,000	0.00004	
Benzene	µg/kg dw	25/49	1.8 – 56	1.6 – 15	10	6	1,100	5×10^{-8}		86,000	0.0007	
Bromobenzene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4				300,000		0.00001
Bromochloromethane	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
Bromodichloromethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	270		3×10^{-8}	1,600,000		0.000005
Bromoform	µg/kg dw	0/49	nd	1.5 – 15	nd	2	61,000		1×10^{-10}	1,200,000		0.000006
Bromomethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2				7,300		0.001
Carbon disulfide	µg/kg dw	3/49	3.9 – 7.5	1.5 – 59.8	5.7	2.8				820,000	0.000009	
Carbon tetrachloride	µg/kg dw	0/49	nd	1.5 – 15	nd	2	610		1×10^{-8}	110,000		0.00007
Chlorobenzene	µg/kg dw	0/49	nd	1.5 – 15	nd	2				290,000		0.00003
Chloroethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2						
Chloroform	µg/kg dw	0/49	nd	1.5 – 15	nd	2	290		3×10^{-8}	210,000		0.00004
Chloromethane	µg/kg dw	0/49	nd	1.5 – 29.9	nd	1.9				120,000		0.0001
cis-1,2-Dichloroethene	µg/kg dw	4/49	1.9 – 9.7	1.5 – 15	4.8	2				780,000	0.00001	
cis-1,3-Dichloropropene	µg/kg dw	0/49	nd	1.5 – 15	nd	2	1,700		4×10^{-9}	74,000		0.0001
Cyclohexane	µg/kg dw	0/5	nd	3 – 15	nd	3				7,000,000		0.000001
p-Cymene	µg/kg dw	3/44	3.4 J – 72 J	1.5 – 7.7	28	3.2						
Dibromochloromethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2	680		1×10^{-8}	1,200,000		0.000006
Dibromomethane	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4				25,000		0.0002
Dichlorodifluoromethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2				180,000		0.00004
Dichloromethane	µg/kg dw	4/49	4.1 – 5.3	3 – 58.7	4.6	3.9						
Ethylbenzene	µg/kg dw	2/49	3.0 – 3.4	1.5 – 15	3.2	2	5,400	6×10^{-10}		3,500,000	0.000001	
Isopropylbenzene	µg/kg dw	0/49	nd	1.5 – 15	nd	2						
Methyl acetate	µg/kg dw	0/5	nd	15.3 – 74.8	nd	16.1				78,000,000		0.0000005

Table 3. Comparison of Wetland Soil Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Residential RSL			Non-Cancer Residential RSL		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]
Methyl ethyl ketone	µg/kg dw	42/49	9.7 – 260	9 – 150	61	55						
Methyl isobutyl ketone	µg/kg dw	2/49	15 – 16	7.5 – 59.8	16	7.7						
Methylcyclohexane	µg/kg dw	0/5	nd	3 – 15	nd	3						
n-Butylbenzene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
n-Propylbenzene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
sec-Butylbenzene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
Styrene	µg/kg dw	0/49	nd	1.5 – 15	nd	2				6,300,000		0.000001
tert-Butyl methyl ether	µg/kg dw	0/49	nd	1.5 – 15	nd	2	43,000		2×10^{-10}	17,000,000		0.0000004
tert-Butylbenzene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
Tetrachloroethene	µg/kg dw	2/49	5.1 – 30	1.5 – 15	18	2	550	5×10^{-8}		370,000	0.00008	
Toluene	µg/kg dw	36/49	1.8 – 68	1.6 – 15	14	10				5,000,000	0.00001	
trans-1,2-Dichloroethene	µg/kg dw	0/44	nd	1.5 – 7.7	nd	1.4						
trans-1,3-Dichloropropene	µg/kg dw	0/49	nd	1.5 – 15	nd	2						
Trichloroethene	µg/kg dw	3/49	2.4 – 4.7	1.5 – 15	3.3	2	2,800	2×10^{-9}				
Trichlorofluoromethane	µg/kg dw	0/49	nd	1.5 – 15	nd	2				790,000		0.000009
Vinyl acetate	µg/kg dw	0/43	nd	7.5 – 39	nd	6.9				970,000		0.00002
Vinyl chloride	µg/kg dw	0/49	nd	1.5 – 15	nd	2	60		1×10^{-7}	74,000		0.0001
o-Xylene	µg/kg dw	2/49	4.4 – 5.2	1.5 – 15	4.8	2				3,800,000	0.000001	
m,p-Xylene	µg/kg dw	6/49	2.0 J – 11	1.5 – 29.9	4.5	2.3				3,400,000	0.000003	
Total xylenes	µg/kg dw	6/49	2.0 J – 15	1.5 – 29.9	6.0	2.5				630,000	0.00002	
Petroleum												
TPH – gasoline range	mg/kg dw	2/57	19 – 20	8.4 – 58	20	10						
TPH – diesel range	mg/kg dw	55/61	8.4 – 4,000	7.4 – 10	400	360						
TPH – motor oil range	mg/kg dw	57/61	28 – 6,600	15 – 17	1,100	1,000						
Total Risk								**5×10^{-4}**	**2×10^{-4}**		**13**	**2**

[a] Cancer and non-cancer RSLs are from EPA (2009).
[b] Exceedance factors based on half the maximum RL are shown only for chemicals never detected in wetland soil.

BHC – benzene hexachloride
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
EDB – ethylene dibromide
EPA – US Environmental Protection Agency
HQ – hazard quotient
J – estimated concentration
na – not applicable
nd – not detected
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RL – reporting limit
RSL – regional screening level
SVOC – semivolatile organic compound
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Bold indicates excess cancer risks greater than 1×10^{-6} or non-cancer HQs greater than 1.

Table 4. Comparison of Groundwater Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Tap Water RSL			Non-Cancer Tap Water RSL			Tap Water MCL or Non-Zero MCLG		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
Metals (dissolved)															
Antimony	µg/L	5/22	0.2 – 0.6	0.2	0.3	0.1				15	0.04		6	0.1	
Arsenic	µg/L	22/22	0.8 – 32.2	na	10	10	0.045	**7×10^{-4}**		11	**2.9**		10	**3.2**	
Barium	µg/L	22/22	65 – 389	na	190	190				7,300	0.05		2,000	0.2	
Cadmium	µg/L	0/22	nd	0.2	nd	0.1									
Chromium	µg/L	0/22	nd	5	nd	3									
Cobalt	µg/L	9/22	3 – 25	3	9	5				11	**2.3**				
Copper	µg/L	2/22	3 – 5	2	4	1				1,500	0.003		1,300	0.004	
Iron	µg/L	22/22	1,720 – 64,400	na	29,000	29,000				26,000	**2.5**				
Lead	µg/L	0/22	nd	1	nd	0.5							15		0.03
Manganese	µg/L	22/22	724 – 6,510	na	3,100	3,100				880	**7.4**				
Mercury	µg/L	0/22	nd	0.1	nd	0.05				11		0.005	2		0.03
Nickel	µg/L	5/22	10 – 20	10	10	7				730	0.03				
Selenium	µg/L	8/22	0.5 – 1.2	0.5 – 2	0.7	0.7				180	0.007		50	0.02	
Vanadium	µg/L	5/22	3 – 9	3	5	3				180	0.05				
Zinc	µg/L	2/22	40 – 80	10	60	10				11,000	0.007				
Metals (total)															
Aluminum	µg/L	6/6	193 – 5,890	na	1,330	1,330				37,000	0.2				
Antimony	µg/L	2/28	0.2 – 0.5	0.2 – 1.6	0.4	0.3				15	0.03		6	0.08	
Arsenic	µg/L	28/28	1 – 31.6	na	10	10	0.045	**7×10^{-4}**		11	**2.9**		10	**3.2**	
Barium	µg/L	28/28	65 – 497	na	230	230				7,300	0.07		2,000	0.2	
Beryllium	µg/L	1/6	1.5	1	1.5	0.7				73	0.02		4	0.4	
Cadmium	µg/L	4/28	0.3 – 1.31	0.2	0.7	0.2									
Chromium	µg/L	4/28	6 J – 8.1	5	7	4									
Cobalt	µg/L	9/28	3 – 23	3 – 5	9	4				11	**2.1**				
Copper	µg/L	8/28	2 – 25.1	2 – 4	8	3				1,500	0.02		1,300	0.02	
Iron	µg/L	28/28	3,130 – 65,700	na	31,000	31,000				26,000	**2.5**				
Lead	µg/L	8/28	0.36 – 19.6	1	5	2							15	**1.3**	

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Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Tap Water RSL			Non-Cancer Tap Water RSL			Tap Water MCL or Non-Zero MCLG		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
Magnesium	µg/L	6/6	24,900 – 95,800	na	45,700	45,700									
Manganese	µg/L	28/28	667 – 7,860	na	3,400	3,400				880	**8.9**				
Mercury	µg/L	1/28	0.14	0.1	0.14	0.05				11	0.01		2	0.07	
Nickel	µg/L	8/28	10 – 25	10	20	8				730	0.03				
Selenium	µg/L	10/28	0.5 – 4.7	0.5 – 2	1	1				180	0.03		50	0.09	
Silver	µg/L	1/6	1	1	1	0.6				180	0.006				
Thallium	µg/L	6/6	0.00894 – 0.0527	na	0.0242	0.0242							2	0.03	
Vanadium	µg/L	14/28	3 – 54.4	3	10	7				180	0.3				
Zinc	µg/L	10/28	8.7 – 1,180	4 – 10	200	60				11,000	0.1				
PAHs															
2-Chloronaphthalene	µg/L	0/6	nd	0.37 – 0.4	nd	0.2				2,900		0.00007			
2-Methylnaphthalene	µg/L	7/28	0.1 J – 1.8	0.1 – 0.38	0.7	0.2				150	0.01				
Acenaphthene	µg/L	11/28	0.14 – 3.2	0.1 – 0.4	0.99	0.4				2,200	0.001				
Acenaphthylene	µg/L	0/28	nd	0.1 – 0.4	nd	0.08									
Anthracene	µg/L	5/28	0.10 – 0.24	0.1 – 0.4	0.17	0.1				11,000	0.00002				
Benzo(g,h,i)perylene	µg/L	0/28	nd	0.1 – 2	nd	0.2									
Dibenzofuran	µg/L	2/28	0.16 – 0.18	0.1 – 0.4	0.17	0.09									
Fluoranthene	µg/L	3/28	0.12 – 0.64	0.1 – 0.4	0.30	0.1				1,500	0.0004				
Fluorene	µg/L	9/28	0.13 – 1.9	0.1 – 0.4	0.48	0.2				1,500	0.001				
Naphthalene	µg/L	7/28	0.10 – 1.5	0.1 – 0.4	0.47	0.2	0.14	**1×10^{-5}**		6.2	0.2				
Phenanthrene	µg/L	3/28	0.13 – 0.25	0.1 – 0.4	0.18	0.09									
Pyrene	µg/L	3/28	0.12 – 0.53	0.1 – 0.4	0.26	0.09				1,100	0.0005				
cPAHs TEQ	µg/L	0/28	nd	0.091 – 1.5	nd	0.186	0.0029		**3×10^{-4}**				0.2		**3.8**
Phthalates															
Bis(2-ethylhexyl)phthalate	µg/L	5/6	0.59 – 1.8	0.38	1.2	1.0	4.8	4×10^{-7}		730	0.002		6	0.3	
Butyl benzyl phthalate	µg/L	0/6	nd	1.8 – 2	nd	0.9	35		3×10^{-8}	7,300		0.0001			
Diethyl phthalate	µg/L	1/6	0.25 J	0.37 – 0.4	0.25	0.2				29,000	0.000009				
Dimethyl phthalate	µg/L	0/6	nd	0.74 – 0.8	nd	0.4									
Di-n-butyl phthalate	µg/L	2/6	0.1 J – 0.15 J	0.37 – 0.4	0.1	0.2				3,700	0.00004				
Di-n-octyl phthalate	µg/L	0/6	nd	1.8 – 2	nd	0.9									

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							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
Other SVOCs															
1,2,4-Trichlorobenzene	µg/L	0/28	nd	0.5 – 5	nd	2	2.3		**1×10^{-6}**	4.1		0.6	70		0.04
1,2-Dichlorobenzene	µg/L	2/28	0.22 J – 0.50	0.2 – 1	0.36	0.5				370	0.001		600	0.0008	
1,3-Dichlorobenzene	µg/L	2/28	0.2 J – 0.35 J	0.2 – 1	0.3	0.4									
1,4-Dichlorobenzene	µg/L	4/28	0.18 J – 1.4	0.2 – 1	0.8	0.5	0.43	**3×10^{-6}**		1,000	0.001		75	0.02	
2,4,5-Trichlorophenol	µg/L	0/6	nd	1.8 – 2	nd	0.9				3,700		0.0003			
2,4,6-Trichlorophenol	µg/L	0/6	nd	0.74 – 0.8	nd	0.4	6.1		7×10^{-8}	37		0.01			
2,4-Dichlorophenol	µg/L	0/6	nd	0.37 – 0.4	nd	0.2				110		0.002			
2,4-Dimethylphenol	µg/L	0/6	nd	0.37 – 0.4	nd	0.2				730		0.0003			
2,4-Dinitrophenol	µg/L	0/6	nd	7.4 – 8	nd	4				73		0.05			
2,4-Dinitrotoluene	µg/L	0/6	nd	0.74 – 0.8	nd	0.4	0.22		**2×10^{-6}**	73		0.005			
2,6-Dinitrotoluene	µg/L	0/6	nd	3.7 – 4	nd	2				37		0.05			
2-Chlorophenol	µg/L	1/6	0.97	0.37 – 0.38	0.97	0.32				180	0.005				
2-Methylphenol	µg/L	0/6	nd	0.37 – 0.4	nd	0.2				1,800		0.0001			
2-Nitroaniline	µg/L	0/6	nd	0.74 – 0.8	nd	0.4				370		0.001			
2-Nitrophenol	µg/L	0/6	nd	1.8 – 2	nd	0.9									
3,3'-Dichlorobenzidine	µg/L	0/6	nd	1.8 – 2	nd	0.9	0.15		**7×10^{-6}**						
3-Nitroaniline	µg/L	0/6	nd	1.8 – 2	nd	0.9									
4,6-Dinitro-o-cresol	µg/L	0/6	nd	3.7 – 4	nd	2				2.9		0.7			
4-Bromophenyl phenyl ether	µg/L	0/6	nd	0.37 – 0.4	nd	0.2									
4-Chloro-3-methylphenol	µg/L	0/6	nd	1.8 – 2	nd	0.9									
4-Chloroaniline	µg/L	0/6	nd	0.74 – 0.8	nd	0.4	0.34		**1×10^{-6}**	150		0.003			
4-Chlorophenyl phenyl ether	µg/L	0/6	nd	0.37 – 0.4	nd	0.2									
4-Methylphenol	µg/L	0/6	nd	0.37 – 0.4	nd	0.2				180		0.001			
4-Nitroaniline	µg/L	0/6	nd	1.8 – 2	nd	0.9	3.4		3×10^{-7}	150		0.007			
4-Nitrophenol	µg/L	0/6	nd	3.7 – 4	nd	2									
Acetophenone	µg/L	1/6	0.16 J	0.37 – 0.38	0.16	0.19				3,700	0.00004				
Atrazine	µg/L	0/6	nd	1.8 – 2	nd	0.9	0.29		**3×10^{-6}**	1,300		0.0008	3		0.3
Benzaldehyde	µg/L	2/6	0.12 J – 0.13 J	0.37 – 0.4	0.13	0.2				3,700	0.00004				
Biphenyl	µg/L	0/6	nd	0.37 – 0.4	nd	0.2				1,800		0.0001			

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							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
bis(2-chloroethoxy)methane	µg/L	0/6	nd	0.37 – 119	nd	10				110		0.5			
bis(2-chloroethyl)ether	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	0.012		**2×10^{-5}**						
bis(2-chloroisopropyl)ether	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	0.32		6×10^{-7}	1,500		0.0001			
Caprolactam	µg/L	0/6	nd	1.8 – 2	nd	0.9				18,000		0.00006			
Carbazole	µg/L	0/6	nd	0.37 – 0.4	nd	0.2									
Hexachlorobenzene	µg/L	0/4	nd	0.005	nd	0.0025	0.042		6×10^{-8}	29		0.00009	1		0.003
Hexachlorobenzene	µg/L	0/28	nd	0.005 – 0.4	nd	0.04	0.042		**5×10^{-6}**	29		0.007	1		0.2
Hexachlorobutadiene	µg/L	0/4	nd	0.005	nd	0.0025	0.86		3×10^{-9}	37		0.00007			
Hexachlorobutadiene	µg/L	0/28	nd	0.005 – 0.4	nd	0.04	0.86		2×10^{-7}	37		0.005			
Hexachlorocyclopentadiene	µg/L	0/6	nd	1.8 – 2	nd	0.9				220		0.005	50		0.02
Hexachloroethane	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	4.8		4×10^{-8}	37		0.005			
Isophorone	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	71		3×10^{-9}	7,300		0.00003			
Nitrobenzene	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	0.12		**2×10^{-6}**	15		0.01			
n-Nitroso-di-n-propylamine	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	0.0096		**2×10^{-5}**						
n-Nitrosodiphenylamine	µg/L	0/6	nd	0.37 – 0.4	nd	0.2	14		1×10^{-8}						
Pentachlorophenol	µg/L	0/6	nd	1.8 – 2	nd	0.9	0.56		**2×10^{-6}**	1,100		0.0009	1		1.0
Phenol	µg/L	5/6	0.095 J – 0.37 J	0.38	0.18	0.19				11,000	0.00003				
PCBs															
Total PCBs	µg/L	0/28	nd	0.1 – 0.96	nd	0.14	0.034		**1×10^{-5}**	0.73		0.7			
Pesticides (normal)															
Total DDTs	µg/L	12/28	0.0071 J – 0.24 J	0.01 – 0.019	0.063	0.030	0.2	**1×10^{-6}**		18	0.01				
Aldrin	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039	0.004		**2×10^{-6}**	1.1		0.009			
Dieldrin	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059	0.0042		**2×10^{-6}**	1.8		0.005			
Total aldrin/dieldrin	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059									
alpha-BHC	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039	0.011		9×10^{-7}	290		0.00003			
beta-BHC	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039	0.037		3×10^{-7}						
gamma-BHC	µg/L	0/28	nd	0.005 – 0.019	nd	0.0042	0.061		2×10^{-7}	11		0.0009	0.2		0.05
delta-BHC	µg/L	0/28	nd	0.005 – 0.043	nd	0.0046									
alpha-Chlordane	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039									
gamma-Chlordane	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039									

Table 4. Comparison of Groundwater Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Tap Water RSL			Non-Cancer Tap Water RSL			Tap Water MCL or Non-Zero MCLG		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
Total chlordane	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039	0.19		5×10^{-8}	18		0.0005	2		0.005
alpha-Endosulfan	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039				220		0.00004			
beta-Endosulfan	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059									
Endosulfan sulfate	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059									
Endrin	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059				11		0.0009	2		0.005
Endrin aldehyde	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059									
Endrin ketone	µg/L	0/28	nd	0.01 – 0.019	nd	0.0059									
Heptachlor	µg/L	0/28	nd	0.005 – 0.024	nd	0.0043	0.015		8×10^{-7}	18		0.0007	0.4		0.03
Heptachlor epoxide	µg/L	0/28	nd	0.005 – 0.019	nd	0.0039	0.0074		**1×10^{-6}**	0.47		0.02	0.2		0.05
Methoxychlor	µg/L	0/28	nd	0.018 – 0.05	nd	0.022				180		0.0001	40		0.0006
Toxaphene	µg/L	0/28	nd	0.5 – 4.8	nd	0.69	0.061		4×10^{-5}				3		0.8
Pesticides (dissolved)															
Total DDTs	µg/L	2/4	0.011 – 0.073 J	0.01	0.042	0.024	0.2	4×10^{-7}		18	0.004				
Aldrin	µg/L	0/4	nd	0.005	nd	0.0025	0.004		6×10^{-7}	1.1		0.002			
Dieldrin	µg/L	0/4	nd	0.01	nd	0.0050	0.0042		**1×10^{-6}**	1.8		0.003			
Total aldrin/dieldrin	µg/L	0/4	nd	0.01	nd	0.0050									
alpha-BHC	µg/L	0/4	nd	0.005	nd	0.0025	0.011		2×10^{-7}	290		0.000009			
beta-BHC	µg/L	0/4	nd	0.005	nd	0.0025	0.037		7×10^{-8}						
gamma-BHC	µg/L	0/4	nd	0.005	nd	0.0025	0.061		4×10^{-8}	11		0.0002	0.2		0.01
delta-BHC	µg/L	0/4	nd	0.005	nd	0.0025									
alpha-Chlordane	µg/L	0/4	nd	0.005	nd	0.0025									
gamma-Chlordane	µg/L	0/4	nd	0.005	nd	0.0025									
Total chlordane	µg/L	0/4	nd	0.005	nd	0.0025	0.19		1×10^{-8}	18		0.0001	2		0.001
alpha-Endosulfan	µg/L	0/4	nd	0.005	nd	0.0025				220		0.00001			
beta-Endosulfan	µg/L	0/4	nd	0.01	nd	0.0050									
Endosulfan sulfate	µg/L	0/4	nd	0.01	nd	0.0050									
Endrin	µg/L	0/4	nd	0.01	nd	0.0050				11		0.0005	2		0.003
Endrin aldehyde	µg/L	0/4	nd	0.01	nd	0.0050									
Endrin ketone	µg/L	0/4	nd	0.01	nd	0.0050									
Heptachlor	µg/L	0/4	nd	0.005	nd	0.0025	0.015		2×10^{-7}	18		0.0001	0.4		0.006

Table 4. Comparison of Groundwater Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Tap Water RSL			Non-Cancer Tap Water RSL			Tap Water MCL or Non-Zero MCLG		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
Heptachlor epoxide	µg/L	0/4	nd	0.005	nd	0.0025	0.0074		3×10^{-7}	0.47		0.005	0.2		0.01
Methoxychlor	µg/L	0/4	nd	0.05	nd	0.025				180		0.0001	40		0.0006
Toxaphene	µg/L	0/4	nd	0.5	nd	0.25	0.061		**$4x\ 10^{-6}$**				3		0.08
VOCs															
1,1,1,2-Tetrachloroethane	µg/L	0/22	nd	0.2 – 1	nd	0.45	0.52		1×10^{-6}	1,100		0.0005			
1,1,1-Trichloroethane	µg/L	0/28	nd	0.2 – 1	nd	0.5				9,100		0.00005	200		0.003
1,1,2,2-Tetrachloroethane	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.067		**7×10^{-6}**	150		0.003			
1,1,2-Trichloroethane	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.24		**2×10^{-6}**	150		0.003	5		0.1
1,1,2-Trichlorotrifluoroethane	µg/L	0/28	nd	0.2 – 2	nd	0.8				59,000		0.00002			
1,1-Dichloroethane	µg/L	0/28	nd	0.2 – 1	nd	0.5	2.4		2×10^{-7}	7,300		0.00007			
1,1-Dichloroethene	µg/L	0/28	nd	0.2 – 1	nd	0.5				340		0.001	7		0.07
1,1-Dichloropropene	µg/L	0/22	nd	0.2 – 1	nd	0.45									
1,2,3-Trichlorobenzene	µg/L	0/22	nd	0.5 – 5	nd	2.2									
1,2,3-Trichloropropane	µg/L	0/22	nd	0.5 – 2	nd	0.90	0.00072		**1×10^{-3}**	0.62		**1.6**			
1,2,4-Trimethylbenzene	µg/L	2/22	3.7 – 7.2	0.2 – 1	5.5	0.91				15	0.5				
1,2-Dibromo-3-chloropropane	µg/L	0/28	nd	0.5 – 5	nd	2	0.00032		**8×10^{-3}**	0.39		**6.4**	0.2		**13**
1,2-Dibromoethane (EDB)	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.0065		**8×10^{-5}**	18		0.03	0.05		**10**
1,2-Dichloroethane	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.15		**3×10^{-6}**	640		0.0008	5		0.1
1,2-Dichloroethene (total)	µg/L	0/6	nd	1	nd	0.5				110		0.005	100		0.005
1,2-Dichloropropane	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.39		**1×10^{-6}**	8.3		0.06	5		0.1
1,3,5-Trimethylbenzene	µg/L	3/22	1.5 – 3.0	0.2 – 1	2.3	0.71				370	0.008				
1,3-Dichloropropane	µg/L	0/22	nd	0.2 – 5	nd	1.2				730		0.003			
2,2-Dichloropropane	µg/L	0/22	nd	0.2 – 1	nd	0.45									
2-Chlorotoluene	µg/L	0/22	nd	0.2 – 1	nd	0.45				730		0.0007			
2-Hexanone	µg/L	0/28	nd	2 – 5	nd	2									
4-Chlorotoluene	µg/L	0/22	nd	0.2 – 1	nd	0.45				2,600		0.0002			
Acetone	µg/L	11/28	4.4 – 18	2 – 15.6	9.3	6				22,000	0.0008				
Benzene	µg/L	8/28	0.80 – 140	0.2 – 6.2	20	6	0.41	**3×10^{-4}**		44	**3.2**		5	**28**	
Bromobenzene	µg/L	0/22	nd	0.2 – 1	nd	0.45				88		0.006			
Bromochloromethane	µg/L	0/22	nd	0.2 – 1	nd	0.45									

Table 4. Comparison of Groundwater Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Tap Water RSL			Non-Cancer Tap Water RSL			Tap Water MCL or Non-Zero MCLG		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
Bromodichloromethane	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.12		**4×10^{-6}**	730		0.0007	80		0.006
Bromoform	µg/L	0/28	nd	0.2 – 1	nd	0.5	8.5		6×10^{-8}	730		0.0007	80		0.006
Bromomethane	µg/L	0/28	nd	0.5 – 1	nd	0.5				8.7		0.06			
Carbon disulfide	µg/L	0/28	nd	0.2 – 2	nd	0.6				1,000		0.001			
Carbon tetrachloride	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.44		**1×10^{-6}**	86		0.006	5		0.1
Chlorobenzene	µg/L	15/28	0.20 – 130	0.2 – 1	30	10				91	**1.4**		100	**1.3**	
Chloroethane	µg/L	0/28	nd	0.2 – 2	nd	0.6									
Chloroform	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.19		**3×10^{-6}**	130		0.004	80		0.006
Chloromethane	µg/L	0/28	nd	0.2 – 1	nd	0.5				190		0.003			
cis-1,2-Dichloroethene	µg/L	1/28	0.23 J	0.2 – 1	0.23	0.4				370	0.0006		70	0.003	
cis-1,3-Dichloropropene	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.43		**1×10^{-6}**	40		0.01			
Cyclohexane	µg/L	0/6	nd	1	nd	0.5				13,000		0.00004			
p-Cymene	µg/L	1/22	0.30	0.2 – 1	0.30	0.45									
Dibromochloromethane	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.15		**3×10^{-6}**	730		0.0007	80		0.006
Dibromomethane	µg/L	0/22	nd	0.2 – 1	nd	0.45				8.2		0.06			
Dichlorodifluoromethane	µg/L	0/28	nd	0.2 – 1	nd	0.5				390		0.001			
Dichloromethane	µg/L	0/28	nd	0.5 – 2	nd	0.8									
Ethylbenzene	µg/L	1/28	1.2	0.2 – 1	1.2	0.5	1.5	8×10^{-7}		1,300	0.0009		700	0.002	
Isopropylbenzene	µg/L	4/28	0.039 J – 8.3	0.2 – 1	3.7	0.9									
Methyl acetate	µg/L	0/6	nd	1	nd	0.5				37,000		0.00001			
Methyl ethyl ketone	µg/L	0/28	nd	2 – 5	nd	2									
Methyl isobutyl ketone	µg/L	0/28	nd	2 – 5	nd	2									
Methylcyclohexane	µg/L	0/6	nd	1	nd	0.5									
n-Butylbenzene	µg/L	1/22	0.50	0.2 – 1	0.50	0.46									
n-Propylbenzene	µg/L	4/22	1.8 – 11	0.2 – 1	5.3	1.3									
sec-Butylbenzene	µg/L	1/22	0.40	0.2 – 1	0.40	0.46									
Styrene	µg/L	1/28	0.24 J	0.2 – 1	0.24	0.4				1,600	0.0002		100	0.002	
tert-Butyl methyl ether	µg/L	14/28	1.4 – 160	0.5 – 1	30	10	12	**1×10^{-5}**		6,300	0.03				
tert-Butylbenzene	µg/L	0/22	nd	0.2 – 1	nd	0.45									
Tetrachloroethene	µg/L	0/28	nd	0.2 – 1	nd	0.5	0.11		**5×10^{-6}**	220		0.002	5		0.1
Toluene	µg/L	2/28	0.60 – 4.8	0.2 – 1	2.7	0.6				2,300	0.002		1,000	0.005	

Table 4. Comparison of Groundwater Data with RSLs for the Hypothetical Future Resident Screening Assessment

Chemical	Unit	Detect Ratio	Detect or Range of Detects	RL or Range of RLs	Mean Detect	Mean Value	Cancer Tap Water RSL			Non-Cancer Tap Water RSL			Tap Water MCL or Non-Zero MCLG		
							RSL[a]	Excess Cancer Risk (Max Detect)	Excess Cancer Risk (Half Max RL)[b]	RSL[a]	HQ (Max Detect)	HQ (Half Max RL)[b]	MCL/ MCLG	EF (Max Detect)	EF (Half Max RL)[b]
trans-1,2-Dichloroethene	µg/L	0/22	nd	0.2 – 1	nd	0.45									
trans-1,3-Dichloropropene	µg/L	0/28	nd	0.2 – 1	nd	0.5									
Trichloroethene	µg/L	0/28	nd	0.2 – 1	nd	0.5	2		3×10^{-7}				5		0.1
Trichlorofluoromethane	µg/L	0/28	nd	0.2 – 1	nd	0.5				1,300		0.0004			
Vinyl acetate	µg/L	0/22	nd	1 – 5	nd	2.2				410		0.006			
Vinyl chloride	µg/L	1/28	0.22 J	0.2 – 1	0.22	0.4	0.016	1×10^{-5}		72	0.003		2	0.1	
o-Xylene	µg/L	2/28	4.0 – 6.0	0.2 – 1	5.0	0.8				1,200	0.005				
m,p-Xylene	µg/L	3/28	1.4 – 10	0.4 – 2	5	1				1,200	0.008				
Total xylenes	µg/L	3/28	1.4 – 20	0.4 – 2	10	2				200	0.1		10,000	0.002	
Petroleum															
TPH – gasoline range	mg/l	5/22	0.27 – 0.81	0.25	0.53	0.22									
TPH – diesel range	mg/l	1/22	0.26 J	0.25	0.26	0.14									
TPH – motor oil range	mg/l	0/22	nd	0.5	nd	0.25									
Total Risk[c]								**1×10^{-3}**	**1×10^{-2}**		**23**	**11**		**35**	**32**

[a] Cancer and non-cancer RSLs are from EPA (2009).
[b] Exceedance factors based on half the maximum RL are shown only for chemicals never detected in groundwater.
[c] The total exceedance factor is calculated using the higher of either dissolved or total water concentrations for chemicals where both sample types were analyzed.

BHC – benzene hexachloride
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
EDB – ethylene dibromide
EPA – US Environmental Protection Agency
EF – exceedance factor
HQ – hazard quotient
J – estimated concentration
MCL – maximum contaminant level
MCLG – maximum contaminant level goal
na – not applicable
nd – not detected
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RL – reporting limit
RSL – regional screening level
SVOC – semivolatile organic compound
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Bold indicates excess cancer risks greater than 1×10^{-6} or non-cancer HQs greater than 1.

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ATTACHMENT 2 –METHODS FOR CALCULATING FISH TISSUE CONCENTRATIONS

Tissue data were not collected from the Harbor Oil Superfund Study Area for chemistry analysis. In order to estimate risks to people based on the consumption of fish in the human health risk assessment (HHRA), concentrations in fish tissues were estimated from concentrations in lake sediment.

Fish tissue concentrations were estimated from sediment using biota-sediment accumulation factors (BSAFs), which represent the steady-state relationship between concentrations in sediment and tissue. Other assumptions (i.e., tissue-specific moisture and lipid content, sediment organic carbon [OC] content) were also used to calculate fish tissue residue concentrations.

Equations 1 and 2 present how BSAFs are commonly derived as a ratio for inorganic (metals) and organic chemicals, respectively.

$$BSAF = \frac{C_{tiss,dw}}{C_{sed,dw}} \qquad \textbf{Equation 1}$$

Where:

BSAF	ratio	chemical- and species-specific biota-sediment accumulation factor
$C_{tiss,dw}$	mg/kg dw	dry weight concentration in tissue
$C_{sed,dw}$	mg/kg dw	dry weight concentration in sediment

$$BSAF = \frac{C_{tiss,ww} / Lipid_{tiss}}{C_{sed,dw} / OC_{sed}} \qquad \textbf{Equation 2}$$

Where:

BSAF	ratio	chemical - and species-specific biota-sediment accumulation factor
$C_{tiss,ww}$	mg/kg ww	wet weight concentration in tissue
$Lipid_{tiss}$	fraction	lipid content in tissue (expressed as a fraction)
$C_{sed,dw}$	mg/kg dw	dry weight concentration in sediment
OC_{sed}	fraction	organic carbon content in sediment (expressed as a fraction)

Fish tissue concentrations (C_{tiss}) used in the HHRA were derived on a sample-by-sample basis from Force Lake surface sediment concentrations (C_{sed}) by algebraically rearranging Equations 1 and 2 and using literature-based BSAFs and generic assumptions regarding moisture content and lipid content (Table 1). Moisture content was needed to convert BSAF-estimated dry weight tissue concentrations (for inorganic chemicals) into wet weight tissue concentrations. For organic compounds, Force Lake sediment concentrations were OC-normalized using the sample-specific total organic carbon (TOC) (Table 2), and tissue concentrations were converted from lipid-normalized concentrations to wet weight concentrations using an average fish lipid content.

Table 1. Assumptions Used to Estimate Tissue Concentrations

Parameter	Assumption	Source
Sediment TOC	see Table 2	Force Lake data
Moisture content – fish	72%	EPA (1993)
Lipid content – fish	3.7%[a]	EPA (2008)

[a] Average reported lipid content for pumpkinseed, carp, and brown bullhead.
TOC – total organic carbon

Table 2. TOC Data Used to Estimate Organic Chemical Concentrations in Fish Tissue

Surface Sediment Sampling Location	TOC (%)
SE-01	6.71
SE-02	5.1
SE-03	6.54
SE-04	10.4
SE-05	6.02
SE-06	10.6
SE-07	13.1
SE-08	3.02
SE-09	8.44
SE-10	7.07
SE-11	1.34

TOC – total organic carbon

For inorganic chemicals, the following equation was used to estimate dry weight fish tissue concentrations on a sample-by-sample basis:

$$C_{tiss,dw} = C_{sed,dw} \times BSAF \qquad \textbf{Equation 3}$$

Where:

$C_{tiss,dw}$	mg/kg dw	sample-specific estimated dry weight tissue concentration
$C_{sed,\ dw}$	mg/kg dw	sample-specific dry weight Force Lake sediment concentration
BSAF	ratio	chemical -specific fish biota-sediment accumulation factor

Inorganic chemical dry weight tissue concentrations were then converted into wet weight tissue concentrations using the following equation and fish percent moisture assumption:

$$C_{tiss,ww} = C_{tiss,dw} \times (1 - 0.72) \qquad \textbf{Equation 4}$$

Where:

$C_{tiss,ww}$	mg/kg ww	sample-specific estimated wet weight tissue concentration
$C_{tiss,dw}$	mg/kg dw	sample-specific estimated dry weight tissue concentration
0.72	fraction	fish moisture content (Table 1)

For organic compounds, the following equation and assumption were used to derive wet weight fish tissue concentrations:

$$C_{tiss,ww} = \left[\frac{C_{sed,dw}}{OC_{sed}} \times BSAF \right] \times 0.037 \qquad \textbf{Equation 5}$$

Where:

$C_{tiss,ww}$	mg/kg ww	sample-specific estimated wet weight tissue concentration
$C_{sed,\ dw}$	mg/kg dw	sample-specific dry weight Force Lake sediment concentration
OC_{sed}	fraction	sample-specific TOC in sediment (expressed as a fraction)
BSAF	ratio	chemical -specific fish biota-sediment accumulation factor
0.037	fraction	fish lipid content (Table 1)

A search for fish literature-based BSAFs was conducted for all chemicals analyzed in lake sediment, with particular emphasis on chemicals detected in lake sediment. BSAFs were selected from a variety of sources; their availability varied depending on the chemical class and modeled species. BSAFs were selected based on the following hierarchy:

- Fish and invertebrate BSAFs for organic chemicals were based on EPA's BSAF database (EPA 2008) when available.
- Fish BSAFs were derived as the mean BSAF reported in the collection of BSAFs compiled by PTI (1995a, b).
- A surrogate BSAF was used for some related chemicals (e.g., technical chlordane was used as a surrogate for total chlordane).
- A default value of 1 was used for chemicals with no published value from the above sources. The use of this default value assumed that sediment and tissue concentrations were equal, which is a conservative assumption for chemicals that are regulated by fish (e.g., metals) or do not accumulate (e.g., VOCs) and would therefore have BSAFs lower than 1. The default BSAF assumption of 1 could underestimate risks for bioaccumulative chemicals; however, literature-based BSAFs are available for the key known bioaccumulative chemicals such as polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDTs).

The US Army Corps of Engineers (USACE) BSAF database (2008) was used as a secondary source for obtaining BSAFs; however, units for BSAFs in this database were not clearly presented (i.e., whether BSAFs for organics were expressed as lipid- and OC-normalized tissue and sediment concentration ratios or as unadjusted tissue and sediment concentration ratios); thus, these BSAFs were not used.

Based on above sources, Table 3 presents the fish BSAFs used in the HHRA and their source.

Table 3. Fish BSAFs Used in the HHRA

Chemical	BSAF[a]	Source and Details on Selected Value
Metals (dw/dw)		
Antimony	1	No fish BSAF was available from the literature; default value was used.
Arsenic	0.12	Only fish BSAF was presented in PTI (1995b).
Barium	1	No fish BSAF was available from the literature; default value was used.
Cadmium	0.785	Based on the mean BSAF reported by PTI (1995b); value was based on nine BSAFs ranging from 0.043 to 2.0 compiled from one location.
Chromium	0.043	Only fish BSAF was presented in PTI (1995b).
Cobalt	1	No fish BSAF was available from the literature; default value was used.
Copper	1	No fish BSAF was available from the literature; default value was used.
Lead	0.180	Based on the mean BSAF reported by PTI (1995b); value was based on nine BSAFs ranging from 0.028 to 0.43 compiled from one location.
Mercury	0.38	Only fish BSAF was presented in PTI (1995b).
Nickel	1	No fish BSAF was available from the literature; default value was used.
Selenium	1	No fish BSAF was available from the literature; default value was used.
Vanadium	1	No fish BSAF was available from the literature; default value was used.
Zinc	1.83	Based on the mean BSAF reported by PTI (1995b); value was based on 10 BSAFs ranging from 0.13 to 5.0 compiled from two locations.
PAHs (lipid/OC)		
2-Methylnaphthalene	0.147	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 14 BSAFs ranging from 0.0109 to 0.972.
Acenaphthene	0.0313	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 11 BSAFs ranging from 0.00484 to 0.0602.
Acenaphthylene	0.0138	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 11 BSAFs ranging from 0.00032 to 0.0287.
Anthracene	0.0078	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 15 BSAFs ranging from 0.00020 to 0.0148.
Benzo(a)anthracene	0.0135	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 8 BSAFs ranging from 0.00030 to 0.0941.
Benzo(a)pyrene	0.0021	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 4 BSAFs ranging from 0.00023 to 0.0040.
Benzo(b)fluoranthene	0.0025	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 5 BSAFs ranging from 0.00022 to 0.0043.

Table 3. Fish BSAFs Used in the HHRA

Chemical	BSAF[a]	Source and Details on Selected Value
Benzo(g,h,i)perylene	0.0250	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 3 BSAFs ranging from 0.00118 to 0.0699.
Benzo(k)fluoranthene	0.0023	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 5 BSAFs ranging from 0.00021 to 0.0041.
Chrysene	0.0100	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 8 BSAFs ranging from 0.00032 to 0.0636.
Dibenzo(a,h)anthracene	0.0022	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 5 BSAFs ranging from 0.00031 to 0.0043.
Dibenzofuran	0.0259	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 12 BSAFs ranging from 0.00211 to 0.0496.
Fluoranthene	0.0056	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 15 BSAFs ranging from 0.00008 to 0.0383.
Fluorene	0.0626	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 16 BSAFs ranging from 0.00058 to 0.5256.
Indeno(1,2,3-cd)pyrene	0.0144	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 6 BSAFs ranging from 0.00021 to 0.0756.
Naphthalene	0.135	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 11 BSAFs ranging from 0.0123 to 0.813.
Phenanthrene	0.0237	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 17 BSAFs ranging from 0.00021 to 0.161.
Pyrene	0.0158	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 8 BSAFs ranging from 0.00025 to 0.0638.
cPAH TEQ	0.0021	Based on the mean BSAF for benzo(a)pyrene reported in EPA's BSAF database (EPA 2008) for all fish species.[b]
Other SVOCs (lipid/OC)		
1,2,4-Trichlorobenzene	0.132	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 2 BSAFs ranging from 0.0770 to 0.186.
1,2-Dichlorobenzene	0.112	Based on the only BSAF reported in EPA's BSAF database (EPA 2008).
1,3-Dichlorobenzene	0.020	Based on the only BSAF reported in EPA's BSAF database (EPA 2008).
1,4-Dichlorobenzene	0.014	Based on the only BSAF reported in EPA's BSAF database (EPA 2008).
Hexachlorobenzene	0.015	Based on the geometric mean BSAF reported by PTI (1995a).
Hexachlorobutadiene	0.015	Based on the geometric mean BSAF reported by PTI (1995a).

Table 3. Fish BSAFs Used in the HHRA

Chemical	BSAF[a]	Source and Details on Selected Value
PCBs (lipid/OC)		
Total PCBs	6.45	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 285 BSAFs ranging from 0.00375 to 258.
Pesticides (lipid/OC)		
Aldrin	1	No fish BSAF was available from the literature; default value was used.
alpha-BHC	1	No fish BSAF was available from the literature; default value was used.
alpha-Chlordane	1.46	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 27 BSAFs ranging from 0.146 to 6.13.
alpha-Endosulfan	1	No fish BSAF was available from the literature; default value was used.
beta-BHC	1	No fish BSAF was available from the literature; default value was used.
beta-Endosulfan	1	No fish BSAF was available from the literature; default value was used.
delta-BHC	1	No fish BSAF was available from the literature; default value was used.
Dieldrin	2.23	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 21 BSAFs ranging from 0.0931 to 17.9
Endosulfan sulfate	1	No fish BSAF was available from the literature; default value was used
Endrin	1	No fish BSAF was available from the literature; default value was used
Endrin aldehyde	1	No fish BSAF was available from the literature; default value was used
Endrin ketone	1	No fish BSAF was available from the literature; default value was used
gamma-BHC	1	No fish BSAF was available from the literature; default value was used
gamma-Chlordane	1.14	Based on the mean BSAF reported in EPA's BSAF database (EPA 2008) for all fish species; value was based on 17 BSAFs ranging from 0.0981 to 3.43.
Heptachlor	0.13	Based on the geometric mean BSAF reported by PTI (1995a).
Heptachlor epoxide	29	Based on the geometric mean BSAF reported by PTI (1995a).
Methoxychlor	1	No fish BSAF was available from the literature; default value was used.
Total aldrin/dieldrin	1	No fish BSAF was available from the literature; default value was used.
Total chlordane	26	Based on the geometric mean BSAF reported by PTI (1995a); surrogate = technical chlordane.
Total DDTs	3.0	Based on the weighted average of BSAFs for the three DDT components detected in Force Lake: 16% 2,4′-DDD (geometric mean BSAF of 0.045 from PTI (1995a)), 29% 4,4'-DDD (mean BSAF of 0.83 from EPA (2008)), and 55% 4,4'-DDE (mean BSAF of 5.00 from EPA (2008)).
Toxaphene	1	No fish BSAF was available from the literature; default value was used.

Table 3. Fish BSAFs Used in the HHRA

Chemical	BSAF[a]	Source and Details on Selected Value
VOCs (lipid/OC)		
All VOCs analyzed in sediment	1	No fish BSAF was available from the literature for any VOCs; default value was used for all VOCs.

[a] All metal BSAFs are expressed as the ratio of tissue concentration (in dry weight) over sediment concentration (in dry weight); all BSAFs for organic chemicals are expressed as the ratio of tissue concentration (as a lipid-normalized concentration) over sediment concentration (as an OC-normalized concentration).

[b] The cPAH TEQ sum was calculated based on PEFs, which relate the seven cPAHs in the Harbor Oil dataset to the most toxic of these chemicals (benzo[a]pyrene), as described in Section 2.2.4 of the HHRA and Cal EPA (1994). Thus, the benzo(a)pyrene BSAF was used for cPAH TEQ.

BSAF – biota sediment accumulation factor
Cal EPA – California Environmental Protection Agency
cPAH – carcinogenic polycyclic aromatic hydrocarbon
EPA – US Environmental Protection Agency
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PEF – potency equivalency factor
SVOC – semivolatile organic compound
TEQ – toxic equivalent
VOC – volatile organic compound

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ATTACHMENT 3 – SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN

This attachment to the Harbor Oil baseline HHRA presents summary statistics for chemicals analyzed at the Harbor Oil Facility and documents the process for the selection of contaminants of potential concern (COPCs) using the table format suggested in RAGS Part D (EPA 1998). The process used to select COPCs is summarized in Section 3.2 of the main document and is based on the comparison of maximum values to the appropriate literature regional screening levels (RSLs).

This attachment provides a separate table for each scenario-exposure media combination. Note that conventional parameters (e.g., salinity, pH, clay, coarse sand, total organic carbon, total solids) are not included in these tables.

- Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME (reasonable maximum exposure) Scenario
- Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario
- Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario
- Table 4: Occurrence and selection of COPCs for Groundwater in the Industrial/Commercial Worker Vapor Intrusion Scenario
- Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario
- Table 6: Occurrence and selection of COPCs for Lake Sediment in the Force Lake Recreational User RME Scenario
- Table 7: Occurrence and selection of COPCs for Lake Surface Water in the Force Lake Recreational User RME Scenario
- Table 8: Occurrence and selection of COPCs for Calculated Fish Tissue in the Force Lake Fish Consumer RME Scenario

Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value Used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Metals											
Aluminum	7429-90-5	18/18	5,280	12,100	mg/kg dw	na	12,100	na	990,000	no	bsl
Antimony	7440-36-0	4/112	0.7 J	8.4 J	mg/kg dw	0.2 UJ – 4.5 U	8.4 J	4	41	no	bsl
Arsenic	7440-38-2	112/112	0.7	53.1	mg/kg dw	na	53.1	7	1.6	yes	asl
Barium	7440-39-3	112/112	36.5	1,170 J	mg/kg dw	na	1,170 J	na	6,200	no	bsl
Beryllium	7440-41-7	18/18	0.29	0.7	mg/kg dw	na	0.7	na	61	no	bsl
Cadmium	7440-43-9	67/112	0.2	4	mg/kg dw	0.2 UJ – 0.3 U	4	1	80	no	bsl
Calcium	7440-70-2	18/18	3,040	18,500	mg/kg dw	na	18,500	na	na	no	ntx
Chromium	7440-47-3	112/112	4.0	111	mg/kg dw	na	111	42	180	no	bsl
Cobalt	7440-48-4	112/112	2.7 J	35 J	mg/kg dw	na	35 J	na	30	yes	asl
Copper	7440-50-8	112/112	6.1 J	1,370	mg/kg dw	na	1,370	36	1,100	yes	asl
Iron	7439-89-6	18/18	1,400	56,500	mg/kg dw	na	56,500	na	720,000	no	bsl
Lead	7439-92-1	112/112	3	337	mg/kg dw	na	337	17	30	yes	asl
Magnesium	7439-95-4	18/18	2,880	5,370	mg/kg dw	na	5,370	na	na	no	ntx
Manganese	7439-96-5	18/18	158	1,090	mg/kg dw	na	1,090	na	1,400	no	bsl
Mercury	7439-97-6	56/112	0.03	6.69	mg/kg dw	0.03 U – 0.07 U	6.69	0.07	9.3	no	bsl
Nickel	7440-02-0	112/112	4	50 J	mg/kg dw	na	50 J	38	620	no	bsl
Potassium	7440-09-7	18/18	576	2,030	mg/kg dw	na	2,030	na	72	no	his[c]
Selenium	7782-49-2	8/112	0.1	1.1	mg/kg dw	0.1 U – 3 U	3 U	2	510	no	bsl
Silver	7440-22-4	17/18	0.42	3.16	mg/kg dw	0.4 U – 0.4 U	3.16	na	150	no	bsl
Sodium	7440-23-5	18/18	286	850	mg/kg dw	na	850	na	na	no	ntx
Thallium	7440-28-0	0/18	nd	nd	mg/kg dw	0.3 U – 0.75 U	0.75 U	na	6.6	no	bsl
Vanadium	7440-62-2	112/112	15.5 J	165	mg/kg dw	na	165	na	520	no	bsl
Zinc	7440-66-6	112/112	22 J	785 J	mg/kg dw	na	785 J	86	310,000	no	bsl
PAHs											
2-Chloronaphthalene	91-58-7	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	82,000,000	no	bsl
2-Methylnaphthalene	91-57-6	95/115	5.4	29,000	µg/kg dw	4.8 U – 172 U	29,000	na	4,100,000	no	bsl
Acenaphthene	83-32-9	63/115	5.0	28,000	µg/kg dw	4.6 U – 883 U	28,000	na	1,600,000	no	bsl
Acenaphthylene	208-96-8	20/115	5.3	836 J	µg/kg dw	4.5 U – 735 U	836 J	na	3,300,000	no	bsl
Anthracene	120-12-7	96/115	4.8	110,000	µg/kg dw	4.8 U – 735 U	110,000	na	9,000,000	no	bsl
Benzo(a)anthracene	56-55-3	95/115	5.0	8,800	µg/kg dw	4.8 U – 883 U	8,800	na	2100	yes	teq
Benzo(a)pyrene	50-32-8	98/115	5.0	3,800	µg/kg dw	4.8 U – 350 U	3,800	na	210	yes	teq
Benzo(b)fluoranthene	205-99-2	100/115	5.4	3,000	µg/kg dw	4.8 U – 1,470 U	3,000	na	2100	yes	teq
Benzo(g,h,i)perylene	191-24-2	96/115	5.0	3,390 J	µg/kg dw	4.8 U – 874 U	3,390 J	na	na	no	ntx
Benzo(k)fluoranthene	207-08-9	94/115	5.4	3,500	µg/kg dw	4.8 U – 883 U	3,500	na	21,000	no	teq
Total benzofluoranthenes	56832-73-6	101/115	6.4	6,400	µg/kg dw	4.8 U – 1,470 U	6,400	na	na	no	ntx

Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value Used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Chrysene	218-01-9	105/115	5.9	13,000	µg/kg dw	4.8 U – 735 U	13,000	na	210,000	no	teq
Dibenzo(a,h)anthracene	53-70-3	39/115	5.0 JN	420	µg/kg dw	4.6 U – 8,830 U	8,830 U	na	210	yes	teq
Dibenzofuran	132-64-9	75/115	5.1	18,000	µg/kg dw	4.5 U – 735 U	18,000	na	na	no	ntx
Fluoranthene	206-44-0	106/115	6.0	35,000	µg/kg dw	4.8 U – 172 U	35,000	na	890,000	no	bsl
Fluorene	86-73-7	70/115	6.2	40,000	µg/kg dw	4.6 U – 735 U	40,000	na	1,200,000	no	bsl
Indeno(1,2,3-cd)pyrene	193-39-5	87/115	5.9	3,830 J	µg/kg dw	4.7 U – 1,750 U	3,830 J	na	2,100	yes	teq
Naphthalene	91-20-3	85/115	4.8	19,000	µg/kg dw	4.8 U – 242 U	19,000	na	410	yes	asl
Phenanthrene	85-01-8	107/115	5.4 J	77,000	µg/kg dw	5.0 U – 172 U	77,000	na	na	no	ntx
Pyrene	129-00-0	109/115	6.5	31,000	µg/kg dw	4.8 U – 172 U	31,000	na	670,000	no	bsl
Total HPAHs	na	110/115	12.5	99,000	µg/kg dw	4.8 U – 1,720 U	99,000	na	na	no	ntx
Total LPAHs	na	107/115	5.4 J	260,000	µg/kg dw	5.0 U – 172 U	260,000	na	na	no	ntx
cPAH TEQ	na	106/115	5.00	5,200	µg/kg dw	4.30 U – 637 U	5,200	na	210	yes	asl
Total PAHs	na	113/115	7.8	360,000	µg/kg dw	1,200 U – 1,720 U	360,000	na	na	no	ntx
Phthalates											
Bis(2-ethylhexyl)phthalate	117-81-7	35/46	11 J	5,730	µg/kg dw	20 U – 175 U	5,730	na	120,000	no	bsl
Butyl benzyl phthalate	85-68-7	8/46	86	3,140 J	µg/kg dw	20 U – 3,680 U	3,680 U	na	910,000	no	bsl
Diethyl phthalate	84-66-2	1/46	184 J	184 J	µg/kg dw	20 U – 883 U	883 U	na	490,000,000	no	bsl
Dimethyl phthalate	131-11-3	0/46	nd	nd	µg/kg dw	20 U – 1,770 U	1,770 U	na	na	no	ntx
Di-n-butyl phthalate	84-74-2	3/46	56	194	µg/kg dw	20 U – 883 U	883 U	na	6,200,000	no	bsl
Di-n-octyl phthalate	117-84-0	0/46	nd	nd	µg/kg dw	20 U – 4,420 U	4,420 U	na	na	no	ntx
Other SVOCs											
1,2,4-Trichlorobenzene	120-82-1	2/113	7.2 J	24 J	µg/kg dw	2.2 U – 4,000 U	4,000 U	na	400,000	no	bsl
1,2-Dichlorobenzene	95-50-1	19/112	1.3	980	µg/kg dw	0.9 U – 440 U	980	na	3,800	no	bsl
1,3-Dichlorobenzene	541-73-1	7/111	1.3	120 J	µg/kg dw	0.9 U – 810 U	810 U	na	1,100	no	bsl
1,4-Dichlorobenzene	106-46-7	20/112	1.6	490 J	µg/kg dw	0.9 U – 810 U	810 U	na	540	no	ife
2,4,5-Trichlorophenol	95-95-4	0/46	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	6,200,000	no	bsl
2,4,6-Trichlorophenol	88-06-2	0/46	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	13,000	no	bsl
2,4-Dichlorophenol	120-83-2	0/46	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	180,000	no	bsl
2,4-Dimethylphenol	105-67-9	4/46	69.4 J	480	µg/kg dw	20 U – 883 U	883 U	na	1,200,000	no	bsl
2,4-Dinitrophenol	51-28-5	0/44	nd	nd	µg/kg dw	200 U – 17,700 U	17,700 U	na	120,000	no	bsl
2,4-Dinitrotoluene	121-14-2	0/46	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	5,500	no	bsl
2,6-Dinitrotoluene	606-20-2	0/46	nd	nd	µg/kg dw	98 U – 8,830 U	8,830 U	na	1,700	yes	asl
2-Chlorophenol	95-57-8	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	510,000	no	bsl
2-Methylphenol	95-48-7	3/46	78 J	518	µg/kg dw	20 U – 883 U	883 U	na	3,100,000	no	bsl
2-Nitroaniline	88-74-4	0/46	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	180,000	no	bsl
2-Nitrophenol	88-75-5	0/46	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	na	no	ntx

Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value Used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
3,3'-Dichlorobenzidine	91-94-1	0/44	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	200	yes	asl
3-Nitroaniline	99-09-2	0/46	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	na	no	ntx
4,6-Dinitro-o-cresol	534-52-1	0/46	nd	nd	µg/kg dw	200 U – 8,830 U	8,830 U	na	6,200	no	ife
4-Bromophenyl phenyl ether	101-55-3	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	na	no	ntx
4-Chloro-3-methylphenol	59-50-7	0/46	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	na	no	ntx
4-Chloroaniline	106-47-8	0/46	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	8,600	no	bsl
4-Chlorophenyl phenyl ether	7005-72-3	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	na	no	ntx
4-Methylphenol	106-44-5	11/46	17 J	1,240	µg/kg dw	20 U – 883 U	1,240	na	310,000	no	bsl
4-Nitroaniline	100-01-6	0/46	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	86,000	no	bsl
4-Nitrophenol	100-02-7	0/46	nd	nd	µg/kg dw	98 U – 8,830 U	8,830 U	na	na	no	ntx
Acetophenone	98-86-2	3/18	68.2 J	630 J	µg/kg dw	119 U – 1,730 U	1,730 U	na	100,000,000	no	bsl
Aniline	62-53-3	0/27	nd	nd	µg/kg dw	20 UJ – 440 U	440 U	na	300,000	no	bsl
Atrazine	1912-24-9	0/18	nd	nd	µg/kg dw	596 U – 4,420 U	4,420 U	na	7,500	no	bsl
Benzaldehyde	100-52-7	3/17	37.2 J	1,080 J	µg/kg dw	119 UJ – 288 UJ	1,080 J	na	100,000,000	no	bsl
Benzoic acid	65-85-0	8/28	120 J	820	µg/kg dw	200 U – 4,400 U	4,400 U	na	2.5×10^9	no	bsl
Benzyl alcohol	100-51-6	3/28	17 J	170	µg/kg dw	20 U – 440 U	440 U	na	310,000,000	no	bsl
Biphenyl	92-52-4	7/18	44.7 J	1,000	µg/kg dw	119 U – 735 U	1,000	na	51,000,000	no	bsl
bis(2-chloroethoxy)methane	111-91-1	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	180,000	no	bsl
bis(2-chloroethyl)ether	111-44-4	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	900	no	bsl
bis(2-chloroisopropyl)ether	108-60-1	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	17,000	no	bsl
Caprolactam	105-60-2	0/18	nd	nd	µg/kg dw	596 U – 4,420 U	4,420 U	na	310,000,000	no	bsl
Carbazole	86-74-8	9/46	12 J	940	µg/kg dw	20 U – 883 U	940	na	na	no	ntx
Hexachlorobenzene	118-74-1	4/115	3.2	230	µg/kg dw	0.96 U – 4,800 U	4,800 U	na	1,100	no	ife
Hexachlorobutadiene	87-68-3	0/116	nd	nd	µg/kg dw	0.96 U – 4,000 U	4,000 U	na	22,000	no	bsl
Hexachlorocyclopentadiene	77-47-4	0/45	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	370,000	no	bsl
Hexachloroethane	67-72-1	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	16,000	no	bsl
Isophorone	78-59-1	0/46	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	1,800,000	no	bsl
Nitrobenzene	98-95-3	0/46	nd	nd	µg/kg dw	20 U – 2,000 U	2,000 U	na	22,000	no	bsl
n-Nitroso-di-n-propylamine	621-64-7	0/46	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	250	yes	asl
n-Nitrosodiphenylamine	86-30-6	0/46	nd	nd	µg/kg dw	20 U – 2,500 U	2,500 U	na	350,000	no	bsl
Pentachlorophenol	87-86-5	0/46	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	3,500	no	ife
Phenol	108-95-2	8/46	53	825	µg/kg dw	20 U – 440 U	825	na	180,000,000	no	bsl
PCBs											
Aroclor-1016	12674-11-2	0/114	nd	nd	µg/kg dw	15 U – 650 U	650 U	na	21,000	no	sum
Aroclor-1221	11104-28-2	0/114	nd	nd	µg/kg dw	30 U – 650 U	650 U	na	620	no	sum
Aroclor-1232	11141-16-5	0/114	nd	nd	µg/kg dw	15 U – 650 U	650 U	na	620	no	sum

Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value Used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Aroclor-1242	53469-21-9	2/114	140	1,300	µg/kg dw	15 U – 360 U	1,300	na	740	no	sum
Aroclor-1248	12672-29-6	29/114	46	14,000	µg/kg dw	15 U – 650 U	14,000	na	740	no	sum
Aroclor-1254	11097-69-1	20/114	65	8,200	µg/kg dw	15 U – 1,700 U	8,200	na	740	no	sum
Aroclor-1260	11096-82-5	69/114	4.9 J	9,900	µg/kg dw	17 U – 650 U	9,900	na	740	no	sum
Total PCBs	1336-36-3	74/114	4.9 J	32,000	µg/kg dw	32 U – 200 U	32,000	na	740	yes	asl
Pesticides											
2,4'-DDD	53-19-0	68/97	2.8	12,000	µg/kg dw	1.9 U – 540 U	12,000	na	na	no	sum
2,4'-DDE	3424-82-6	1/97	7.0	7.0	µg/kg dw	1.9 U – 9,600 U	9,600 U	na	na	no	sum
2,4'-DDT	789-02-6	5/97	3.0 J	920	µg/kg dw	1.9 U – 9,600 U	9,600 U	na	na	no	sum
4,4'-DDD	72-54-8	102/115	2.4 J	64,000	µg/kg dw	0.6 U – 130 U	64,000	na	7,200	no	sum
4,4'-DDE	72-55-9	46/115	1.6	5,200 J	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	5,100	no	sum
4,4'-DDT	50-29-3	46/115	0.95	8,400	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,000	no	sum
Total DDTs	na	104/115	2.4 J	78,000 J	µg/kg dw	0.6 U – 130 U	78,000 J	na	7,000	yes	asl
Aldrin	309-00-2	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	100	no	ife
Dieldrin	60-57-1	0/115	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	110	yes	asl
Total aldrin/dieldrin	na	0/115	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	na	no	ntx
alpha-BHC	319-84-6	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	35	yes	asl
beta-BHC	319-85-7	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	960	no	ife
gamma-BHC	58-89-9	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	100	no	ife
delta-BHC	319-86-8	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
alpha-Chlordane	5103-71-9	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
gamma-Chlordane	5103-74-2	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
Total chlordane	57-74-9	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
alpha-Endosulfan	959-98-8	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	140,000	no	bsl
beta-Endosulfan	33213-65-9	0/115	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	140,000	no	bsl
Endosulfan sulfate	1031-07-8	0/115	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	140,000	no	bsl
Endrin	72-20-8	1/115	2.6	2.6	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,100	no	ife
Endrin aldehyde	7421-93-4	0/115	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,100	no	ife
Endrin ketone	53494-70-5	0/115	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,100	no	ife
Heptachlor	76-44-8	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	380	no	ife
Heptachlor epoxide	1024-57-3	0/115	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	190	no	ife
Methoxychlor	72-43-5	0/115	nd	nd	µg/kg dw	0.6 U – 48,000 U	48,000 U	na	310,000	no	bsl
Toxaphene	8001-35-2	0/115	nd	nd	µg/kg dw	96 UJ – 480,000 U	480,000 U	na	1,600	yes	asl
VOCs											
1,1,1,2-Tetrachloroethane	630-20-6	0/95	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	9,800	no	bsl
1,1,1-Trichloroethane	71-55-6	1/113	170	170	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	15,000	no	bsl

Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value Used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
1,1,2,2-Tetrachloroethane	79-34-5	0/111	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	2,900	no	bsl
1,1,2-Trichloroethane	79-00-5	2/113	1.5 J	41	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	190	no	ife
1,1,2-Trichlorotrifluoroethane	76-13-1	0/113	nd	nd	µg/kg dw	1.8 U – 2,200 U	2,200 U	na	180,000,000	no	bsl
1,1-Dichloroethane	75-34-3	4/113	1.1	680	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	190	yes	asl
1,1-Dichloroethene	75-35-4	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	4,300	no	bsl
1,1-Dichloropropene	563-58-6	0/95	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
1,2,3-Trichlorobenzene	87-61-6	0/93	nd	nd	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	na	no	ntx
1,2,3-Trichloropropane	96-18-4	0/93	nd	nd	µg/kg dw	1.8 U – 2,200 U	2,200 U	na	410	no	ife
1,2,4-Trimethylbenzene	95-63-6	49/95	1.3 J	40,000	µg/kg dw	0.9 U – 7.1 UJ	40,000	na	5,500	yes	asl
1,2-Dibromo-3-chloropropane	96-12-8	0/113	nd	nd	µg/kg dw	3 UJ – 5,600 U	5,600 U	na	73	yes	asl
1,2-Dibromoethane (EDB)	106-93-4	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	0.44	yes	asl
1,2-Dichloroethane	107-06-2	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	7.4	yes	asl
1,2-Dichloroethene (total)	540-59-0	0/18	nd	nd	µg/kg dw	2.2 U – 4.7 U	4.7 U	na	50,000	no	bsl
1,2-Dichloropropane	78-87-5	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	4,700	no	bsl
1,3,5-Trimethylbenzene	108-67-8	34/95	1.3	12,000	µg/kg dw	0.9 U – 120 U	12,000	na	1,200	yes	asl
1,3-Dichloropropane	142-28-9	0/95	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	20,000,000	no	bsl
2,2-Dichloropropane	594-20-7	0/95	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
2-Chlorotoluene	95-49-8	0/93	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	20,000,000	no	bsl
2-Hexanone	591-78-6	0/113	nd	nd	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	na	no	ntx
4-Chlorotoluene	106-43-4	0/93	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	72,000,000	no	bsl
Acetone	67-64-1	83/113	11	1,800	µg/kg dw	5.6 U – 5,600 U	5,600 U	na	610,000,000	no	bsl
Benzene	71-43-2	52/113	1.1	6,400	µg/kg dw	0.9 U – 810 U	6,400	na	52	yes	asl
Bromobenzene	108-86-1	0/93	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	41,000	no	bsl
Bromochloromethane	74-97-5	0/95	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
Bromodichloromethane	75-27-4	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	23	yes	asl
Bromoform	75-25-2	0/111	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	1,600	no	bsl
Bromomethane	74-83-9	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	39	yes	asl
Carbon disulfide	75-15-0	38/113	1.3	460	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	3,000,000	no	bsl
Carbon tetrachloride	56-23-5	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	70	yes	asl
Chlorobenzene	108-90-7	24/113	1.2 JN	2,900 J	µg/kg dw	0.9 U – 1,100 U	2,900 J	na	2,600	yes	asl
Chloroethane	75-00-3	1/113	2.9	2.9	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	370	no	ife
Chloroform	67-66-3	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	18	yes	asl
Chloromethane	74-87-3	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	150	no	ife
cis-1,2-Dichloroethene	156-59-2	10/113	1.2	130,000	µg/kg dw	0.9 U – 1,100 U	130,000	na	400	yes	asl
cis-1,3-Dichloropropene	10061-01-5	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	8400	no	bsl
Cyclohexane	110-82-7	3/18	1.3 J	31.6 J	µg/kg dw	2.2 U – 4.3 UJ	31.6 J	na	30,000,000	no	bsl

Table 1: Occurrence and selection of COPCs for Facility Soil in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value Used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
p-Cymene	99-87-6	27/95	1.3	11,000 J	µg/kg dw	0.9 U – 98 U	11,000 J	na	na	no	ntx
Dibromochloromethane	124-48-1	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	3,400	no	bsl
Dibromomethane	74-95-3	0/95	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	10,000,000	no	bsl
Dichlorodifluoromethane	75-71-8	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	78,000	no	bsl
Dichloromethane	75-09-2	27/113	2.0	370	µg/kg dw	1.9 U – 2,200 U	2,200 U	na	230	yes	asl
Ethylbenzene	100-41-4	35/113	1.4	26,000	µg/kg dw	0.9 U – 120 U	26,000	na	860	yes	asl
Isopropylbenzene	98-82-8	37/111	1.3	2,300	µg/kg dw	0.9 U – 120 U	2,300	na	2,400,000	no	bsl
Methyl acetate	79-20-9	0/18	nd	nd	µg/kg dw	11.1 UJ – 23.3 UJ	23.3 UJ	na	1.0×10^9	no	bsl
Methyl ethyl ketone	78-93-3	53/113	7.0	240	µg/kg dw	4.8 U – 5,600 U	5,600 U	na	na	no	ntx
Methyl isobutyl ketone	108-10-1	6/113	5.2 J	100	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	na	no	ntx
Methylcyclohexane	108-87-2	6/18	3.7	185 J	µg/kg dw	2.2 U – 4.3 UJ	185 J	na	na	no	ntx
n-Butylbenzene	104-51-8	33/95	1.3	12,000	µg/kg dw	0.9 U – 83 U	12,000	na	na	no	ntx
n-Propylbenzene	103-65-1	37/94	1.3	6,700	µg/kg dw	0.9 U – 120 U	6,700	na	230,000	no	bsl
sec-Butylbenzene	135-98-8	22/93	1.2	2,000	µg/kg dw	0.9 U – 1,100 U	2,000	na	16,000	no	bsl
Styrene	100-42-5	1/113	1.9	1.9	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	5,000,000	no	bsl
tert-Butyl methyl ether	1634-04-4	15/113	2.2	69	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	500	no	ife
tert-Butylbenzene	98-06-6	1/93	2.0	2.0	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
Tetrachloroethene	127-18-4	6/113	1.9	10.8 J	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	2,700	no	bsl
Toluene	108-88-3	54/113	1.2	49,000	µg/kg dw	0.9 U – 810 U	49,000	na	2,400,000	no	bsl
trans-1,2-Dichloroethene	156-60-5	1/95	5,500	5,500	µg/kg dw	0.9 U – 1,100 U	5,500	na	1,000	yes	asl
trans-1,3-Dichloropropene	10061-02-6	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	8,400	no	bsl
Trichloroethene	79-01-6	9/113	1.5	2,400	µg/kg dw	0.9 U – 1,100 U	2,400	na	9.9	yes	asl
Trichlorofluoromethane	75-69-4	0/113	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	29,000	no	bsl
Vinyl acetate	108-05-4	0/93	nd	nd	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	4,200,000	no	bsl
Vinyl chloride	75-01-4	2/113	13	1,200	µg/kg dw	0.9 U – 1,100 U	1,200	na	10	yes	asl
o-Xylene	95-47-6	43/113	1.2	33,000	µg/kg dw	0.9 U – 380 U	33,000	na	10,000	no	sum
m,p-Xylene	108383/ 106423	49/113	1.1 J	120,000 J	µg/kg dw	0.9 U – 380 U	120,000 J	na	10,000	no	sum
Total xylenes	1330-20-7	53/113	1.1 J	150,000 J	µg/kg dw	0.9 U – 380 U	150,000 J	na	10,000	yes	asl
Petroleum[d]											
TPH - Gasoline range	na	49/97	5.3	3,800	mg/kg dw	5.6 U – 57 U	3,800	na	110	yes	asl
TPH - Diesel range	na	104/110	6.3	13,000	mg/kg dw	6.3 U – 29 U	13,000	na	23,000	no	bsl
TPH - Motor oil range	na	108/110	14	12,000	mg/kg dw	13 U – 14 U	12,000	na	40,000	no	bsl

[a] Background values are from DEQ (2002).

[b] The worker soil RSL is the lowest of EPA industrial screening levels (2009d) and DEQ human health occupational, construction worker, or excavation worker RBCs for the following four exposure routes: soil ingestion, dermal absorption, and inhalation; volatilization to outdoor air; vapor intrusion into buildings; and leaching to groundwater (2007). For TPHs, the screening level is the lowest occupational DEQ RBC (2003).

[c] Potassium was analyzed only in historical data, but not in samples collected in the RI/FS sampling effort because potassium is an essential nutrient and is not expected to be toxic to humans based on the daily reference intake for potassium of 4.7 g/day (Institute of Medicine 2004).

[d] Aromatic and aliphatic TPHs were assumed to be equal to 15% and 85% of the TPH total for each of the three fractions (gasoline, diesel, and motor oil) based on ATSDR (1999). For the purposes of this HHRA, only aliphatic TPHs were carried forward as COPCs when above screening levels because the components of the aromatic TPHs (e.g., various PAHs and VOCs) were already assessed and thus the assessment of aromatic TPHs as an additional chemical group would double count risks.

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – Chemical Abstracts Service
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
EDB – 1,2-dibromoethane
HCID – hydrocarbon identification
his – chemical analyzed only in historical data
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
ife – infrequent exceedance of RSL by RLs (not selected as COPC)
J – estimated concentration
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
na – not available
N – tentative identification
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Metals										
Aluminum (total)	7429-90-5	6/6	193	5,890	µg/L	na	5,890	na	no	ntx
Antimony (dissolved)	7440-36-0	5/22	0.2	0.6	µg/L	0.2 U – 0.2 U	0.6	na	no	ntx
Antimony (total)	7440-36-0	2/28	0.2	0.5	µg/L	0.2 U – 1.6 U	1.6 U	na	no	ntx
Arsenic (dissolved)	7440-38-2	22/22	0.8	32.2	µg/L	na	32.2	0.038	yes	asl
Arsenic (total)	7440-38-2	28/28	1	31.6	µg/L	na	31.6	0.038	yes	asl
Barium (dissolved)	7440-39-3	22/22	65	389	µg/L	na	389	730	no	bsl
Barium (total)	7440-39-3	28/28	65	497	µg/L	na	497	730	no	bsl
Beryllium (total)	7440-41-7	1/6	1.5	1.5	µg/L	1 U – 1 U	1.5	4	no	bsl
Cadmium (dissolved)	7440-43-9	0/22	nd	nd	µg/L	0.2 U – 0.2 U	0.2 U	na	no	ntx
Cadmium (total)	7440-43-9	4/28	0.3	1.31	µg/L	0.2 U – 0.2 U	1.31	na	no	ntx
Calcium (total)	7440-70-2	6/6	80,200	208,000	µg/L	na	208,000	na	no	ntx
Chromium (dissolved)	7440-47-3	0/22	nd	nd	µg/L	5 UJ – 5 UJ	5 U	100	no	bsl
Chromium (total)	7440-47-3	4/28	6 J	8.1	µg/L	5 U – 5 UJ	8.1	100	no	bsl
Cobalt (dissolved)	7440-48-4	9/22	3	25	µg/L	3 U – 3 U	25	na	no	ntx
Cobalt (total)	7440-48-4	9/28	3	23	µg/L	3 U – 5 U	23	na	no	ntx
Copper (dissolved)	7440-50-8	2/22	3	5	µg/L	2 U – 2 U	5	140	no	bsl
Copper (total)	7440-50-8	8/28	2	25.1	µg/L	2 U – 4 U	25.1	140	no	bsl
Iron (dissolved)	7439-89-6	22/22	1,720	64,400	µg/L	na	64,400	na	no	ntx
Iron (total)	7439-89-6	28/28	3,130	65,700	µg/L	na	65,700	na	no	ntx
Lead (dissolved)	7439-92-1	0/22	nd	nd	µg/L	1 U – 1 U	1 U	15	no	bsl
Lead (total)	7439-92-1	8/28	0.36	19.6	µg/L	1 U – 1 U	19.6	15	yes	asl
Magnesium (total)	7439-95-4	6/6	24,900	95,800	µg/L	na	95,800	na	no	ntx
Manganese (dissolved)	7439-96-5	22/22	724	6,510	µg/L	na	6,510	170	yes	asl
Manganese (total)	7439-96-5	28/28	667	7,860	µg/L	na	7,860	170	yes	asl
Mercury (dissolved)	7439-97-6	0/22	nd	nd	µg/L	0.1 U – 0.1 U	0.1 U	1.1	no	bsl
Mercury (total)	7439-97-6	1/28	0.14	0.14	µg/L	0.1 U – 0.1 U	0.14	1.1	no	bsl
Nickel (dissolved)	7440-02-0	5/22	10 J	20	µg/L	10 U – 10 U	20	73	no	bsl
Nickel (total)	7440-02-0	8/28	10	25	µg/L	10 UJ – 10 UJ	25	73	no	bsl

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Potassium (total)	7440-09-7	6/6	17,700	63,300	µg/L	na	63,300	na	no	his[b]
Selenium (dissolved)	7782-49-2	8/22	0.5	1.2	µg/L	0.5 U – 2 U	2 U	na	no	ntx
Selenium (total)	7782-49-2	10/28	0.5	4.7	µg/L	0.5 U – 2 U	4.7	na	no	ntx
Silver (total)	7440-22-4	1/6	1	1	µg/L	1 U – 1 U	1 U	18	no	bsl
Sodium (total)	7440-23-5	6/6	15,600	150,000	µg/L	na	150,000	na	no	ntx
Thallium (total)	7440-28-0	6/6	0.00894	0.0527	µg/L	na	0.0527	na	no	ntx
Vanadium (dissolved)	7440-62-2	5/22	3	9	µg/L	3 U – 3 U	9	na	no	ntx
Vanadium (total)	7440-62-2	14/28	3	54.4	µg/L	3 U – 3 U	54.4	na	no	ntx
Zinc (dissolved)	7440-66-6	2/22	40	80	µg/L	10 U – 10 U	80	na	no	ntx
Zinc (total)	7440-66-6	10/28	8.7	1,180	µg/L	4 U – 10 U	1,180	na	no	ntx
PAHs										
2-Chloronaphthalene	91-58-7	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
2-Methylnaphthalene	91-57-6	7/28	0.1 J	1.8	µg/L	0.10 U – 0.38 U	1.8	na	no	ntx
Acenaphthene	83-32-9	11/28	0.14	3.2	µg/L	0.10 U – 0.4 U	3.2	37	no	bsl
Acenaphthylene	208-96-8	0/28	nd	nd	µg/L	0.10 U – 0.4 U	0.4 U	37	no	bsl
Anthracene	120-12-7	5/28	0.10	0.24	µg/L	0.10 U – 0.4 U	0.4 U	180	no	bsl
Benzo(a)anthracene	56-55-3	0/28	nd	nd	µg/L	0.10 U – 0.4 U	0.4 U	0.029	yes	teq
Benzo(a)pyrene	50-32-8	0/28	nd	nd	µg/L	0.10 U – 0.8 U	0.8 U	0.0029	yes	teq
Benzo(b)fluoranthene	205-99-2	0/28	nd	nd	µg/L	0.10 U – 0.8 U	0.8 U	0.029	yes	teq
Benzo(g,h,i)perylene	191-24-2	0/28	nd	nd	µg/L	0.10 U – 2 U	2 U	na	no	ntx
Benzo(k)fluoranthene	207-08-9	0/28	nd	nd	µg/L	0.10 U – 0.4 U	0.4 U	0.29	yes	teq
Total benzofluoranthenes	56832-73-6	0/28	nd	nd	µg/L	0.10 U – 0.8 U	0.8 U	na	no	ntx
Chrysene	218-01-9	0/28	nd	nd	µg/L	0.10 U – 0.4 U	0.4 U	2.9	no	teq
Dibenzo(a,h)anthracene	53-70-3	0/28	nd	nd	µg/L	0.10 U – 4 U	4 U	0.0029	yes	teq
Dibenzofuran	132-64-9	2/28	0.16	0.18	µg/L	0.10 U – 0.4 U	0.4 U	na	no	ntx
Fluoranthene	206-44-0	3/28	0.12	0.64	µg/L	0.10 U – 0.4 U	0.64	150	no	bsl
Fluorene	86-73-7	9/28	0.13	1.9	µg/L	0.10 U – 0.4 U	1.9	24	no	bsl
Indeno(1,2,3-cd)pyrene	193-39-5	0/28	nd	nd	µg/L	0.10 U – 4 U	4 U	0.029	yes	teq
Naphthalene	91-20-3	7/28	0.10	1.5	µg/L	0.10 U – 0.4 U	1.5	0.12	yes	asl
Phenanthrene	85-01-8	3/28	0.13	0.25	µg/L	0.10 U – 0.4 U	0.4 U	na	no	ntx

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Pyrene	129-00-0	3/28	0.12 J	0.53	µg/L	0.10 U – 0.4 U	0.53	110	no	bsl
Total HPAHs	na	4/28	0.12	1.17	µg/L	0.10 U – 4 U	4 U	na	no	ntx
Total LPAHs	na	12/28	0.10	5.1	µg/L	0.10 U – 0.4 U	5.1	na	no	ntx
cPAH TEQ	na	0/28	nd	nd	µg/L	0.0910 U – 1.50 U	1.50 U	0.0029	yes	asl
Total PAHs	na	12/28	0.10	6.3	µg/L	0.10 U – 4 U	6.3	na	no	ntx
Phthalates										
Bis(2-ethylhexyl)phthalate	117-81-7	5/6	0.59	1.8	µg/L	0.38 U – 0.38 U	1.8	4.1	no	bsl
Butyl benzyl phthalate	85-68-7	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
Diethyl phthalate	84-66-2	1/6	0.25 J	0.25 J	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
Dimethyl phthalate	131-11-3	0/6	nd	nd	µg/L	0.74 U – 0.8 U	0.8 U	na	no	ntx
Di-n-butyl phthalate	84-74-2	2/6	0.1 J	0.15 J	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
Di-n-octyl phthalate	117-84-0	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
Other SVOCs										
1,2,4-Trichlorobenzene	120-82-1	0/28	nd	nd	µg/L	0.50 U – 5.0 U	5.0 U	na	no	ntx
1,2-Dichlorobenzene	95-50-1	2/28	0.22 J	0.50	µg/L	0.20 U – 1.0 U	1 U	5	no	bsl
1,3-Dichlorobenzene	541-73-1	2/28	0.2 J	0.35 J	µg/L	0.20 U – 1.0 U	1 U	1.5	no	bsl
1,4-Dichlorobenzene	106-46-7	4/28	0.18 J	1.4	µg/L	0.20 U – 1.0 U	1.4	0.48	yes	asl
2,4,5-Trichlorophenol	95-95-4	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
2,4,6-Trichlorophenol	88-06-2	0/6	nd	nd	µg/L	0.74 U – 0.8 U	0.8 U	5.2	no	bsl
2,4-Dichlorophenol	120-83-2	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
2,4-Dimethylphenol	105-67-9	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
2,4-Dinitrophenol	51-28-5	0/6	nd	nd	µg/L	7.4 U – 8 U	8 U	na	no	ntx
2,4-Dinitrotoluene	121-14-2	0/6	nd	nd	µg/L	0.74 U – 0.8 U	0.8 U	na	no	ntx
2,6-Dinitrotoluene	606-20-2	0/6	nd	nd	µg/L	3.7 U – 4 U	4 U	3.7	yes	asl
2-Chlorophenol	95-57-8	1/6	0.97	0.97	µg/L	0.37 U – 0.38 U	0.97	na	no	ntx
2-Methylphenol	95-48-7	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
2-Nitroaniline	88-74-4	0/6	nd	nd	µg/L	0.74 U – 0.8 U	0.8 U	na	no	ntx
2-Nitrophenol	88-75-5	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
3,3'-Dichlorobenzidine	91-94-1	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	0.13	yes	asl
3-Nitroaniline	99-09-2	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
4,6-Dinitro-o-cresol	534-52-1	0/6	nd	nd	µg/L	3.7 U – 4 U	4 U	na	no	ntx
4-Bromophenyl phenyl ether	101-55-3	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
4-Chloro-3-methylphenol	59-50-7	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
4-Chloroaniline	106-47-8	0/6	nd	nd	µg/L	0.74 U – 0.8 U	0.8 U	na	no	ntx
4-Chlorophenyl phenyl ether	7005-72-3	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
4-Methylphenol	106-44-5	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
4-Nitroaniline	100-01-6	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
4-Nitrophenol	100-02-7	0/6	nd	nd	µg/L	3.7 U – 4 U	4 U	na	no	ntx
Acetophenone	98-86-2	1/6	0.16 J	0.16 J	µg/L	0.37 U – 0.38 U	0.38 U	na	no	ntx
Atrazine	1912-24-9	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
Benzaldehyde	100-52-7	2/6	0.12 J	0.13 J	µg/L	0.37 UJ – 0.4 UJ	0.4 UJ	na	no	ntx
Biphenyl	92-52-4	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
bis(2-chloroethoxy)methane	111-91-1	0/6	nd	nd	µg/L	0.37 U – 119 U	119 U	na	no	ntx
bis(2-chloroethyl)ether	111-44-4	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
bis(2-chloroisopropyl)ether	108-60-1	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
Caprolactam	105-60-2	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
Carbazole	86-74-8	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
Hexachlorobenzene (dissolved)	118-74-1	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.035	no	bsl
Hexachlorobenzene	118-74-1	0/28	nd	nd	µg/L	0.0050 U – 0.4 U	0.4 U	0.035	yes	asl
Hexachlorobutadiene (dissolved)	87-68-3	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	na	no	ntx
Hexachlorobutadiene	87-68-3	0/28	nd	nd	µg/L	0.0050 U – 0.4 U	0.4 U	na	no	ntx
Hexachlorocyclopentadiene	77-47-4	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	na	no	ntx
Hexachloroethane	67-72-1	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	4.1	no	bsl
Isophorone	78-59-1	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
Nitrobenzene	98-95-3	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
n-Nitroso-di-n-propylamine	621-64-7	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
n-Nitrosodiphenylamine	86-30-6	0/6	nd	nd	µg/L	0.37 U – 0.4 U	0.4 U	na	no	ntx
Pentachlorophenol	87-86-5	0/6	nd	nd	µg/L	1.8 U – 2 U	2 U	0.47	yes	asl
Phenol	108-95-2	5/6	0.095 J	0.37 J	µg/L	0.38 U – 0.38 U	0.38 U	na	no	ntx

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
PCBs										
Aroclor-1016	12674-11-2	0/28	nd	nd	µg/L	0.10 U – 0.48 U	0.48 U	na	no	sum
Aroclor-1221	11104-28-2	0/28	nd	nd	µg/L	0.10 U – 0.96 U	0.96 U	na	no	sum
Aroclor-1232	11141-16-5	0/28	nd	nd	µg/L	0.10 U – 0.48 U	0.48 U	na	no	sum
Aroclor-1242	53469-21-9	0/28	nd	nd	µg/L	0.10 U – 0.48 U	0.48 U	na	no	sum
Aroclor-1248	12672-29-6	0/28	nd	nd	µg/L	0.10 U – 0.48 U	0.48 U	na	no	sum
Aroclor-1254	11097-69-1	0/28	nd	nd	µg/L	0.10 U – 0.48 U	0.48 U	na	no	sum
Aroclor-1260	11096-82-5	0/28	nd	nd	µg/L	0.10 U – 0.48 U	0.48 U	na	no	sum
Total PCBs	1336-36-3	0/28	nd	nd	µg/L	0.10 U – 0.96 U	0.96 U	0.028	yes	asl
Pesticides										
2,4'-DDD (dissolved)	53-19-0	1/4	0.014	0.014	µg/L	0.010 U – 0.010 U	0.014	na	no	sum
2,4'-DDD	53-19-0	6/22	0.0063 J	0.032	µg/L	0.010 U – 0.010 U	0.032	na	no	sum
2,4'-DDE (dissolved)	3424-82-6	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum
2,4'-DDE	3424-82-6	0/22	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum
2,4'-DDT (dissolved)	789-02-6	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum
2,4'-DDT	789-02-6	0/22	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum
4,4'-DDD (dissolved)	72-54-8	2/4	0.011	0.059 J	µg/L	0.010 U – 0.010 U	0.059 J	0.24	no	sum
4,4'-DDD	72-54-8	12/28	0.0071 J	0.24 J	µg/L	0.010 U – 0.019 U	0.24 J	0.24	no	sum
4,4'-DDE (dissolved)	72-55-9	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.17	no	sum
4,4'-DDE	72-55-9	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	0.17	no	sum
4,4'-DDT (dissolved)	50-29-3	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.17	no	sum
4,4'-DDT	50-29-3	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	0.17	no	sum
Total DDTs (dissolved)	na	2/4	0.011	0.073 J	µg/L	0.010 U – 0.010 U	0.073 J	0.17	no	bsl
Total DDTs	na	12/28	0.0071 J	0.24 J	µg/L	0.010 U – 0.019 U	0.24 J	0.17	yes	asl
Aldrin (dissolved)	309-00-2	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.0033	yes	asl
Aldrin	309-00-2	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	0.0033	yes	asl
Dieldrin (dissolved)	60-57-1	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.0035	yes	asl
Dieldrin	60-57-1	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	0.0035	yes	asl
Total aldrin/dieldrin (dissolved)	na	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	ntx
Total aldrin/dieldrin	na	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	na	no	ntx

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
alpha-BHC (dissolved)	319-84-6	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.009	no	bsl
alpha-BHC	319-84-6	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	0.009	yes	asl
beta-BHC (dissolved)	319-85-7	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	na	no	ntx
beta-BHC	319-85-7	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	na	no	ntx
gamma-BHC (dissolved)	58-89-9	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.044	no	bsl
gamma-BHC	58-89-9	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	0.044	no	bsl
delta-BHC (dissolved)	319-86-8	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	na	no	ntx
delta-BHC	319-86-8	0/28	nd	nd	µg/L	0.0050 U – 0.043 U	0.043 U	na	no	ntx
alpha-Chlordane (dissolved)	5103-71-9	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.16	no	bsl
alpha-Chlordane	5103-71-9	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	0.16	no	bsl
gamma-Chlordane (dissolved)	5103-74-2	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	na	no	ntx
gamma-Chlordane	5103-74-2	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	na	no	ntx
Total chlordane (dissolved)	57-74-9	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.16	no	bsl
Total chlordane	57-74-9	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	0.16	no	bsl
alpha-Endosulfan (dissolved)	959-98-8	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	22	no	bsl
alpha-Endosulfan	959-98-8	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	22	no	bsl
beta-Endosulfan (dissolved)	33213-65-9	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	22	no	bsl
beta-Endosulfan	33213-65-9	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	22	no	bsl
Endosulfan sulfate (dissolved)	1031-07-8	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	22	no	bsl
Endosulfan sulfate	1031-07-8	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	22	no	bsl
Endrin (dissolved)	72-20-8	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	1.1	no	bsl
Endrin	72-20-8	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	1.1	no	bsl
Endrin aldehyde (dissolved)	7421-93-4	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	1.1	no	bsl
Endrin aldehyde	7421-93-4	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	1.1	no	bsl
Endrin ketone (dissolved)	53494-70-5	0/4	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	1.1	no	bsl
Endrin ketone	53494-70-5	0/28	nd	nd	µg/L	0.010 U – 0.019 U	0.019 U	1.1	no	bsl
Heptachlor (dissolved)	76-44-8	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.013	no	bsl
Heptachlor	76-44-8	0/28	nd	nd	µg/L	0.0050 U – 0.024 U	0.024 U	0.013	yes	asl
Heptachlor epoxide (dissolved)	1024-57-3	0/4	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.0062	no	bsl
Heptachlor epoxide	1024-57-3	0/28	nd	nd	µg/L	0.0050 U – 0.019 U	0.019 U	0.0062	yes	asl

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Methoxychlor (dissolved)	72-43-5	0/4	nd	nd	µg/L	0.050 U – 0.050 U	0.050 U	na	no	ntx
Methoxychlor	72-43-5	0/28	nd	nd	µg/L	0.018 U – 0.050 U	0.050 U	na	no	ntx
Toxaphene (dissolved)	8001-35-2	0/4	nd	nd	µg/L	0.50 U – 0.50 U	0.50 U	0.052	yes	asl
Toxaphene	8001-35-2	0/28	nd	nd	µg/L	0.50 U – 4.8 U	4.8 U	0.052	yes	asl
VOCs										
1,1,1,2-Tetrachloroethane	630-20-6	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
1,1,1-Trichloroethane	71-55-6	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	84	no	bsl
1,1,2,2-Tetrachloroethane	79-34-5	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
1,1,2-Trichloroethane	79-00-5	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	2.4	no	bsl
1,1,2-Trichlorotrifluoroethane	76-13-1	0/28	nd	nd	µg/L	0.20 U – 2.0 U	2.0 U	na	no	ntx
1,1-Dichloroethane	75-34-3	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	2	no	bsl
1,1-Dichloroethene	75-35-4	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	7	no	bsl
1,1-Dichloropropene	563-58-6	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
1,2,3-Trichlorobenzene	87-61-6	0/22	nd	nd	µg/L	0.50 U – 5.0 U	5.0 U	na	no	ntx
1,2,3-Trichloropropane	96-18-4	0/22	nd	nd	µg/L	0.50 U – 2.0 U	2.0 U	na	no	ntx
1,2,4-Trimethylbenzene	95-63-6	2/22	3.7	7.2	µg/L	0.20 U – 1.0 U	7.2	1.2	yes	asl
1,2-Dibromo-3-chloropropane	96-12-8	0/28	nd	nd	µg/L	0.50 U – 5.0 U	5.0 U	na	no	ntx
1,2-Dibromoethane (EDB)	106-93-4	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	0.0057	yes	asl
1,2-Dichloroethane	107-06-2	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	0.13	yes	asl
1,2-Dichloroethene (total)	540-59-0	0/6	nd	nd	µg/L	1 U – 1 U	1 U	na	no	ntx
1,2-Dichloropropane	78-87-5	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	na	no	ntx
1,3,5-Trimethylbenzene	108-67-8	3/22	1.5	3.0	µg/L	0.20 U – 1.0 U	3.0	1.2	yes	asl
1,3-Dichloropropane	142-28-9	0/22	nd	nd	µg/L	0.20 U – 5.0 U	5.0 U	na	no	ntx
2,2-Dichloropropane	594-20-7	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
2-Chlorotoluene	95-49-8	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
2-Hexanone	591-78-6	0/28	nd	nd	µg/L	2 U – 5.0 U	5.0 U	na	no	ntx
4-Chlorotoluene	106-43-4	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Acetone	67-64-1	11/28	4.4	18	µg/L	2 U – 15.6 U	18	na	no	ntx
Benzene	71-43-2	8/28	0.80	140	µg/L	0.20 U – 6.2 U	140	0.35	yes	asl
Bromobenzene	108-86-1	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Bromochloromethane	74-97-5	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Bromodichloromethane	75-27-4	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	0.18	yes	asl
Bromoform	75-25-2	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	7.2	no	bsl
Bromomethane	74-83-9	0/28	nd	nd	µg/L	0.50 U – 1.0 U	1 U	0.85	yes	asl
Carbon disulfide	75-15-0	0/28	nd	nd	µg/L	0.20 U – 2 U	2 U	na	no	ntx
Carbon tetrachloride	56-23-5	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	0.17	yes	asl
Chlorobenzene	108-90-7	15/28	0.2 J	130	µg/L	0.20 U – 1.0 U	130	9	yes	asl
Chloroethane	75-00-3	0/28	nd	nd	µg/L	0.20 U – 2 U	2 U	3.9	no	bsl
Chloroform	67-66-3	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	0.18	yes	asl
Chloromethane	74-87-3	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	2.3	no	bsl
cis-1,2-Dichloroethene	156-59-2	1/28	0.23 J	0.23 J	µg/L	0.20 U – 1.0 U	1 U	6.1	no	bsl
cis-1,3-Dichloropropene	10061-01-5	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Cyclohexane	110-82-7	0/6	nd	nd	µg/L	1 U – 1 U	1 U	na	no	ntx
p-Cymene	99-87-6	1/22	0.30	0.30	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Dibromochloromethane	124-48-1	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Dibromomethane	74-95-3	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Dichlorodifluoromethane	75-71-8	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	na	no	ntx
Dichloromethane	75-09-2	0/28	nd	nd	µg/L	0.50 U – 2.0 U	2.0 U	4.1	no	bsl
Ethylbenzene	100-41-4	1/28	1.2	1.2	µg/L	0.20 U – 1.0 U	1.2	1.2	no	bsl
Isopropylbenzene	98-82-8	4/28	0.039 J	8.3	µg/L	0.20 U – 1.0 U	8.3	66	no	bsl
Methyl acetate	79-20-9	0/6	nd	nd	µg/L	1 U – 1 U	1 U	na	no	ntx
Methyl ethyl ketone	78-93-3	0/28	nd	nd	µg/L	2 U – 5.0 U	5.0 U	na	no	ntx
Methyl isobutyl ketone	108-10-1	0/28	nd	nd	µg/L	2 U – 5.0 U	5.0 U	na	no	ntx
Methylcyclohexane	108-87-2	0/6	nd	nd	µg/L	1 U – 1 U	1 U	na	no	ntx
n-Butylbenzene	104-51-8	1/22	0.50	0.50	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
n-Propylbenzene	103-65-1	4/22	1.8	11	µg/L	0.20 U – 1.0 U	11	6.1	yes	asl
sec-Butylbenzene	135-98-8	1/22	0.40	0.40	µg/L	0.20 U – 1.0 U	1.0 U	6.1	no	bsl
Styrene	100-42-5	1/28	0.24 J	0.24 J	µg/L	0.20 U – 1.0 U	1 U	100	no	bsl
tert-Butyl methyl ether	1634-04-4	14/28	1.4	160	µg/L	0.50 U – 1.0 U	160	11	yes	asl
tert-Butylbenzene	98-06-6	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx

Table 2: Occurrence and selection of COPCs for Groundwater in the Industrial (Construction/Trenching) Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Worker Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Tetrachloroethene	127-18-4	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	na	no	ntx
Toluene	108-88-3	2/28	0.60	4.8	µg/L	0.20 U – 1.0 U	4.8	230	no	bsl
trans-1,2-Dichloroethene	156-60-5	0/22	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	11	no	bsl
trans-1,3-Dichloropropene	10061-02-6	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1.0 U	na	no	ntx
Trichloroethene	79-01-6	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	0.029	yes	asl
Trichlorofluoromethane	75-69-4	0/28	nd	nd	µg/L	0.20 U – 1.0 U	1 U	130	no	bsl
Vinyl acetate	108-05-4	0/22	nd	nd	µg/L	1.0 U – 5.0 U	5.0 U	na	no	ntx
Vinyl chloride	75-01-4	1/28	0.22 J	0.22 J	µg/L	0.20 U – 1.0 U	1 U	0.025	yes	asl
o-Xylene	95-47-6	2/28	4.0	6.0	µg/L	0.20 U – 1.0 U	6.0	21	no	sum
m,p-Xylene	108383/106423	3/28	1.4	10	µg/L	0.40 U – 2.0 U	10	21	no	sum
Total xylenes	1330-20-7	3/28	1.4	20	µg/L	0.40 U – 2.0 U	20	21	no	bsl
Petroleum[c]										
TPH - Gasoline range	na	5/22	0.27	0.81	mg/L	0.25 U – 0.25 U	0.81	4	no	bsl
TPH - Diesel range	na	1/22	0.26 J	0.26 J	mg/L	0.25 U – 0.25 U	0.26 J	3.5	no	bsl
TPH - Motor oil range	na	0/22	nd	nd	mg/L	0.50 U – 0.50 U	0.50 U	4.9	no	bsl

[a] The worker water RSL is the lowest of EPA water screening levels (2009d), EPA MCL or non-zero MCLGs (2009a), and DEQ human health occupational RBCs for the following four exposure pathways: ingestion and inhalation from tap water, volatilization to outdoor air, vapor intrusion into buildings, and leaching to groundwater during excavation (DEQ 2007). For TPHs, the screening level is the lowest occupational DEQ RBC (2003).

[b] Potassium was analyzed only in historical data, but not in samples collected in the RI/FS sampling effort because potassium is an essential nutrient and is not expected to be toxic to humans based on the daily reference intake for potassium of 4.7 g/day (Institute of Medicine 2004).

[c] Aromatic and aliphatic TPHs were assumed to be equal to 15% and 85% of the TPH total for each of the three fractions (gasoline, diesel, and motor oil) based on ATSDR (1999). For the purposes of this HHRA, only aliphatic TPHs were carried forward as COPCs when above screening levels because the components of the aromatic TPHs (e.g., various PAHs and VOCs) were already assessed and thus the assessment of aromatic TPHs as an additional chemical group would double count risks.

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – chemical abstracts service
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
EDB – 1,2-dibromoethane
HCID – hydrocarbon identification
HPAH – high-molecular-weight PAH
J – estimated concentration
LPAH – low-molecular-weight PAH
MCL – maximum contaminant level
MCLG – maximum contaminant level goals
na – not available
N – tentative identification
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Metals								na			
Aluminum	7429-90-5	15/15	5,280	12,100	mg/kg dw	na	12,100	na	990,000	no	bsl
Antimony	7440-36-0	4/69	0.7 J	8.4 J	mg/kg dw	0.2 UJ – 4.5 U	8.4 J	4	41	no	bsl
Arsenic	7440-38-2	69/69	0.7	53.1	mg/kg dw	na	53.1	7	1.6	yes	asl
Barium	7440-39-3	69/69	36.5	1,170 J	mg/kg dw	na	1,170 J	na	6,200	no	bsl
Beryllium	7440-41-7	15/15	0.29	0.601	mg/kg dw	na	0.601	na	61	no	bsl
Cadmium	7440-43-9	46/69	0.2	4	mg/kg dw	0.2 UJ – 0.3 U	4	1	80	no	bsl
Calcium	7440-70-2	15/15	3,040	18,500	mg/kg dw	na	18,500	na	na	no	ntx
Chromium	7440-47-3	69/69	4.0	111	mg/kg dw	na	111	42	180	no	bsl
Cobalt	7440-48-4	69/69	4.1 J	32	mg/kg dw	na	32	na	30	yes	asl
Copper	7440-50-8	69/69	9.23	1,240 J	mg/kg dw	na	1,240 J	36	1100	yes	asl
Iron	7439-89-6	15/15	1,400	56,500	mg/kg dw	na	56,500	na	720,000	no	bsl
Lead	7439-92-1	69/69	3	337	mg/kg dw	na	337	17	30	yes	asl
Magnesium	7439-95-4	15/15	2,880	5,370	mg/kg dw	na	5,370	na	na	no	ntx
Manganese	7439-96-5	15/15	158	1,090	mg/kg dw	na	1,090	na	1,400	no	bsl
Mercury	7439-97-6	37/69	0.03	6.69	mg/kg dw	0.04 UJ – 0.07 U	6.69	0.07	9.3	no	bsl
Nickel	7440-02-0	69/69	4	50 J	mg/kg dw	na	50 J	38	620	no	bsl
Potassium	7440-09-7	15/15	576	1,720	mg/kg dw	na	1,720	na	72	no	his[c]
Selenium	7782-49-2	6/69	0.1	1.1	mg/kg dw	0.1 U – 3 U	3 U	2	510	no	bsl
Silver	7440-22-4	14/15	0.42	3.16	mg/kg dw	0.4 U – 0.4 U	3.16	na	150	no	bsl
Sodium	7440-23-5	15/15	286	850	mg/kg dw	na	850	na	na	no	ntx
Thallium	7440-28-0	0/15	nd	nd	mg/kg dw	0.3 U – 0.75 U	0.75 U	na	6.6	no	bsl
Vanadium	7440-62-2	69/69	29.4 J	165	mg/kg dw	na	165	na	520	no	bsl
Zinc	7440-66-6	69/69	35	748	mg/kg dw	na	748	86	310,000	no	bsl
PAHs											
2-Chloronaphthalene	91-58-7	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	82,000,000	no	bsl
2-Methylnaphthalene	91-57-6	60/73	13	29,000	µg/kg dw	5.0 U – 131 U	29,000	na	4,100,000	no	bsl
Acenaphthene	83-32-9	35/73	5.3	28,000	µg/kg dw	4.6 U – 883 U	28,000	na	1,600,000	no	bsl
Acenaphthylene	208-96-8	15/73	5.3	836 J	µg/kg dw	4.6 U – 735 U	836 J	na	3,300,000	no	bsl
Anthracene	120-12-7	61/73	7.9	110,000	µg/kg dw	5.0 U – 735 U	110,000	na	9,000,000	no	bsl
Benzo(a)anthracene	56-55-3	60/73	6.9	8,800	µg/kg dw	9.7 U – 883 U	8,800	na	2,100	yes	teq
Benzo(a)pyrene	50-32-8	65/73	9.9	3,800	µg/kg dw	15 U – 265 U	3,800	na	210	yes	teq
Benzo(b)fluoranthene	205-99-2	63/73	14	3,000	µg/kg dw	15 U – 1,470 U	3,000	na	2,100	yes	teq
Benzo(g,h,i)perylene	191-24-2	65/73	5.7	3,390 J	µg/kg dw	14 U – 665 U	3,390 J	na	na	no	ntx

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Benzo(k)fluoranthene	207-08-9	61/73	6.4	3,500	µg/kg dw	15 U – 883 U	3,500	na	21,000	no	teq
Total benzofluoranthenes	56832-73-6	64/73	11 J	6,400	µg/kg dw	15 U – 1,470 U	6,400	na	na	no	ntx
Chrysene	218-01-9	68/73	11	13,000	µg/kg dw	37 U – 735 U	13,000	na	210,000	no	teq
Dibenzo(a,h)anthracene	53-70-3	27/73	9.4	420	µg/kg dw	4.6 U – 8,830 U	8,830 U	na	210	yes	teq
Dibenzofuran	132-64-9	47/73	5.1	18,000	µg/kg dw	5.0 U – 735 U	18,000	na	na	no	ntx
Fluoranthene	206-44-0	67/73	9.7	35,000	µg/kg dw	15 U – 131 U	35,000	na	890,000	no	bsl
Fluorene	86-73-7	40/73	7.2	40,000	µg/kg dw	4.6 U – 735 U	40,000	na	1,200,000	no	bsl
Indeno(1,2,3-cd)pyrene	193-39-5	58/73	8.6	3,830 J	µg/kg dw	4.7 U – 1,330 U	3,830 J	na	2,100	yes	teq
Naphthalene	91-20-3	52/73	5.8	19,000	µg/kg dw	5.0 U – 242 U	19,000	na	410	yes	asl
Phenanthrene	85-01-8	67/73	7.9	77,000	µg/kg dw	9.7 U – 131 U	77,000	na	na	no	ntx
Pyrene	129-00-0	70/73	16	31,000	µg/kg dw	20 U – 120 U	31,000	na	670,000	no	bsl
Total HPAHs	na	71/73	36 J	99,000	µg/kg dw	62 U – 1,200 U	99,000	na	na	no	ntx
Total LPAHs	na	67/73	7.9	260,000	µg/kg dw	9.7 U – 131 U	260,000	na	na	no	ntx
cPAH TEQ	na	69/73	14.0	5,200	µg/kg dw	33.0 U – 450 U	5,200	na	210	yes	asl
Total PAHs	na	72/73	36 J	360,000	µg/kg dw	1,200 U – 1,200 U	360,000	na	na	no	ntx
Phthalates											
Bis(2-ethylhexyl)phthalate	117-81-7	31/37	11 J	5,730	µg/kg dw	56 U – 133 U	5,730	na	120,000	no	bsl
Butyl benzyl phthalate	85-68-7	7/37	190	3,140 J	µg/kg dw	20 U – 3,680 U	3,680 U	na	910,000	no	bsl
Diethyl phthalate	84-66-2	1/37	184 J	184 J	µg/kg dw	20 U – 883 U	883 U	na	4.9×10^8	no	bsl
Dimethyl phthalate	131-11-3	0/37	nd	nd	µg/kg dw	20 U – 1,770 U	1,770 U	na	na	no	ntx
Di-n-butyl phthalate	84-74-2	2/37	59	194	µg/kg dw	20 U – 883 U	883 U	na	6,200,000	no	bsl
Di-n-octyl phthalate	117-84-0	0/37	nd	nd	µg/kg dw	20 U – 4,420 U	4,420 U	na	na	no	ntx
Other SVOCs											
1,2,4-Trichlorobenzene	120-82-1	2/69	7.2 J	24 J	µg/kg dw	2.2 U – 4,000 U	4,000 U	na	400,000	no	bsl
1,2-Dichlorobenzene	95-50-1	11/68	1.3 JN	980	µg/kg dw	0.9 U – 440 U	980	na	3,800	no	bsl
1,3-Dichlorobenzene	541-73-1	4/67	1.4 J	2.7 J	µg/kg dw	0.9 U – 810 U	810 U	na	1,100	no	bsl
1,4-Dichlorobenzene	106-46-7	13/68	2.2	99	µg/kg dw	0.9 U – 810 U	810 U	na	540	no	ife
2,4,5-Trichlorophenol	95-95-4	0/37	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	6,200,000	no	bsl
2,4,6-Trichlorophenol	88-06-2	0/37	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	13,000	no	bsl
2,4-Dichlorophenol	120-83-2	0/37	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	180,000	no	bsl
2,4-Dimethylphenol	105-67-9	3/37	70	480	µg/kg dw	20 U – 883 U	883 U	na	1,200,000	no	bsl
2,4-Dinitrophenol	51-28-5	0/35	nd	nd	µg/kg dw	200 U – 17,700 U	17,700 U	na	120,000	no	bsl
2,4-Dinitrotoluene	121-14-2	0/37	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	5,500	no	bsl
2,6-Dinitrotoluene	606-20-2	0/37	nd	nd	µg/kg dw	98 U – 8,830 U	8,830 U	na	1,700	yes	asl
2-Chlorophenol	95-57-8	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	510,000	no	bsl

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
2-Methylphenol	95-48-7	2/37	163	518	µg/kg dw	20 U – 883 U	883 U	na	3,100,000	no	bsl
2-Nitroaniline	88-74-4	0/37	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	180,000	no	bsl
2-Nitrophenol	88-75-5	0/37	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	na	no	ntx
3,3'-Dichlorobenzidine	91-94-1	0/36	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	200	yes	asl
3-Nitroaniline	99-09-2	0/37	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	na	no	ntx
4,6-Dinitro-o-cresol	534-52-1	0/37	nd	nd	µg/kg dw	200 U – 8,830 U	8,830 U	na	6,200	no	ife
4-Bromophenyl phenyl ether	101-55-3	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	na	no	ntx
4-Chloro-3-methylphenol	59-50-7	0/37	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	na	no	ntx
4-Chloroaniline	106-47-8	0/37	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	8,600	no	bsl
4-Chlorophenyl phenyl ether	7005-72-3	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	na	no	ntx
4-Methylphenol	106-44-5	7/37	25	1,240	µg/kg dw	20 U – 883 U	1,240	na	310,000	no	bsl
4-Nitroaniline	100-01-6	0/37	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	86,000	no	bsl
4-Nitrophenol	100-02-7	0/37	nd	nd	µg/kg dw	98 U – 8,830 U	8,830 U	na	na	no	ntx
Acetophenone	98-86-2	3/15	68.2 J	630 J	µg/kg dw	119 U – 1,730 U	1,730 U	na	1.0×10^{8}	no	bsl
Aniline	62-53-3	0/21	nd	nd	µg/kg dw	20 U – 440 U	440 U	na	300,000	no	bsl
Atrazine	1912-24-9	0/15	nd	nd	µg/kg dw	596 U – 4,420 U	4,420 U	na	7,500	no	bsl
Benzaldehyde	100-52-7	3/14	37.2 J	1,080 J	µg/kg dw	119 UJ – 288 UJ	1,080 J	na	1.0×10^{8}	no	bsl
Benzoic acid	65-85-0	4/22	250	820	µg/kg dw	200 U – 4,400 U	4,400 U	na	2.5×10^{9}	no	bsl
Benzyl alcohol	100-51-6	2/22	17 J	170	µg/kg dw	20 U – 440 U	440 U	na	3.1×10^{8}	no	bsl
Biphenyl	92-52-4	6/15	44.7 J	1,000	µg/kg dw	119 U – 735 U	1,000	na	5.1×10^{7}	no	bsl
bis(2-chloroethoxy)methane	111-91-1	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	180,000	no	bsl
bis(2-chloroethyl)ether	111-44-4	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	900	no	bsl
bis(2-chloroisopropyl)ether	108-60-1	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	17,000	no	bsl
Caprolactam	105-60-2	0/15	nd	nd	µg/kg dw	596 U – 4,420 U	4,420 U	na	3.1×10^{8}	no	bsl
Carbazole	86-74-8	8/37	12 J	940	µg/kg dw	20 U – 883 U	940	na	na	no	ntx
Hexachlorobenzene	118-74-1	2/72	42	230	µg/kg dw	0.97 U – 4,800 U	4,800 U	na	1,100	no	ife
Hexachlorobutadiene	87-68-3	0/72	nd	nd	µg/kg dw	0.97 U – 4,000 U	4,000 U	na	22,000	no	bsl
Hexachlorocyclopentadiene	77-47-4	0/36	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	370,000	no	bsl
Hexachloroethane	67-72-1	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	16,000	no	bsl
Isophorone	78-59-1	0/37	nd	nd	µg/kg dw	20 U – 883 U	883 U	na	1,800,000	no	bsl
Nitrobenzene	98-95-3	0/37	nd	nd	µg/kg dw	20 U – 2,000 U	2,000 U	na	22,000	no	bsl
n-Nitroso-di-n-propylamine	621-64-7	0/37	nd	nd	µg/kg dw	98 U – 2,200 U	2,200 U	na	250	yes	asl
n-Nitrosodiphenylamine	86-30-6	0/37	nd	nd	µg/kg dw	20 U – 2,500 U	2,500 U	na	350,000	no	bsl
Pentachlorophenol	87-86-5	0/37	nd	nd	µg/kg dw	98 U – 4,420 U	4,420 U	na	3,500	no	ife
Phenol	108-95-2	7/37	53	825	µg/kg dw	20 U – 440 U	825	na	1.8×10^{8}	no	bsl

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
PCBs											
Aroclor-1016	12674-11-2	0/71	nd	nd	µg/kg dw	15 U – 360 U	360 U	na	21,000	no	sum
Aroclor-1221	11104-28-2	0/71	nd	nd	µg/kg dw	30 U – 360 U	360 U	na	620	no	sum
Aroclor-1232	11141-16-5	0/71	nd	nd	µg/kg dw	15 U – 360 U	360 U	na	620	no	sum
Aroclor-1242	53469-21-9	0/71	nd	nd	µg/kg dw	15 U – 360 U	360 U	na	740	no	sum
Aroclor-1248	12672-29-6	26/71	46	14,000	µg/kg dw	15 U – 180 U	14,000	na	740	no	sum
Aroclor-1254	11097-69-1	15/71	74	8,200	µg/kg dw	15 U – 1,700 U	8,200	na	740	no	sum
Aroclor-1260	11096-82-5	56/71	4.9 J	9,900	µg/kg dw	17 U – 160 U	9,900	na	740	no	sum
Total PCBs	1336-36-3	59/71	4.9 J	32,000	µg/kg dw	32 U – 160 U	32,000	na	740	yes	asl
Pesticides											
2,4'-DDD	53-19-0	44/57	7.4	12,000	µg/kg dw	2.0 U – 540 U	12,000	na	na	no	sum
2,4'-DDE	3424-82-6	1/57	7.0	7.0	µg/kg dw	2.0 U – 9,600 U	9,600 U	na	na	no	sum
2,4'-DDT	789-02-6	5/57	3.0 J	920	µg/kg dw	2.0 U – 9,600 U	9,600 U	na	na	no	sum
4,4'-DDD	72-54-8	66/72	5.0	64,000	µg/kg dw	0.6 U – 130 U	64,000	na	7,200	no	sum
4,4'-DDE	72-55-9	29/72	1.6	5,200 J	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	5,100	no	sum
4,4'-DDT	50-29-3	33/72	5.6	8,400	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,000	no	sum
Total DDTs	na	68/72	5.0	78,000 J	µg/kg dw	0.6 U – 130 U	78,000 J	na	7,000	yes	asl
Aldrin	309-00-2	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	100	yes	asl
Dieldrin	60-57-1	0/72	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	110	yes	asl
Total aldrin/dieldrin	na	0/72	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	na	no	ntx
alpha-BHC	319-84-6	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	35	yes	asl
beta-BHC	319-85-7	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	960	no	ife
gamma-BHC	58-89-9	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	100	yes	asl
delta-BHC	319-86-8	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
alpha-Chlordane	5103-71-9	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
gamma-Chlordane	5103-74-2	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
Total chlordane	57-74-9	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	6,500	no	bsl
alpha-Endosulfan	959-98-8	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	140,000	no	bsl
beta-Endosulfan	33213-65-9	0/72	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	140,000	no	bsl
Endosulfan sulfate	1031-07-8	0/72	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	140,000	no	bsl
Endrin	72-20-8	1/72	2.6	2.6	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,100	no	ife
Endrin aldehyde	7421-93-4	0/72	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,100	no	ife
Endrin ketone	53494-70-5	0/72	nd	nd	µg/kg dw	0.6 U – 9,600 U	9,600 U	na	7,100	no	ife
Heptachlor	76-44-8	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	380	no	ife
Heptachlor epoxide	1024-57-3	0/72	nd	nd	µg/kg dw	0.6 U – 4,800 U	4,800 U	na	190	yes	asl

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Methoxychlor	72-43-5	0/72	nd	nd	µg/kg dw	0.6 U – 48,000 U	48,000 U	na	310,000	no	bsl
Toxaphene	8001-35-2	0/72	nd	nd	µg/kg dw	97 UJ – 480,000 U	480,000 U	na	1,600	yes	asl
VOCs											
1,1,1,2-Tetrachloroethane	630-20-6	0/54	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	9,800	no	bsl
1,1,1-Trichloroethane	71-55-6	1/69	170	170	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	15,000	no	bsl
1,1,2,2-Tetrachloroethane	79-34-5	0/67	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	2,900	no	bsl
1,1,2-Trichloroethane	79-00-5	2/69	1.5 J	41	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	190	no	ife
1,1,2-Trichlorotrifluoroethane	76-13-1	0/69	nd	nd	µg/kg dw	1.8 U – 2,200 U	2,200 U	na	1.8×10^8	no	bsl
1,1-Dichloroethane	75-34-3	3/69	1.1	680	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	190	yes	asl
1,1-Dichloroethene	75-35-4	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	4,300	no	bsl
1,1-Dichloropropene	563-58-6	0/54	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
1,2,3-Trichlorobenzene	87-61-6	0/52	nd	nd	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	na	no	ntx
1,2,3-Trichloropropane	96-18-4	0/52	nd	nd	µg/kg dw	1.8 U – 2,200 U	2,200 U	na	410	no	ife
1,2,4-Trimethylbenzene	95-63-6	24/54	1.9 J	40,000	µg/kg dw	0.9 U – 7.1 UJ	40,000	na	5,500	yes	asl
1,2-Dibromo-3-chloropropane	96-12-8	0/69	nd	nd	µg/kg dw	3 UJ – 5,600 U	5,600 U	na	73	no	ife
1,2-Dibromoethane (EDB)	106-93-4	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	0.44	yes	asl
1,2-Dichloroethane	107-06-2	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	7.4	no	ife
1,2-Dichloroethene (total)	540-59-0	0/15	nd	nd	µg/kg dw	2.2 U – 4.7 U	4.7 U	na	50,000	no	bsl
1,2-Dichloropropane	78-87-5	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	4700	no	bsl
1,3,5-Trimethylbenzene	108-67-8	18/54	1.5	12,000	µg/kg dw	0.9 U – 120 U	12,000	na	1200	yes	asl
1,3-Dichloropropane	142-28-9	0/54	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	20,000,000	no	bsl
2,2-Dichloropropane	594-20-7	0/54	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
2-Chlorotoluene	95-49-8	0/52	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	20000000	no	bsl
2-Hexanone	591-78-6	0/69	nd	nd	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	na	no	ntx
4-Chlorotoluene	106-43-4	0/52	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	72,000,000	no	bsl
Acetone	67-64-1	49/69	11	1,800	µg/kg dw	5.6 U – 5,600 U	5,600 U	na	6.1×10^8	no	bsl
Benzene	71-43-2	25/69	1.1	6,400	µg/kg dw	0.9 U – 810 U	6,400	na	52	yes	asl
Bromobenzene	108-86-1	0/52	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	41,000	no	bsl
Bromochloromethane	74-97-5	0/54	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
Bromodichloromethane	75-27-4	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	23	no	ife
Bromoform	75-25-2	0/67	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	1,600	no	bsl
Bromomethane	74-83-9	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	39	no	ife
Carbon disulfide	75-15-0	23/69	1.4	460	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	3,000,000	no	bsl
Carbon tetrachloride	56-23-5	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	70	no	ife

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Chlorobenzene	108-90-7	7/69	1.2 JN	320	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	2,600	no	bsl
Chloroethane	75-00-3	1/69	2.9	2.9	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	370	no	ife
Chloroform	67-66-3	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	18	no	ife
Chloromethane	74-87-3	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	150	no	ife
cis-1,2-Dichloroethene	156-59-2	4/69	1.6 J	130,000	µg/kg dw	0.9 U – 1,100 U	130,000	na	400	yes	asl
cis-1,3-Dichloropropene	10061-01-5	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	8,400	no	bsl
Cyclohexane	110-82-7	3/15	1.3 J	31.6 J	µg/kg dw	2.2 U – 4.3 UJ	31.6 J	na	30,000,000	no	bsl
p-Cymene	99-87-6	17/54	1.3	11,000 J	µg/kg dw	0.9 U – 83 U	11,000 J	na	na	no	ntx
Dibromochloromethane	124-48-1	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	3,400	no	bsl
Dibromomethane	74-95-3	0/54	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	10,000,000	no	bsl
Dichlorodifluoromethane	75-71-8	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	78,000	no	bsl
Dichloromethane	75-09-2	18/69	2.0	370	µg/kg dw	1.9 U – 2,200 U	2,200 U	na	230	yes	asl
Ethylbenzene	100-41-4	19/69	2.0 J	26,000	µg/kg dw	0.9 U – 120 U	26,000	na	860	yes	asl
Isopropylbenzene	98-82-8	19/67	1.3	2,300	µg/kg dw	0.9 U – 120 U	2,300	na	2,400,000	no	bsl
Methyl acetate	79-20-9	0/15	nd	nd	µg/kg dw	11.1 UJ – 23.3 UJ	23.3 UJ	na	1.0×10^9	no	bsl
Methyl ethyl ketone	78-93-3	36/69	7.6	240	µg/kg dw	4.9 U – 5,600 U	5,600 U	na	na	no	ntx
Methyl isobutyl ketone	108-10-1	3/69	5.2 J	18	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	na	no	ntx
Methylcyclohexane	108-87-2	5/15	3.7	185 J	µg/kg dw	2.2 U – 4.3 UJ	185 J	na	na	no	ntx
n-Butylbenzene	104-51-8	19/54	1.4 J	12,000	µg/kg dw	0.9 U – 83 U	12,000	na	na	no	ntx
n-Propylbenzene	103-65-1	19/53	1.3	6,700	µg/kg dw	0.9 U – 120 U	6,700	na	230,000	no	bsl
sec-Butylbenzene	135-98-8	11/52	1.2	2,000	µg/kg dw	0.9 U – 1,100 U	2,000	na	16,000	no	bsl
Styrene	100-42-5	1/69	1.9	1.9	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	5,000,000	no	bsl
tert-Butyl methyl ether	1634-04-4	3/69	2.2	6.9	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	500	no	ife
tert-Butylbenzene	98-06-6	0/52	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	na	no	ntx
Tetrachloroethene	127-18-4	5/69	1.9	10.8 J	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	2,700	no	bsl
Toluene	108-88-3	32/69	1.2	49,000	µg/kg dw	0.9 U – 810 U	49,000	na	2,400,000	no	bsl
trans-1,2-Dichloroethene	156-60-5	1/54	5,500	5,500	µg/kg dw	0.9 U – 1,100 U	5,500	na	1,000	yes	asl
trans-1,3-Dichloropropene	10061-02-6	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	8,400	no	bsl
Trichloroethene	79-01-6	6/69	1.5	2,400	µg/kg dw	0.9 U – 1,100 U	2,400	na	9.9	yes	asl
Trichlorofluoromethane	75-69-4	0/69	nd	nd	µg/kg dw	0.9 U – 1,100 U	1,100 U	na	29,000	no	bsl
Vinyl acetate	108-05-4	0/53	nd	nd	µg/kg dw	4.4 U – 5,600 U	5,600 U	na	4,200,000	no	bsl
Vinyl chloride	75-01-4	1/69	1,200	1,200	µg/kg dw	0.9 U – 1,100 U	1,200	na	10	yes	asl
o-Xylene	95-47-6	26/69	1.6	33,000	µg/kg dw	0.9 U – 83 U	33,000	na	10,000	no	sum
m,p-Xylene	108383/ 106423	27/69	1.5	120,000 J	µg/kg dw	0.9 U – 83 U	120,000 J	na	10,000	no	sum

Table 3: Occurrence and selection of COPCs for Facility Soil in the Future Outdoor Worker RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Worker Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Total xylenes	1330-20-7	29/69	1.8 J	150,000 J	µg/kg dw	0.9 U – 83 U	150,000 J	na	10,000	yes	asl
Petroleum[d]											
TPH - Gasoline range	na	28/56	5.3	3,800	mg/kg dw	5.6 U – 57 U	3,800	na	110	no	asl
TPH - Diesel range	na	67/68	6.3	13,000	mg/kg dw	29 U – 29 U	13,000	na	23,000	no	bsl
TPH - Motor oil range	na	68/68	37	12,000	mg/kg dw	na	12,000	na	40,000	no	bsl

[a] Background values are from DEQ (2002).

[b] The worker soil RSL is the lowest of EPA industrial screening levels (2009d)and DEQ human health occupational, construction worker, or excavation worker RBCs for the following four exposure routes: soil ingestion, dermal absorption, and inhalation; volatilization to outdoor air; vapor intrusion into buildings; and leaching to groundwater (2007). For TPHs, the screening level is the lowest occupational DEQ RBC (2003).

[c] Potassium was analyzed only in historical data, but not in samples collected in the RI/FS sampling effort because potassium is an essential nutrient and is not expected to be toxic to humans based on the daily reference intake for potassium of 4.7 g/day (Institute of Medicine 2004).

[d] Aromatic and aliphatic TPHs were assumed to be equal to 15% and 85% of the TPH total for each of the three fractions (gasoline, diesel, and motor oil) based on ATSDR (1999). For the purposes of this HHRA, only aliphatic TPHs were carried forward as COPCs when above screening levels because the components of the aromatic TPHs (e.g., various PAHs and VOCs) were already assessed and thus the assessment of aromatic TPHs as an additional chemical group would double count risks.

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – Chemical Abstracts Service
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DL – detection limit
dw – dry weight
EDB – 1,2-Dibromoethane
HCID – hydrocarbon identification
hic – analyzed only in historical data
HPAH – high-molecular-weight
ife – infrequent exceedance of RSL by RLs (not selected as COPC)
J – estimated concentration
LPAH – low-molecular-weight PAH
na – not available
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Metals											
Aluminum (total)	7429-90-5	µg/L	2/2	621	5,890	na	5,890	na	na	no	ntx
Antimony (dissolved)	7440-36-0	µg/L	0/4	nd	nd	0.2 U	0.2	na	na	no	ntx
Antimony (total)	7440-36-0	µg/L	0/6	nd	nd	0.2 U - 1.6 U	1.6	na	na	no	ntx
Arsenic (dissolved)	7440-38-2	µg/L	4/4	3	19.4	na	19.4	na	na	no	ntx
Arsenic (total)	7440-38-2	µg/L	6/6	3.7	19.3	na	19.3	na	na	yes	cac
Barium (dissolved)	7440-39-3	µg/L	4/4	103	122	na	122	na	na	no	ntx
Barium (total)	7440-39-3	µg/L	6/6	116	365	na	365	na	na	no	ntx
Beryllium (total)	7440-41-7	µg/L	1/2	1.5	1.5	1 U	1.5	na	na	no	ntx
Cadmium (dissolved)	7440-43-9	µg/L	0/4	nd	nd	0.2 U	0.2	na	na	no	ntx
Cadmium (total)	7440-43-9	µg/L	2/6	0.4	0.869	0.2 U	0.869	na	na	no	ntx
Calcium (total)	7440-70-2	µg/L	2/2	80,200	89,900	na	89,900	na	na	no	ntx
Chromium (dissolved)	7440-47-3	µg/L	0/4	nd	nd	5 UJ	5	na	na	no	ntx
Chromium (total)	7440-47-3	µg/L	3/6	6 J	8	5 UJ	8	na	na	no	ntx
Cobalt (dissolved)	7440-48-4	µg/L	0/4	nd	nd	3 U	3	na	na	no	ntx
Cobalt (total)	7440-48-4	µg/L	2/6	3	12	3 U - 5 U	12	na	na	no	ntx
Copper (dissolved)	7440-50-8	µg/L	0/4	nd	nd	2 U	2	na	na	no	ntx
Copper (total)	7440-50-8	µg/L	3/6	6	11	2 U - 4 U	11	na	na	no	ntx
Iron (dissolved)	7439-89-6	µg/L	4/4	15,500	21,600	na	21,600	na	na	no	ntx
Iron (total)	7439-89-6	µg/L	6/6	19,600	28,800	na	28,800	na	na	no	ntx
Lead (dissolved)	7439-92-1	µg/L	0/4	nd	nd	1 U	1	na	na	no	ntx
Lead (total)	7439-92-1	µg/L	4/6	2	8.51	1 U	8.51	na	na	no	ntx
Magnesium (total)	7439-95-4	µg/L	2/2	24,900	27,100	na	27,100	na	na	no	ntx
Manganese (dissolved)	7439-96-5	µg/L	4/4	2,110	3,210	na	3,210	na	na	no	ntx
Manganese (total)	7439-96-5	µg/L	6/6	2,050	3,350	na	3,350	na	na	no	ntx
Mercury (dissolved)	7439-97-6	µg/L	0/4	nd	nd	0.1 U	0.1	yes	0.68	no	bsl
Mercury (total)	7439-97-6	µg/L	1/6	0.14	0.14	0.1 U	0.14	yes	0.68	no	bsl
Nickel (dissolved)	7440-02-0	µg/L	0/4	nd	nd	10 U - 10 UJ	10	na	na	no	ntx
Nickel (total)	7440-02-0	µg/L	2/6	10	20	10 U	20	na	na	no	ntx
Potassium (total)	2023695	µg/L	2/2	17,700	23,700	na	23,700	na	na	no	ntx
Selenium (dissolved)	7782-49-2	µg/L	2/4	0.5	0.7	0.5 U	0.7	na	na	no	ntx
Selenium (total)	7782-49-2	µg/L	1/6	0.5	0.5	0.5 U - 2 U	2	na	na	no	ntx
Silver (total)	7440-22-4	µg/L	0/2	nd	nd	1 U	1	na	na	no	ntx
Sodium (total)	7440-23-5	µg/L	2/2	15,600	21,100	na	21,100	na	na	no	ntx

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Thallium (total)	7440-28-0	µg/L	2/2	0.0272	0.0301	na	0.0301	na	na	no	ntx
Vanadium (dissolved)	7440-62-2	µg/L	0/4	nd	nd	3 U	3	na	na	no	ntx
Vanadium (total)	7440-62-2	µg/L	4/6	4.3	54.4	3 U	54.4	na	na	no	ntx
Zinc (dissolved)	7440-66-6	µg/L	0/4	nd	nd	10 U	10	na	na	no	ntx
Zinc (total)	7440-66-6	µg/L	4/6	10	208	10 U	208	na	na	no	ntx
PAHs											
2-Chloronaphthalene	91-58-7	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	yes	icp	no	icp
2-Methylnaphthalene	91-57-6	µg/L	1/6	0.1 J	0.1 J	0.10 U - 0.37 U	0.37	yes	3,300	no	bsl
Acenaphthene	83-32-9	µg/L	3/6	2.5	3.2	0.10 U - 0.4 U	3.2	yes	icp	no	icp
Acenaphthylene	208-96-8	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	yes	icp	no	icp
Anthracene	120-12-7	µg/L	2/6	0.15	0.18	0.10 U - 0.4 U	0.4	no	na	no	ntx
Benzo(a)anthracene	56-55-3	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	no	na	no	teq
Benzo(a)pyrene	50-32-8	µg/L	0/6	nd	nd	0.10 U - 0.8 U	0.8	no	na	no	teq
Benzo(b)fluoranthene	205-99-2	µg/L	0/6	nd	nd	0.10 U - 0.8 U	0.8	yes	icp	no	teq
Benzo(g,h,i)perylene	191-24-2	µg/L	0/6	nd	nd	0.10 U - 2 U	2	na	na	no	ntx
Benzo(k)fluoranthene	207-08-9	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	no	na	no	teq
Total benzofluoranthenes	56832-73-6	µg/L	0/6	nd	nd	0.10 U - 0.8 U	0.8	na	na	no	ntx
Chrysene	218-01-9	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	yes	icp	no	teq
Dibenzo(a,h)anthracene	53-70-3	µg/L	0/6	nd	nd	0.10 U - 4 U	4	no	na	no	teq
Dibenzofuran	132-64-9	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	yes	icp	no	icp
Fluoranthene	206-44-0	µg/L	3/6	0.12	0.64	0.10 U - 0.4 U	0.64	no	na	no	ntx
Fluorene	86-73-7	µg/L	3/6	0.29	1.9	0.10 U - 0.4 U	1.9	yes	icp	no	icp
Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	0/6	nd	nd	0.10 U - 4 U	4	no	na	no	teq
Naphthalene	91-20-3	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	yes	150	no	bsl
Phenanthrene	85-01-8	µg/L	0/6	nd	nd	0.10 U - 0.4 U	0.4	na	na	no	ntx
Pyrene	129-00-0	µg/L	2/6	0.12	0.53	0.10 U - 0.4 U	0.53	yes	icp	no	icp
Total HPAHs	na	µg/L	3/6	0.12	1.17	0.10 U - 4 U	4	na	na	no	ntx
Total LPAHs	na	µg/L	3/6	3.1	5.1	0.10 U - 0.4 U	5.1	na	na	no	ntx
cPAH TEQ	na	µg/L	0/6	nd	nd	0.0910 U - 1.50 U	1.5	no	na	no	ntx
Total PAHs	na	µg/L	3/6	3.3	6.3	0.10 U - 4 U	6.3	na	na	no	ntx
Phthalates											
Bis(2-ethylhexyl)phthalate	117-81-7	µg/L	2/2	0.62	1.6	na	1.6	no	na	no	ntx
Butyl benzyl phthalate	85-68-7	µg/L	0/2	nd	nd	1.8 U - 2 U	2	no	na	no	ntx
Diethyl phthalate	84-66-2	µg/L	1/2	0.25 J	0.25 J	0.4 U	0.4	no	na	no	ntx
Dimethyl phthalate	131-11-3	µg/L	0/2	nd	nd	0.74 U - 0.8 U	0.8	no	na	no	ntx

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Di-n-butyl phthalate	84-74-2	µg/L	1/2	0.15 J	0.15 J	0.4 U	0.4	no	na	no	ntx
Di-n-octyl phthalate	117-84-0	µg/L	0/2	nd	nd	1.8 U - 2 U	2	no	na	no	ntx
Other SVOCs											
1,2,4-Trichlorobenzene	120-82-1	µg/L	0/6	nd	nd	1 U - 5.0 U	5	yes	3,400	no	bsl
1,2-Dichlorobenzene	95-50-1	µg/L	1/6	0.22 J	0.22 J	1.0 U	1	yes	2,600	no	bsl
1,3-Dichlorobenzene	541-73-1	µg/L	2/6	0.2 J	0.35 J	1.0 U	1	yes	830	no	bsl
1,4-Dichlorobenzene	106-46-7	µg/L	2/6	1	1.4	1.0 U	1.4	yes	8,200	no	bsl
2,4,5-Trichlorophenol	95-95-4	µg/L	0/2	nd	nd	1.8 U - 2 U	2	no	na	no	ntx
2,4,6-Trichlorophenol	88-06-2	µg/L	0/2	nd	nd	0.74 U - 0.8 U	0.8	no	na	no	ntx
2,4-Dichlorophenol	120-83-2	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
2,4-Dimethylphenol	105-67-9	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
2,4-Dinitrophenol	51-28-5	µg/L	0/2	nd	nd	7.4 U - 8 U	8	no	na	no	ntx
2,4-Dinitrotoluene	121-14-2	µg/L	0/2	nd	nd	0.74 U - 0.8 U	0.8	no	na	no	ntx
2,6-Dinitrotoluene	606-20-2	µg/L	0/2	nd	nd	3.7 U - 4 U	4	no	na	no	ntx
2-Chlorophenol	95-57-8	µg/L	1/2	0.97	0.97	0.37 U	0.97	yes	1,100	no	bsl
2-Methylphenol	95-48-7	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
2-Nitroaniline	88-74-4	µg/L	0/2	nd	nd	0.74 U - 0.8 U	0.8	na	na	no	ntx
2-Nitrophenol	88-75-5	µg/L	0/2	nd	nd	1.8 U - 2 U	2	no	na	no	ntx
3,3'-Dichlorobenzidine	91-94-1	µg/L	0/2	nd	nd	1.8 U - 2 U	2	no	na	no	ntx
3-Nitroaniline	99-09-2	µg/L	0/2	nd	nd	1.8 U - 2 U	2	na	na	no	ntx
4,6-Dinitro-o-cresol	534-52-1	µg/L	0/2	nd	nd	3.7 U - 4 U	4	no	na	no	ntx
4-Bromophenyl phenyl ether	101-55-3	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	na	na	no	ntx
4-Chloro-3-methylphenol	59-50-7	µg/L	0/2	nd	nd	1.8 U - 2 U	2	na	na	no	ntx
4-Chloroaniline	106-47-8	µg/L	0/2	nd	nd	0.74 U - 0.8 U	0.8	na	na	no	ntx
4-Chlorophenyl phenyl ether	7005-72-3	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	na	na	no	ntx
4-Methylphenol	106-44-5	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
4-Nitroaniline	100-01-6	µg/L	0/2	nd	nd	1.8 U - 2 U	2	na	na	no	ntx
4-Nitrophenol	100-02-7	µg/L	0/2	nd	nd	3.7 U - 4 U	4	no	na	no	ntx
Acetophenone	98-86-2	µg/L	1/2	0.16 J	0.16 J	0.37 U	0.37	yes	8.0×10^5	no	bsl
Atrazine	1912-24-9	µg/L	0/2	nd	nd	1.8 U - 2 U	2	na	na	no	ntx
Benzaldehyde	100-52-7	µg/L	0/2	nd	nd	0.37 UJ - 0.4 UJ	0.4	yes	3.6×10^5	no	bsl
Biphenyl	92-52-4	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	yes	icp	no	icp
bis(2-chloroethoxy)methane	111-91-1	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	na	na	no	ntx
bis(2-chloroethyl)ether	111-44-4	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	yes	10	no	bsl
bis(2-chloroisopropyl)ether	108-60-1	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	yes	51	no	bsl

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Caprolactam	105-60-2	µg/L	0/2	nd	nd	1.8 U - 2 U	2	na	na	no	ntx
Carbazole	86-74-8	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
Hexachlorobenzene (dissolved)	118-74-1	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	1.0	no	bsl
Hexachlorobenzene	118-74-1	µg/L	0/6	nd	nd	0.0050 U - 0.4 U	0.4	yes	1.0	no	bsl
Hexachlorobutadiene (dissolved)	87-68-3	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	0.33	no	bsl
Hexachlorobutadiene	87-68-3	µg/L	0/6	nd	nd	0.0050 U - 0.4 U	0.4	yes	0.33	yes	asl
Hexachlorocyclopentadiene	77-47-4	µg/L	0/2	nd	nd	1.8 U - 2 U	2	yes	50	no	bsl
Hexachloroethane	67-72-1	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	yes	3.8	no	bsl
Isophorone	78-59-1	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
Nitrobenzene	98-95-3	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	yes	2,000	no	bsl
n-Nitroso-di-n-propylamine	621-64-7	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
n-Nitrosodiphenylamine	86-30-6	µg/L	0/2	nd	nd	0.37 U - 0.4 U	0.4	no	na	no	ntx
Pentachlorophenol	87-86-5	µg/L	0/2	nd	nd	1.8 U - 2 U	2	no	na	no	ntx
Phenol	108-95-2	µg/L	2/2	0.23 J	0.37 J	na	0.37	no	na	no	ntx
PCBs											
Aroclor-1016	12674-11-2	µg/L	0/6	nd	nd	0.10 U - 0.46 UJ	0.46	na	na	no	sum
Aroclor-1221	11104-28-2	µg/L	0/6	nd	nd	0.10 U - 0.92 UJ	0.92	na	na	no	sum
Aroclor-1232	11141-16-5	µg/L	0/6	nd	nd	0.10 U - 0.46 UJ	0.46	na	na	no	sum
Aroclor-1242	53469-21-9	µg/L	0/6	nd	nd	0.10 U - 0.46 UJ	0.46	na	na	no	sum
Aroclor-1248	12672-29-6	µg/L	0/6	nd	nd	0.10 U - 0.46 UJ	0.46	na	na	no	sum
Aroclor-1254	11097-69-1	µg/L	0/6	nd	nd	0.10 U - 0.46 UJ	0.46	na	na	no	sum
Aroclor-1260	11096-82-5	µg/L	0/6	nd	nd	0.10 U - 0.46 UJ	0.46	na	na	no	sum
Total PCBs	1336-36-3	µg/L	0/6	nd	nd	0.10 U - 0.92 UJ	0.92	na	na	no	ntx
Pesticides											
2,4'-DDD (dissolved)	53-19-0	µg/L	0/1	nd	nd	0.010 U	0.01	no	na	no	sum
2,4'-DDD	53-19-0	µg/L	2/4	0.0093 J	0.012	0.010 U	0.012	no	na	no	sum
2,4'-DDE (dissolved)	3424-82-6	µg/L	0/1	nd	nd	0.010 U	0.01	yes	29	no	sum
2,4'-DDE	3424-82-6	µg/L	0/4	nd	nd	0.010 U	0.01	yes	29	no	sum
2,4'-DDT (dissolved)	789-02-6	µg/L	0/1	nd	nd	0.010 U	0.01	no	na	no	sum
2,4'-DDT	789-02-6	µg/L	0/4	nd	nd	0.010 U	0.01	no	na	no	sum
4,4'-DDD (dissolved)	72-54-8	µg/L	1/1	0.011	0.011	na	0.011	no	na	no	sum
4,4'-DDD	72-54-8	µg/L	3/6	0.029	0.24 J	0.010 U - 0.018 U	0.24	no	na	no	sum
4,4'-DDE (dissolved)	72-55-9	µg/L	0/1	nd	nd	0.010 U	0.01	yes	29	no	sum
4,4'-DDE	72-55-9	µg/L	0/6	nd	nd	0.010 U - 0.018 UJ	0.018	yes	29	no	sum
4,4'-DDT (dissolved)	50-29-3	µg/L	0/1	nd	nd	0.010 U	0.01	no	na	no	sum

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
4,4'-DDT	50-29-3	µg/L	0/6	nd	nd	0.010 U - 0.018 U	0.018	no	na	no	sum
Total DDTs (dissolved)	na	µg/L	1/1	0.011	0.011	na	0.011	yes	29	no	bsl
Total DDTs	na	µg/L	3/6	0.038 J	0.24 J	0.010 U - 0.018 U	0.24	yes	29	no	bsl
Aldrin (dissolved)	309-00-2	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	0.071	no	bsl
Aldrin	309-00-2	µg/L	0/6	nd	nd	0.0050 U - 0.018 U	0.018	yes	0.071	no	bsl
Dieldrin (dissolved)	60-57-1	µg/L	0/1	nd	nd	0.010 U	0.01	yes	0.86	no	bsl
Dieldrin	60-57-1	µg/L	0/6	nd	nd	0.010 U - 0.018 UJ	0.018	yes	0.86	no	bsl
Total aldrin/dieldrin (dissolved)	na	µg/L	0/1	nd	nd	0.010 U	0.01	na	na	no	ntx
Total aldrin/dieldrin	na	µg/L	0/6	nd	nd	0.010 U - 0.018 U	0.018	na	na	no	ntx
alpha-BHC (dissolved)	319-84-6	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	3.1	no	bsl
alpha-BHC	319-84-6	µg/L	0/6	nd	nd	0.0050 U - 0.018 U	0.018	yes	3.1	no	bsl
beta-BHC (dissolved)	319-85-7	µg/L	0/1	nd	nd	0.0050 U	0.005	no	na	no	ntx
beta-BHC	319-85-7	µg/L	0/6	nd	nd	0.0050 U - 0.018 UJ	0.018	no	na	no	ntx
gamma-BHC (dissolved)	58-89-9	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	11	no	bsl
gamma-BHC	58-89-9	µg/L	0/6	nd	nd	0.0050 U - 0.018 U	0.018	yes	11	no	bsl
delta-BHC (dissolved)	319-86-8	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	3.1	no	bsl
delta-BHC	319-86-8	µg/L	0/6	nd	nd	0.0050 U - 0.018 UJ	0.018	yes	3.1	no	bsl
alpha-Chlordane (dissolved)	5103-71-9	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	12	no	bsl
alpha-Chlordane	5103-71-9	µg/L	0/6	nd	nd	0.0050 U - 0.018 UJ	0.018	yes	12	no	bsl
gamma-Chlordane (dissolved)	5103-74-2	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	12	no	bsl
gamma-Chlordane	5103-74-2	µg/L	0/6	nd	nd	0.0050 U - 0.018 U	0.018	yes	12	no	bsl
Total chlordane (dissolved)	57-74-9	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	12	no	bsl
Total chlordane	57-74-9	µg/L	0/6	nd	nd	0.0050 U - 0.018 U	0.018	yes	12	no	bsl
alpha-Endosulfan (dissolved)	959-98-8	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	icp	no	icp
alpha-Endosulfan	959-98-8	µg/L	0/6	nd	nd	0.0050 U - 0.018 UJ	0.018	yes	icp	no	icp
beta-Endosulfan (dissolved)	33213-65-9	µg/L	0/1	nd	nd	0.010 U	0.01	yes	icp	no	icp
beta-Endosulfan	33213-65-9	µg/L	0/6	nd	nd	0.010 U - 0.018 U	0.018	yes	icp	no	icp
Endosulfan sulfate (dissolved)	1031-07-8	µg/L	0/1	nd	nd	0.010 U	0.01	yes	icp	no	icp
Endosulfan sulfate	1031-07-8	µg/L	0/6	nd	nd	0.010 U - 0.018 UJ	0.018	yes	icp	no	icp
Endrin (dissolved)	72-20-8	µg/L	0/1	nd	nd	0.010 U	0.01	no	na	no	ntx
Endrin	72-20-8	µg/L	0/6	nd	nd	0.010 U - 0.018 U	0.018	no	na	no	ntx
Endrin aldehyde (dissolved)	7421-93-4	µg/L	0/1	nd	nd	0.010 U	0.01	no	na	no	ntx
Endrin aldehyde	7421-93-4	µg/L	0/6	nd	nd	0.010 U - 0.018 U	0.018	no	na	no	ntx
Endrin ketone (dissolved)	53494-70-5	µg/L	0/1	nd	nd	0.010 U	0.01	no	na	no	ntx
Endrin ketone	53494-70-5	µg/L	0/6	nd	nd	0.010 U - 0.018 UJ	0.018	no	na	no	ntx

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Heptachlor (dissolved)	76-44-8	µg/L	0/1	nd	nd	0.0050 U	0.005	yes	0.4	no	bsl
Heptachlor	76-44-8	µg/L	0/6	nd	nd	0.0050 U - 0.018 UJ	0.018	yes	0.4	no	bsl
Heptachlor epoxide (dissolved)	1024-57-3	µg/L	0/1	nd	nd	0.0050 U	0.005	no	na	no	ntx
Heptachlor epoxide	1024-57-3	µg/L	0/6	nd	nd	0.0050 U - 0.018 UJ	0.018	no	na	no	ntx
Methoxychlor (dissolved)	72-43-5	µg/L	0/1	nd	nd	0.050 U	0.05	yes	icp	no	icp
Methoxychlor	72-43-5	µg/L	0/6	nd	nd	0.018 U - 0.050 U	0.05	yes	icp	no	icp
Toxaphene (dissolved)	8001-35-2	µg/L	0/1	nd	nd	0.50 U	0.5	no	na	no	ntx
Toxaphene	8001-35-2	µg/L	0/6	nd	nd	0.50 U - 4.6 UJ	4.6	no	na	no	ntx
VOCs											
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	0/4	nd	nd	1.0 U	1	yes	3.3	no	bsl
1,1,1-Trichloroethane	71-55-6	µg/L	0/6	nd	nd	1.0 U	1	yes	3,100	no	bsl
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	0/6	nd	nd	1.0 U	1	yes	3.0	no	bsl
1,1,2-Trichloroethane	79-00-5	µg/L	0/6	nd	nd	1 U	1	yes	5.0	no	bsl
1,1,2-Trichlorotrifluoroethane	76-13-1	µg/L	0/6	nd	nd	1 U - 2.0 U	2	yes	1,500	no	bsl
1,1-Dichloroethane	75-34-3	µg/L	0/6	nd	nd	1.0 U	1	yes	2,200	no	bsl
1,1-Dichloroethene	75-35-4	µg/L	0/6	nd	nd	1.0 U - 1 U	1	yes	190	no	bsl
1,1-Dichloropropene	563-58-6	µg/L	0/4	nd	nd	1.0 U	1	yes	0.84	yes	asl
1,2,3-Trichlorobenzene	87-61-6	µg/L	0/4	nd	nd	5.0 U	5	yes	24	no	bsl
1,2,3-Trichloropropane	96-18-4	µg/L	0/4	nd	nd	2.0 U	2	yes	290	no	bsl
1,2,4-Trimethylbenzene	95-63-6	µg/L	0/4	nd	nd	1.0 U	1	yes	24	no	bsl
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	0/6	nd	nd	1 U - 5.0 U	5	yes	33	no	bsl
1,2-Dibromoethane (EDB)	106-93-4	µg/L	0/6	nd	nd	1.0 U	1	yes	0.36	yes	asl
1,2-Dichloroethane	107-06-2	µg/L	0/6	nd	nd	1 U - 1.0 U	1	yes	5.0	no	bsl
1,2-Dichloroethene (total)	na	µg/L	0/2	nd	nd	1 U	1	yes	190	no	bsl
1,2-Dichloropropane	78-87-5	µg/L	0/6	nd	nd	1.0 U	1	yes	35	no	bsl
1,3,5-Trimethylbenzene	108-67-8	µg/L	0/4	nd	nd	1.0 U	1	yes	25	no	bsl
1,3-Dichloropropane	142-28-9	µg/L	0/4	nd	nd	1.0 U - 5.0 U	5	yes	35	no	bsl
2,2-Dichloropropane	594-20-7	µg/L	0/4	nd	nd	1.0 U	1	yes	35	no	bsl
2-Chlorotoluene	95-49-8	µg/L	0/4	nd	nd	1.0 U	1	na	na	no	ntx
2-Hexanone	591-78-6	µg/L	0/6	nd	nd	2 U - 5.0 U	5	na	na	no	ntx
4-Chlorotoluene	106-43-4	µg/L	0/4	nd	nd	1.0 U	1	na	na	no	ntx
Acetone	67-64-1	µg/L	2/6	5.7	8.3	2 U - 10 U	10	yes	2.2×10^5	no	bsl
Benzene	71-43-2	µg/L	2/6	2.3	2.9	1.0 U - 6.2 U	6.2	yes	5.0	yes	cac
Bromobenzene	108-86-1	µg/L	0/4	nd	nd	1.0 U	1	na	na	no	ntx
Bromochloromethane	74-97-5	µg/L	0/4	nd	nd	1.0 U	1	na	na	no	ntx

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Bromodichloromethane	75-27-4	µg/L	0/6	nd	nd	1.0 U	1	yes	2.1	no	bsl
Bromoform	75-25-2	µg/L	0/6	nd	nd	1 U - 1.0 U	1	yes	0.0083	yes	asl
Bromomethane	74-83-9	µg/L	0/6	nd	nd	1 U	1	na	na	no	ntx
Carbon disulfide	75-15-0	µg/L	0/6	nd	nd	1.0 U - 2 U	2	yes	560	no	bsl
Carbon tetrachloride	56-23-5	µg/L	0/6	nd	nd	1 U - 1.0 U	1	yes	5.0	no	bsl
Chlorobenzene	108-90-7	µg/L	6/6	4.1	130	na	130	yes	390	no	bsl
Chloroethane	75-00-3	µg/L	0/6	nd	nd	1.0 U - 2 U	2	yes	28,000	no	bsl
Chloroform	67-66-3	µg/L	0/6	nd	nd	1.0 U	1	yes	80	no	bsl
Chloromethane	74-87-3	µg/L	0/6	nd	nd	1 U	1	yes	6.7	no	bsl
cis-1,2-Dichloroethene	156-59-2	µg/L	1/6	0.23 J	0.23 J	1 U - 1.0 U	1	yes	210	no	bsl
cis-1,3-Dichloropropene	10061-01-5	µg/L	0/6	nd	nd	1 U	1	yes	0.84	yes	asl
Cyclohexane	110-82-7	µg/L	0/2	nd	nd	1 U	1	na	na	no	ntx
p-Cymene	99-87-6	µg/L	0/4	nd	nd	1.0 U	1	na	na	no	ntx
Dibromochloromethane	124-48-1	µg/L	0/6	nd	nd	1 U - 1.0 U	1	yes	3.2	no	bsl
Dibromomethane	74-95-3	µg/L	0/4	nd	nd	1.0 U	1	yes	990	no	bsl
Dichlorodifluoromethane	75-71-8	µg/L	0/6	nd	nd	1.0 U - 1 U	1	yes	14	no	bsl
Dichloromethane	75-09-2	µg/L	0/6	nd	nd	1 U - 2.0 U	2	yes	58	no	bsl
Ethylbenzene	100-41-4	µg/L	0/6	nd	nd	1.0 U	1	yes	700	no	bsl
Isopropylbenzene	98-82-8	µg/L	1/6	0.039 J	0.039 J	1.0 U	1	yes	8.4	no	bsl
Methyl acetate	79-20-9	µg/L	0/2	nd	nd	1 U	1	yes	7.2×10^5	no	bsl
Methyl ethyl ketone	78-93-3	µg/L	0/6	nd	nd	2 U - 5.0 U	5	yes	4.4×10^5	no	bsl
Methyl isobutyl ketone	108-10-1	µg/L	0/6	nd	nd	2 U - 5.0 U	5	yes	14,000	no	bsl
Methylcyclohexane	108-87-2	µg/L	0/2	nd	nd	1 U	1	yes	710	no	bsl
n-Butylbenzene	104-51-8	µg/L	0/4	nd	nd	1.0 U	1	yes	260	no	bsl
n-Propylbenzene	103-65-1	µg/L	0/4	nd	nd	1.0 U	1	yes	320	no	bsl
sec-Butylbenzene	135-98-8	µg/L	0/4	nd	nd	1.0 U	1	yes	250	no	bsl
Styrene	100-42-5	µg/L	1/6	0.24 J	0.24 J	1.0 U	1	yes	8,900	no	bsl
tert-Butyl methyl ether	1634-04-4	µg/L	0/6	nd	nd	1.0 U - 1 U	1	yes	1.2×10^5	no	bsl
tert-Butylbenzene	98-06-6	µg/L	0/4	nd	nd	1.0 U	1	yes	290	no	bsl
Tetrachloroethene	127-18-4	µg/L	0/6	nd	nd	1.0 U	1	yes	5.0	no	bsl
Toluene	108-88-3	µg/L	0/6	nd	nd	1.0 U	1	yes	1,500	no	bsl
trans-1,2-Dichloroethene	156-60-5	µg/L	0/4	nd	nd	1.0 U	1	yes	180	no	bsl
trans-1,3-Dichloropropene	10061-02-6	µg/L	0/6	nd	nd	0.94 U - 1.0 U	1	yes	0.84	yes	asl
Trichloroethene	79-01-6	µg/L	0/6	nd	nd	1.0 U	1	yes	5.0	no	bsl
Trichlorofluoromethane	75-69-4	µg/L	0/6	nd	nd	1 U - 1.0 U	1	yes	180	no	bsl

Table 4. Occurrence and selection of COPCs for Industrial/Commercial Worker Vapor Intrusion Scenario

Chemical	CAS Number	Unit	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Range of NDs	Value Used for Screening	Toxic and Volatile?[a]	EPA Vapor Intrusion SL[a]	COPC Flag?	Rationale for Selection or Exclusion
Vinyl acetate	108-05-4	µg/L	0/4	nd	nd	5.0 U - 5.0 UJ	5	yes	9,600	no	bsl
Vinyl chloride	75-01-4	µg/L	1/6	0.22 J	0.22 J	1.0 U	1	yes	2.0	yes	cac
o-Xylene	95-47-6	µg/L	0/6	nd	nd	1.0 U	1	yes	33,000	no	bsl
m,p-Xylene	108383/ 106423	µg/L	0/6	nd	nd	1.0 U - 2.0 U	2	yes	22,000	no	bsl
Total xylenes	1330-20-7	µg/L	0/6	nd	nd	1 U - 2.0 U	2	na	na	no	ntx
Petroleum											
TPH - Gasoline range	na	mg/L	1/4	0.27	0.27	0.25 U	0.27	na	na	no	ntx
TPH - Diesel range	na	mg/L	0/4	nd	nd	0.25 U	0.25	na	na	no	ntx
TPH - Motor oil range	na	mg/L	0/4	nd	nd	0.50 U	0.5	na	na	no	ntx

[a] The EPA vapor intrusion screening level for groundwater is from EPA's Draft Vapor Intrusion guidance (2005). This guidance also includes information regarding whether a given chemical is sufficiently toxic and volatile for inclusion in this analysis.

[b] Potassium was analyzed only in historical data, but not in samples collected in the RI/FS sampling effort because potassium is an essential nutrient and is not expected to be toxic to humans based on the daily reference intake for potassium of 4.7 g/day (Institute of Medicine 2004).

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – Chemical Abstracts Service
cac – Class A carcinogen (selected as COPC)
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DL – detection limit
dw – dry weight
EDB – 1,2-dibromoethane
HCID – hydrocarbon identification
HPAH – high-molecular-weight PAH
icp – incomplete pathway
J – estimated concentration
LPAH – low-molecular-weight PAH
MCL – maximum contaminant level
MCLG – maximum contaminant level goal
na – not available
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Metals											
Aluminum	7429-90-5	5/5	5,990	12,100	mg/kg dw	na	12,100	na	7,700	yes	asl
Antimony	7440-36-0	7/61	0.7 J	8.4 J	mg/kg dw	0.2 UJ – 4.5 U	8.4 J	4	3.1	yes	asl
Arsenic	7440-38-2	61/61	1.5	53.1	mg/kg dw	na	53.1	7	0.39	yes	asl
Barium	7440-39-3	61/61	64.5	481	mg/kg dw	na	481	na	1,500	no	bsl
Beryllium	7440-41-7	5/5	0.36	0.544	mg/kg dw	na	0.544	na	15	no	bsl
Cadmium	7440-43-9	54/61	0.2	4	mg/kg dw	0.2 U – 0.4 U	4	1	7	no	bsl
Calcium	7440-70-2	5/5	3,960	18,500	mg/kg dw	na	18,500	na	na	no	ntx
Chromium	7440-47-3	61/61	6.6	149	mg/kg dw	na	149	42	32	yes	asl
Cobalt	7440-48-4	61/61	3.5	34.3	mg/kg dw	na	34.3	na	2.3	yes	asl
Copper	7440-50-8	61/61	10.3	1,240 J	mg/kg dw	na	1,240 J	36	290	yes	asl
Iron	7439-89-6	5/5	17,400	56,500	mg/kg dw	na	56,500	na	5,500	yes	asl
Lead	7439-92-1	61/61	6 J	320	mg/kg dw	na	320	17	30	yes	asl
Magnesium	7439-95-4	5/5	2,800	4,700	mg/kg dw	na	4,700	na	na	no	ntx
Manganese	7439-96-5	5/5	417	1,090	mg/kg dw	na	1,090	na	180	yes	asl
Mercury	7439-97-6	54/61	0.04 J	0.4	mg/kg dw	0.05 U – 0.26 U	0.4	0.07	2.3	no	bsl
Nickel	7440-02-0	61/61	10	48	mg/kg dw	na	48	38	150	no	bsl
Potassium	7440-09-7	5/5	993	2,440	mg/kg dw	na	2,440	na	5.5	no	his[c]
Selenium	7782-49-2	2/61	0.55	1.1	mg/kg dw	0.1 U – 3 U	3 U	2	39	no	bsl
Silver	7440-22-4	5/5	0.55	1.5	mg/kg dw	na	1.5	na	39	no	bsl
Sodium	7440-23-5	5/5	311	850	mg/kg dw	na	850	na	na	no	ntx
Thallium	7440-28-0	0/5	nd	nd	mg/kg dw	0.3 U – 0.75 U	0.75 U	na	0.51	yes	asl
Vanadium	7440-62-2	61/61	16.1	148	mg/kg dw	na	148	na	39	yes	asl
Zinc	7440-66-6	61/61	37	748	mg/kg dw	na	748	86	2300	no	bsl
PAHs											
2-Chloronaphthalene	91-58-7	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	6,300,000	no	bsl
2-Methylnaphthalene	91-57-6	55/61	5.0	2,880	µg/kg dw	5.0 U – 277 U	2,880	na	31,000	no	bsl
Acenaphthene	83-32-9	11/61	5.4	700	µg/kg dw	4.6 U – 883 U	883 U	na	290,000	no	bsl
Acenaphthylene	208-96-8	22/61	4.8	836 J	µg/kg dw	4.6 U – 782 U	836 J	na	340,000	no	bsl
Anthracene	120-12-7	54/61	4.9	2,300	µg/kg dw	5.0 U – 735 U	2,300	na	1,700,000	no	bsl
Benzo(a)anthracene	56-55-3	55/61	6.9	5,700	µg/kg dw	72 U – 883 U	5,700	na	150	yes	teq
Benzo(a)pyrene	50-32-8	58/61	9.9	4,000	µg/kg dw	195 U – 782 U	4,000	na	15	yes	teq
Benzo(b)fluoranthene	205-99-2	57/61	15	2,900	µg/kg dw	389 U – 1,560 U	2,900	na	150	yes	teq
Benzo(g,h,i)perylene	191-24-2	57/61	8.8	6,000	µg/kg dw	72 U – 3,910 U	6,000	na	na	no	ntx

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Benzo(k)fluoranthene	207-08-9	56/61	6.4	3,500	µg/kg dw	195 U – 883 U	3,500	na	1,500	yes	teq
Total benzofluoranthenes	56832-73-6	57/61	21	6,400	µg/kg dw	389 U – 1,560 U	6,400	na	na	no	ntx
Chrysene	218-01-9	58/61	11	6,100	µg/kg dw	195 U – 735 U	6,100	na	15,000	no	teq
Dibenzo(a,h)anthracene	53-70-3	17/61	5.0 J	1,200	µg/kg dw	4.6 U – 8,830 U	8,830 U	na	15	yes	teq
Dibenzofuran	132-64-9	35/61	4.8	781 J	µg/kg dw	4.8 U – 782 U	782 U	na	na	no	ntx
Fluoranthene	206-44-0	60/61	16	17,000	µg/kg dw	277 U – 277 U	17,000	na	230,000	no	bsl
Fluorene	86-73-7	17/61	5.4	417 J	µg/kg dw	4.6 U – 735 U	735 U	na	230,000	no	bsl
Indeno(1,2,3-cd)pyrene	193-39-5	56/61	8.9	3,830 J	µg/kg dw	72 U – 7,820 U	7,820 U	na	150	yes	teq
Naphthalene	91-20-3	55/61	5.0	4,210	µg/kg dw	5.0 U – 277 U	4,210	na	72	yes	asl
Phenanthrene	85-01-8	60/61	7.9	8,800	µg/kg dw	277 U – 277 U	8,800	na	na	no	ntx
Pyrene	129-00-0	60/61	18	16,000	µg/kg dw	277 U – 277 U	16,000	na	170,000	no	bsl
Total HPAHs	na	60/61	105	57,000	µg/kg dw	2,770 U – 2,770 U	57,000	na	na	no	ntx
Total LPAHs	na	60/61	7.9	12,200	µg/kg dw	277 U – 277 U	12,200	na	na	no	ntx
cPAH TEQ	na	59/61	14.7	5,200	µg/kg dw	625 U – 888 U	5,200	na	15	yes	asl
Total PAHs	na	60/61	113	69,000	µg/kg dw	2,770 U – 2,770 U	69,000	na	na	no	ntx
Phthalates											
Bis(2-ethylhexyl)phthalate	117-81-7	13/15	22	9,100	µg/kg dw	195 U – 277 U	9,100	na	35,000	no	bsl
Butyl benzyl phthalate	85-68-7	1/15	3,140 J	3,140 J	µg/kg dw	20 U – 3,910 U	3,910 U	na	260,000	no	bsl
Diethyl phthalate	84-66-2	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	4,900,000	no	bsl
Dimethyl phthalate	131-11-3	0/15	nd	nd	µg/kg dw	20 U – 1,770 U	1,770 U	na	na	no	ntx
Di-n-butyl phthalate	84-74-2	3/15	59	2,400	µg/kg dw	20 U – 883 U	2,400	na	610,000	no	bsl
Di-n-octyl phthalate	117-84-0	0/15	nd	nd	µg/kg dw	20 U – 4,420 U	4,420 U	na	na	no	ntx
Other SVOCs											
1,2,4-Trichlorobenzene	120-82-1	0/52	nd	nd	µg/kg dw	3 UJ – 39 U	39 U	na	8,700	no	bsl
1,2-Dichlorobenzene	95-50-1	0/52	nd	nd	µg/kg dw	0.9 U – 15 UJ	15 UJ	na	940	no	bsl
1,3-Dichlorobenzene	541-73-1	0/52	nd	nd	µg/kg dw	0.9 U – 15 UJ	15 UJ	na	280	no	bsl
1,4-Dichlorobenzene	106-46-7	2/52	2.3 J	19 J	µg/kg dw	0.9 U – 15 UJ	19 J	na	91	no	bsl
2,4,5-Trichlorophenol	95-95-4	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	610,000	no	bsl
2,4,6-Trichlorophenol	88-06-2	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	1,900	no	ife
2,4-Dichlorophenol	120-83-2	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	18,000	no	bsl
2,4-Dimethylphenol	105-67-9	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	120,000	no	bsl
2,4-Dinitrophenol	51-28-5	0/14	nd	nd	µg/kg dw	200 U – 17,700 U	17,700 U	na	12,000	yes	asl
2,4-Dinitrotoluene	121-14-2	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	1,600	yes	asl
2,6-Dinitrotoluene	606-20-2	0/15	nd	nd	µg/kg dw	98 U – 8,830 U	8,830 U	na	420	yes	asl
2-Chlorophenol	95-57-8	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	39,000	no	bsl

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
2-Methylphenol	95-48-7	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	310,000	no	bsl
2-Nitroaniline	88-74-4	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	18,000	no	bsl
2-Nitrophenol	88-75-5	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	na	no	ntx
3,3'-Dichlorobenzidine	91-94-1	0/14	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	28	yes	asl
3-Nitroaniline	99-09-2	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	na	no	ntx
4,6-Dinitro-o-cresol	534-52-1	0/14	nd	nd	µg/kg dw	200 U – 10,000 U	10,000 U	na	610	yes	asl
4-Bromophenyl phenyl ether	101-55-3	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	na	no	ntx
4-Chloro-3-methylphenol	59-50-7	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	na	no	ntx
4-Chloroaniline	106-47-8	0/14	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	2,400	no	ife
4-Chlorophenyl phenyl ether	7005-72-3	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	na	no	ntx
4-Methylphenol	106-44-5	4/15	25	190	µg/kg dw	20 U – 1,000 U	1,000 U	na	31,000	no	bsl
4-Nitroaniline	100-01-6	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	24,000	no	bsl
4-Nitrophenol	100-02-7	0/15	nd	nd	µg/kg dw	98 U – 8,830 U	8,830 U	na	na	no	ntx
Acetophenone	98-86-2	1/5	630 J	630 J	µg/kg dw	195 U – 782 U	782 U	na	7,800,000	no	bsl
Aniline	62-53-3	0/9	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	85,000	no	bsl
Atrazine	1912-24-9	0/5	nd	nd	µg/kg dw	973 U – 4,420 U	4,420 U	na	2,100	yes	asl
Benzaldehyde	100-52-7	5/5	59.6 J	1,080 J	µg/kg dw	na	1,080 J	na	7,800,000	no	bsl
Benzoic acid	65-85-0	8/10	250	28,000	µg/kg dw	590 U – 880 U	28,000	na	240,000,000	no	bsl
Benzyl alcohol	100-51-6	5/10	15 J	2,100	µg/kg dw	20 U – 99 U	2,100	na	3,100,000	no	bsl
Biphenyl	92-52-4	1/5	836 J	836 J	µg/kg dw	195 U – 782 U	836 J	na	3,900,000	no	bsl
bis(2-chloroethoxy)methane	111-91-1	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	18,000	no	bsl
bis(2-chloroethyl)ether	111-44-4	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	190	yes	asl
bis(2-chloroisopropyl)ether	108-60-1	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	3,500	no	bsl
Caprolactam	105-60-2	0/5	nd	nd	µg/kg dw	973 U – 4,420 U	4,420 U	na	3,100,000	no	bsl
Carbazole	86-74-8	4/15	12 J	66 J	µg/kg dw	20 U – 1,000 U	1,000 U	na	na	no	ntx
Hexachlorobenzene	118-74-1	1/61	42	42	µg/kg dw	0.96 U – 883 U	883 U	na	300	no	ife
Hexachlorobutadiene	87-68-3	0/61	nd	nd	µg/kg dw	0.96 U – 883 U	883 U	na	6,200	no	bsl
Hexachlorocyclopentadiene	77-47-4	0/14	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	37,000	no	bsl
Hexachloroethane	67-72-1	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	2,200	no	bsl
Isophorone	78-59-1	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	510,000	no	bsl
Nitrobenzene	98-95-3	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	4,400	no	bsl
n-Nitroso-di-n-propylamine	621-64-7	0/15	nd	nd	µg/kg dw	98 U – 5,200 U	5,200 U	na	69	yes	asl
n-Nitrosodiphenylamine	86-30-6	0/15	nd	nd	µg/kg dw	20 U – 1,000 U	1,000 U	na	99,000	no	bsl
Pentachlorophenol	87-86-5	1/15	80 J	80 J	µg/kg dw	98 U – 5,200 U	5,200 U	na	480	yes	asl
Phenol	108-95-2	5/15	53	498 J	µg/kg dw	20 U – 1,000 U	1,000 U	na	1,800,000	no	bsl

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
PCBs											
Aroclor-1016	12674-11-2	0/61	nd	nd	µg/kg dw	23 U – 1,300 U	1,300 U	na	390	no	sum
Aroclor-1221	11104-28-2	0/61	nd	nd	µg/kg dw	32 U – 1,300 U	1,300 U	na	170	no	sum
Aroclor-1232	11141-16-5	0/61	nd	nd	µg/kg dw	23 U – 1,300 U	1,300 U	na	170	no	sum
Aroclor-1242	53469-21-9	0/61	nd	nd	µg/kg dw	23 U – 1,300 U	1,300 U	na	220	no	sum
Aroclor-1248	12672-29-6	2/61	120	390	µg/kg dw	23 U – 1,300 U	1,300 U	na	220	no	sum
Aroclor-1254	11097-69-1	4/61	170	2,200	µg/kg dw	23 U – 1,300 U	2,200	na	220	no	sum
Aroclor-1260	11096-82-5	39/61	35	2,300	µg/kg dw	24 U – 160 U	2,300	na	220	no	sum
Total PCBs	1336-36-3	40/61	35	4,200	µg/kg dw	32 U – 990 U	4,200	na	220	yes	asl
Pesticides											
2,4'-DDD	53-19-0	38/56	4.2	7,700	µg/kg dw	1.9 U – 78 U	7,700	na	na	no	sum
2,4'-DDE	3424-82-6	4/56	4.5 J	370	µg/kg dw	1.9 U – 980 U	980 U	na	na	no	sum
2,4'-DDT	789-02-6	24/56	6.6	11,000	µg/kg dw	1.9 U – 160 U	11,000	na	na	no	sum
4,4'-DDD	72-54-8	56/61	2.4 J	27,000	µg/kg dw	2.5 U – 130 U	27,000	na	2,000	no	sum
4,4'-DDE	72-55-9	44/61	3.8	2,700	µg/kg dw	2.4 U – 980 U	2,700	na	1,400	no	sum
4,4'-DDT	50-29-3	45/61	2.6	27,000	µg/kg dw	0.97 U – 160 U	27,000	na	1,700	no	sum
Total DDTs	na	60/61	2.7 J	46,000	µg/kg dw	130 U – 130 U	46,000	na	1,700	yes	asl
Aldrin	309-00-2	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	29	yes	asl
Dieldrin	60-57-1	0/61	nd	nd	µg/kg dw	0.97 U – 980 U	980 U	na	23	yes	asl
Total aldrin/dieldrin	na	0/61	nd	nd	µg/kg dw	0.97 U – 980 U	980 U	na	na	no	ntx
alpha-BHC	319-84-6	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	4.8	yes	asl
beta-BHC	319-85-7	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	270	no	ife
gamma-BHC	58-89-9	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	14	yes	asl
delta-BHC	319-86-8	2/61	3.0	3.0	µg/kg dw	0.92 U – 490 U	490 U	na	1,600	no	bsl
alpha-Chlordane	5103-71-9	0/61	nd	nd	µg/kg dw	0.96 U – 490 U	490 U	na	1,600	no	bsl
gamma-Chlordane	5103-74-2	0/61	nd	nd	µg/kg dw	0.96 U – 490 U	490 U	na	1,600	no	bsl
Total chlordane	57-74-9	0/61	nd	nd	µg/kg dw	0.96 U – 490 U	490 U	na	1,600	no	bsl
alpha-Endosulfan	959-98-8	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	37,000	no	bsl
beta-Endosulfan	33213-65-9	0/61	nd	nd	µg/kg dw	0.92 U – 980 U	980 U	na	37,000	no	bsl
Endosulfan sulfate	1031-07-8	0/61	nd	nd	µg/kg dw	1.9 U – 980 U	980 U	na	37,000	no	bsl
Endrin	72-20-8	0/61	nd	nd	µg/kg dw	0.92 U – 980 U	980 U	na	1,800	no	bsl
Endrin aldehyde	7421-93-4	0/61	nd	nd	µg/kg dw	0.97 U – 980 U	980 U	na	1,800	no	bsl
Endrin ketone	53494-70-5	0/61	nd	nd	µg/kg dw	0.97 U – 980 U	980 U	na	1,800	no	bsl
Heptachlor	76-44-8	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	110	no	ife
Heptachlor epoxide	1024-57-3	0/61	nd	nd	µg/kg dw	0.92 U – 490 U	490 U	na	53	no	ife

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Methoxychlor	72-43-5	1/61	4.6 J	4.6 J	µg/kg dw	0.92 U – 4,900 U	4,900 U	na	31,000	no	bsl
Toxaphene	8001-35-2	0/61	nd	nd	µg/kg dw	96 U – 49,000 U	49,000 U	na	440	yes	asl
VOCs											
1,1,1,2-Tetrachloroethane	630-20-6	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	2,000	no	bsl
1,1,1-Trichloroethane	71-55-6	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	3,700	no	bsl
1,1,2,2-Tetrachloroethane	79-34-5	0/52	nd	nd	µg/kg dw	0.9 U – 15 UJ	15 UJ	na	590	no	bsl
1,1,2-Trichloroethane	79-00-5	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	48	no	bsl
1,1,2-Trichlorotrifluoroethane	76-13-1	0/52	nd	nd	µg/kg dw	1.8 U – 15 U	15 U	na	43,000,000	no	bsl
1,1-Dichloroethane	75-34-3	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	32	no	bsl
1,1-Dichloroethene	75-35-4	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	1,100	no	bsl
1,1-Dichloropropene	563-58-6	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	na	no	ntx
1,2,3-Trichlorobenzene	87-61-6	0/47	nd	nd	µg/kg dw	4.4 U – 39 UJ	39 UJ	na	na	no	ntx
1,2,3-Trichloropropane	96-18-4	0/47	nd	nd	µg/kg dw	1.8 U – 15 UJ	15 UJ	na	91	no	bsl
1,2,4-Trimethylbenzene	95-63-6	3/47	3.6 J	9.2	µg/kg dw	0.9 U – 7.7 UJ	9.2	na	1,400	no	bsl
1,2-Dibromo-3-chloropropane	96-12-8	0/52	nd	nd	µg/kg dw	3 UJ – 150 UJ	150 UJ	na	5.6	yes	asl
1,2-Dibromoethane (EDB)	106-93-4	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	0.073	yes	asl
1,2-Dichloroethane	107-06-2	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	1.2	yes	asl
1,2-Dichloroethene (total)	540-59-0	0/5	nd	nd	µg/kg dw	3 U – 15 U	15 U	na	11,000	no	bsl
1,2-Dichloropropane	78-87-5	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	930	no	bsl
1,3,5-Trimethylbenzene	108-67-8	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	310	no	bsl
1,3-Dichloropropane	142-28-9	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	160,000	no	bsl
2,2-Dichloropropane	594-20-7	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	na	no	ntx
2-Chlorotoluene	95-49-8	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	1,600,000	no	bsl
2-Hexanone	591-78-6	0/52	nd	nd	µg/kg dw	4.4 U – 59.8 UJ	59.8 UJ	na	na	no	ntx
4-Chlorotoluene	106-43-4	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	5,500,000	no	bsl
Acetone	67-64-1	47/52	12	2,300	µg/kg dw	61.1 UJ – 299 UJ	2,300	na	6,100,000	no	bsl
Benzene	71-43-2	24/52	1.4	56	µg/kg dw	0.9 U – 15 U	56	na	8.4	yes	asl
Bromobenzene	108-86-1	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	9,400	no	bsl
Bromochloromethane	74-97-5	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	na	no	ntx
Bromodichloromethane	75-27-4	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	3.9	yes	asl
Bromoform	75-25-2	0/52	nd	nd	µg/kg dw	0.9 U – 15 UJ	15 UJ	na	220	no	bsl
Bromomethane	74-83-9	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	9.6	no	ife
Carbon disulfide	75-15-0	3/52	3.9	7.5	µg/kg dw	0.9 U – 59.8 U	59.8 U	na	670,000	no	bsl
Carbon tetrachloride	56-23-5	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	11	no	ife
Chlorobenzene	108-90-7	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	640	no	bsl

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Chloroethane	75-00-3	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	61	no	bsl
Chloroform	67-66-3	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	3.1	yes	asl
Chloromethane	74-87-3	0/52	nd	nd	µg/kg dw	0.9 U – 29.9 U	29.9 U	na	27	no	ife
cis-1,2-Dichloroethene	156-59-2	3/52	1.9	9.7	µg/kg dw	0.9 U – 15 U	15 U	na	100	no	bsl
cis-1,3-Dichloropropene	10061-01-5	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	1,700	no	bsl
Cyclohexane	110-82-7	0/5	nd	nd	µg/kg dw	3 UJ – 15 U	15 U	na	7,200,000	no	bsl
p-Cymene	99-87-6	3/47	3.4 J	72 J	µg/kg dw	0.9 U – 7.7 UJ	72 J	na	na	no	ntx
Dibromochloromethane	124-48-1	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	700	no	bsl
Dibromomethane	74-95-3	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	78,000	no	bsl
Dichlorodifluoromethane	75-71-8	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	19,000	no	bsl
Dichloromethane	75-09-2	5/52	2.1	5.3	µg/kg dw	1.9 U – 58.7 U	58.7 U	na	35	no	ife
Ethylbenzene	100-41-4	1/52	3.0	3.0	µg/kg dw	0.9 U – 15 U	15 U	na	140	no	bsl
Isopropylbenzene	98-82-8	0/52	nd	nd	µg/kg dw	0.9 U – 15 UJ	15 UJ	na	230,000	no	bsl
Methyl acetate	79-20-9	0/5	nd	nd	µg/kg dw	15.3 U – 74.8 U	74.8 U	na	78,000,000	no	bsl
Methyl ethyl ketone	78-93-3	45/52	7.6	260	µg/kg dw	4.9 U – 150 UJ	260	na	na	no	ntx
Methyl isobutyl ketone	108-10-1	1/52	15	15	µg/kg dw	4.4 U – 59.8 UJ	59.8 UJ	na	na	no	ntx
Methylcyclohexane	108-87-2	0/5	nd	nd	µg/kg dw	3 UJ – 15 U	15 U	na	na	no	ntx
n-Butylbenzene	104-51-8	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	na	no	ntx
n-Propylbenzene	103-65-1	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	5,200	no	bsl
sec-Butylbenzene	135-98-8	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	4,000	no	bsl
Styrene	100-42-5	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	39,000	no	bsl
tert-Butyl methyl ether	1634-04-4	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	82	no	bsl
tert-Butylbenzene	98-06-6	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 UJ	7.7 UJ	na	na	no	ntx
Tetrachloroethene	127-18-4	2/52	5.1	30	µg/kg dw	0.9 U – 15 U	30	na	570	no	bsl
Toluene	108-88-3	36/52	1.4	68	µg/kg dw	0.9 U – 15 U	68	na	14,000	no	bsl
trans-1,2-Dichloroethene	156-60-5	0/47	nd	nd	µg/kg dw	0.9 U – 7.7 U	7.7 U	na	250	no	bsl
trans-1,3-Dichloropropene	10061-02-6	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	1,700	no	bsl
Trichloroethene	79-01-6	2/52	2.4	4.7	µg/kg dw	0.9 U – 15 U	15 U	na	1.7	yes	asl
Trichlorofluoromethane	75-69-4	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	7,200	no	bsl
Vinyl acetate	108-05-4	0/47	nd	nd	µg/kg dw	4.4 U – 39 U	39 U	na	99,000	no	bsl
Vinyl chloride	75-01-4	0/52	nd	nd	µg/kg dw	0.9 U – 15 U	15 U	na	0.5	yes	asl
o-Xylene	95-47-6	1/52	5.2	5.2	µg/kg dw	0.9 U – 15 U	15 U	na	2,500	no	sum
m,p-Xylene	108383/ 106423	5/52	2.0 J	6.3	µg/kg dw	0.9 U – 29.9 U	29.9 U	na	2,500	no	sum
Total xylenes	1330-20-7	5/52	2.0 J	11.5	µg/kg dw	0.9 U – 29.9 U	29.9 U	na	2,500	no	bsl

Table 5: Occurrence and selection of COPCs for Wetland Soil in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc.[a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Petroleum[d]											
TPH - Gasoline range	na	4/56	5.3	20	mg/kg dw	6.1 U – 58 U	58 U	na	26	yes	asl
TPH - Diesel range	na	54/60	6.3	4,000	mg/kg dw	7.4 U – 29 U	4,000	na	2,800	yes	asl
TPH - Motor oil range	na	57/60	28	6,600	mg/kg dw	15 U – 17 U	6,600	na	9,800	no	bsl

[a] Background values are from DEQ (2002).

[b] The residential/recreational soil RSL is the lowest of EPA residential screening levels (2009d)and DEQ RBCs through soil ingestion, dermal contact, and inhalation; residential exposure through volatilization to outdoor air and vapor intrusion into buildings; and residential exposure through leaching to groundwater (2007). For TPHs, the screening level is the lowest occupational DEQ RBC (2003).

[c] Potassium was analyzed only in historical data, but not in samples collected in the RI/FS sampling effort because potassium is an essential nutrient and is not expected to be toxic to humans based on the daily reference intake for potassium of 4.7 g/day (Institute of Medicine 2004).

[d] Aromatic and aliphatic TPHs were assumed to be equal to 15% and 85% of the TPH total for each of the three fractions (gasoline, diesel, and motor oil) based on ATSDR (1999). For the purposes of this HHRA, only aliphatic TPHs were carried forward as COPCs when above screening levels because the components of the aromatic TPHs (e.g., various PAHs and VOCs) were already assessed and thus the assessment of aromatic TPHs as an additional chemical group would double count risks.

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – Chemical Abstracts Service
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DL – detection limit
dw – dry weight
EDB – 1,2-dibromoethane
HCID – hydrocarbon identification
HPAH – high-molecular-weight PAH
ife – infrequent exceedance of RSL by RLs (not selected as COPC)
J – estimated concentration
LPAH – low-molecular-weight PAH
na – not available
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
U – not detected at given concentration
VOC – volatile organic compound

Table 6: Occurrence and selection of COPCs for Lake Sediment in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc. [a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Metals											
Antimony	7440-36-0	0/11	nd	nd	mg/kg dw	0.3 UJ – 1 UJ	1 UJ	4	3.1	no	bsl
Arsenic	7440-38-2	11/11	2.6	7	mg/kg dw	na	7	7	0.39	yes	asl
Barium	7440-39-3	11/11	128	220	mg/kg dw	na	220	na	1,500	no	bsl
Cadmium	7440-43-9	8/11	2	2	mg/kg dw	0.3 U – 0.7 U	2	1	7	no	bsl
Chromium	7440-47-3	11/11	7.7	34	mg/kg dw	na	34	42	32	yes	asl
Cobalt	7440-48-4	11/11	7.3	15	mg/kg dw	na	15	na	2.3	yes	asl
Copper	7440-50-8	11/11	16.2	72	mg/kg dw	na	72	36	290	no	bsl
Lead	7439-92-1	11/11	9	56	mg/kg dw	na	56	17	30	yes	asl
Mercury	7439-97-6	1/11	0.2 J	0.2 J	mg/kg dw	0.06 U – 0.3 U	0.3 U	0.07	2.3	no	bsl
Nickel	7440-02-0	11/11	11	31	mg/kg dw	na	31	38	150	no	bsl
Selenium	7782-49-2	0/11	nd	nd	mg/kg dw	0.7 U – 4 U	4 U	2	39	no	bsl
Vanadium	7440-62-2	11/11	32.7	74	mg/kg dw	na	74	na	39	yes	asl
Zinc	7440-66-6	11/11	80	229	mg/kg dw	na	229	86	2,300	no	bsl
PAHs								n			
2-Methylnaphthalene	91-57-6	7/11	7.9	31	µg/kg dw	5.0 U – 30 U	31	na	31,000	no	bsl
Acenaphthene	83-32-9	5/11	5.0	11 JN	µg/kg dw	5.0 U – 30 U	30 U	na	290,000	no	bsl
Acenaphthylene	208-96-8	3/11	5.0	7.0	µg/kg dw	5.0 U – 30 U	30 U	na	340,000	no	bsl
Anthracene	120-12-7	6/11	5.9	26	µg/kg dw	5.0 U – 30 U	30 U	na	1,700,000	no	bsl
Benzo(a)anthracene	56-55-3	11/11	6.9	74	µg/kg dw	na	74	na	150	no	teq
Benzo(a)pyrene	50-32-8	11/11	7.9	83	µg/kg dw	na	83	na	15	yes	teq
Benzo(b)fluoranthene	205-99-2	11/11	8.4	71	µg/kg dw	na	71	na	150	no	teq
Benzo(g,h,i)perylene	191-24-2	9/11	14	71	µg/kg dw	5.0 U – 5.0 U	71	na	na	no	ntx
Benzo(k)fluoranthene	207-08-9	11/11	8.4	71	µg/kg dw	na	71	na	1,500	no	teq
Total benzofluoranthenes	56832-73-6	11/11	16.8	142	µg/kg dw	na	142	na	na	no	ntx
Chrysene	218-01-9	11/11	9.4	110	µg/kg dw	na	110	na	15,000	no	teq
Dibenzo(a,h)anthracene	53-70-3	3/11	5.4	6.5	µg/kg dw	5.0 U – 30 U	30 U	na	15	yes	teq
Dibenzofuran	132-64-9	3/11	5.0	7.4	µg/kg dw	5.0 U – 30 U	30 U	na	na	no	ntx
Fluoranthene	206-44-0	11/11	20	190	µg/kg dw	na	190	na	230,000	no	bsl
Fluorene	86-73-7	6/11	5.9	26	µg/kg dw	5.0 U – 30 U	30 U	na	230,000	no	bsl
Indeno(1,2,3-cd)pyrene	193-39-5	9/11	11	59	µg/kg dw	5.0 U – 5.0 U	59	na	150	no	teq
Naphthalene	91-20-3	11/11	5.4	61	µg/kg dw	na	61	na	72	no	bsl
Phenanthrene	85-01-8	11/11	15	120	µg/kg dw	na	120	na	na	no	ntx
Pyrene	129-00-0	11/11	23	180	µg/kg dw	na	180	na	170,000	no	bsl
Total HPAHs	na	11/11	84	910	µg/kg dw	na	910	na	na	no	ntx

Table 6: Occurrence and selection of COPCs for Lake Sediment in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc. [a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Total LPAHs	na	11/11	20	230	µg/kg dw	na	230	na	na	no	ntx
cPAH TEQ	na	11/11	11.6	118	µg/kg dw	na	118	na	15	yes	asl
Total PAHs	na	11/11	104	1,060	µg/kg dw	na	1,060	na	na	no	ntx
Other SVOCs											
1,2,4-Trichlorobenzene	120-82-1	0/11	nd	nd	µg/kg dw	5.3 U – 41 U	41 U	na	8,700	no	bsl
1,2-Dichlorobenzene	95-50-1	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	940	no	bsl
1,3-Dichlorobenzene	541-73-1	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	280	no	bsl
1,4-Dichlorobenzene	106-46-7	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	91	no	bsl
Hexachlorobenzene	118-74-1	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	300	no	bsl
Hexachlorobutadiene	87-68-3	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	6,200	no	bsl
PCBs											
Aroclor-1016	12674-11-2	0/11	nd	nd	µg/kg dw	32 U – 33 U	33 U	na	390	no	sum
Aroclor-1221	11104-28-2	0/11	nd	nd	µg/kg dw	32 U – 33 U	33 U	na	170	no	sum
Aroclor-1232	11141-16-5	0/11	nd	nd	µg/kg dw	32 U – 33 U	33 U	na	170	no	sum
Aroclor-1242	53469-21-9	0/11	nd	nd	µg/kg dw	32 U – 33 U	33 U	na	220	no	sum
Aroclor-1248	12672-29-6	0/11	nd	nd	µg/kg dw	32 U – 33 U	33 U	na	220	no	sum
Aroclor-1254	11097-69-1	7/11	58	71	µg/kg dw	32 U – 49 U	71	na	220	no	sum
Aroclor-1260	11096-82-5	7/11	35	60	µg/kg dw	32 U – 33 U	60	na	220	no	sum
Total PCBs	1336-36-3	7/11	93	131	µg/kg dw	32 U – 49 U	131	na	220	no	bsl
Pesticides											
2,4'-DDD	53-19-0	8/11	8.6 JN	61 JN	µg/kg dw	4.8 U – 25 U	61 JN	na	na	no	sum
2,4'-DDE	3424-82-6	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	na	no	sum
2,4'-DDT	789-02-6	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	na	no	sum
4,4'-DDD	72-54-8	11/11	11 J	47	µg/kg dw	na	47	na	2,000	no	sum
4,4'-DDE	72-55-9	11/11	9.1	150	µg/kg dw	na	150	na	1,400	no	sum
4,4'-DDT	50-29-3	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	1,700	no	sum
Total DDTs	na	11/11	22 J	250	µg/kg dw	na	250	na	1,700	no	bsl
Aldrin	309-00-2	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	29	no	bsl
Dieldrin	60-57-1	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	23	yes	asl
Total aldrin/dieldrin	na	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	na	no	ntx
alpha-BHC	319-84-6	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	4.8	yes	asl
beta-BHC	319-85-7	0/11	nd	nd	µg/kg dw	2.4 U – 23 U	23 U	na	270	no	bsl
gamma-BHC	58-89-9	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	14	no	bsl
delta-BHC	319-86-8	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	1,600	no	bsl
alpha-Chlordane	5103-71-9	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	1,600	no	bsl
gamma-Chlordane	5103-74-2	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	1,600	no	bsl

Table 6: Occurrence and selection of COPCs for Lake Sediment in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc. [a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Total chlordane	57-74-9	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	1,600	no	bsl
alpha-Endosulfan	959-98-8	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	37,000	no	bsl
beta-Endosulfan	33213-65-9	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	37,000	no	bsl
Endosulfan sulfate	1031-07-8	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	37,000	no	bsl
Endrin	72-20-8	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	1,800	no	bsl
Endrin aldehyde	7421-93-4	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	1,800	no	bsl
Endrin ketone	53494-70-5	0/11	nd	nd	µg/kg dw	4.8 U – 25 U	25 U	na	1,800	no	bsl
Heptachlor	76-44-8	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	110	no	bsl
Heptachlor epoxide	1024-57-3	0/11	nd	nd	µg/kg dw	2.4 U – 12 U	12 U	na	53	no	bsl
Methoxychlor	72-43-5	0/11	nd	nd	µg/kg dw	24 U – 120 U	120 U	na	31,000	no	bsl
Toxaphene	8001-35-2	0/11	nd	nd	µg/kg dw	970 U – 5,000 U	5,000 U	na	440	yes	asl
VOCs											
1,1,1,2-Tetrachloroethane	630-20-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	2,000	no	bsl
1,1,1-Trichloroethane	71-55-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	3,700	no	bsl
1,1,2,2-Tetrachloroethane	79-34-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	590	no	bsl
1,1,2-Trichloroethane	79-00-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	48	no	bsl
1,1,2-Trichlorotrifluoroethane	76-13-1	0/11	nd	nd	µg/kg dw	2.1 U – 16 U	16 U	na	43,000,000	no	bsl
1,1-Dichloroethane	75-34-3	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	32	no	bsl
1,1-Dichloroethene	75-35-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	1,100	no	bsl
1,1-Dichloropropene	563-58-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	na	no	ntx
1,2,3-Trichlorobenzene	87-61-6	0/11	nd	nd	µg/kg dw	5.3 U – 41 U	41 U	na	na	no	ntx
1,2,3-Trichloropropane	96-18-4	0/11	nd	nd	µg/kg dw	2.1 U – 16 U	16 U	na	91	no	bsl
1,2,4-Trimethylbenzene	95-63-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	1,400	no	bsl
1,2-Dibromo-3-chloropropane	96-12-8	0/11	nd	nd	µg/kg dw	5.3 U – 41 U	41 U	na	5.6	yes	asl
1,2-Dibromoethane (EDB)	106-93-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	0.073	yes	asl
1,2-Dichloroethane	107-06-2	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	1.2	yes	asl
1,2-Dichloropropane	78-87-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	930	no	bsl
1,3,5-Trimethylbenzene	108-67-8	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	310	no	bsl
1,3-Dichloropropane	142-28-9	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	160,000	no	bsl
2,2-Dichloropropane	594-20-7	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	na	no	ntx
2-Chlorotoluene	95-49-8	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	1,600,000	no	bsl
2-Hexanone	591-78-6	0/11	nd	nd	µg/kg dw	5.3 U – 41 U	41 U	na	na	no	ntx
4-Chlorotoluene	106-43-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	5,500,000	no	bsl
Acetone	67-64-1	10/11	78 JN	1,100	µg/kg dw	35 U – 35 U	1,100	na	6,100,000	no	bsl
Benzene	71-43-2	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	8.4	yes	cac
Bromobenzene	108-86-1	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	9,400	no	bsl

Table 6: Occurrence and selection of COPCs for Lake Sediment in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc. [a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
Bromochloromethane	74-97-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	na	no	ntx
Bromodichloromethane	75-27-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 UJ	na	3.9	yes	asl
Bromoform	75-25-2	0/10	nd	nd	µg/kg dw	1.1 U – 8.2 UJ	8.2 U	na	220	no	bsl
Bromomethane	74-83-9	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	9.6	no	bsl
Carbon disulfide	75-15-0	11/11	4.9	140	µg/kg dw	na	140	na	670,000	no	bsl
Carbon tetrachloride	56-23-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	11	no	bsl
Chlorobenzene	108-90-7	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	640	no	bsl
Chloroethane	75-00-3	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	61	no	bsl
Chloroform	67-66-3	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	3.1	yes	asl
Chloromethane	74-87-3	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	27	no	bsl
cis-1,2-Dichloroethene	156-59-2	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	100	no	bsl
cis-1,3-Dichloropropene	10061-01-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 UJ	8.2 UJ	na	1,700	no	bsl
p-Cymene	99-87-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	na	no	ntx
Dibromochloromethane	124-48-1	0/10	nd	nd	µg/kg dw	1.1 U – 8.2 UJ	8.2 U	na	700	no	bsl
Dibromomethane	74-95-3	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	78,000	no	bsl
Dichlorodifluoromethane	75-71-8	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	19,000	no	bsl
Dichloromethane	75-09-2	0/11	nd	nd	µg/kg dw	2.1 U – 16 U	16 U	na	35	no	bsl
Ethylbenzene	100-41-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	140	no	bsl
Isopropylbenzene	98-82-8	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	230,000	no	bsl
Methyl ethyl ketone	78-93-3	10/11	9.4	140	µg/kg dw	5.3 U – 5.3 U	140	na	na	no	ntx
Methyl isobutyl ketone	108-10-1	0/11	nd	nd	µg/kg dw	5.3 U – 41 U	41 U	na	na	no	ntx
n-Butylbenzene	104-51-8	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	na	no	ntx
n-Propylbenzene	103-65-1	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	5,200	no	bsl
sec-Butylbenzene	135-98-8	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	4,000	no	bsl
Styrene	100-42-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	39,000	no	bsl
tert-Butyl methyl ether	1634-04-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	82	no	bsl
tert-Butylbenzene	98-06-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	na	no	ntx
Tetrachloroethene	127-18-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	570	no	bsl
Toluene	108-88-3	3/11	1.2	17	µg/kg dw	6.0 U – 8.2 U	17	na	14,000	no	bsl
trans-1,2-Dichloroethene	156-60-5	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	250	no	bsl
trans-1,3-Dichloropropene	10061-02-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	1,700	no	bsl
Trichloroethene	79-01-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	1.7	yes	asl
Trichlorofluoromethane	75-69-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	7,200	no	bsl
Vinyl acetate	108-05-4	0/10	nd	nd	µg/kg dw	5.3 U – 43 U	43 U	na	99,000	no	bsl
Vinyl chloride	75-01-4	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	0.5	yes	asl
o-Xylene	95-47-6	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	2,500	no	sum

Table 6: Occurrence and selection of COPCs for Lake Sediment in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Background Conc. [a]	Residential Recreational Soil RSL[b]	COPC Flag?	Rationale for Selection or Exclusion
m,p-Xylene	108383/ 106423	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	2,500	no	sum
Total xylenes	1330-20-7	0/11	nd	nd	µg/kg dw	1.1 U – 8.2 U	8.2 U	na	2,500	no	bsl
Petroleum[c]											
TPH - Gasoline range	na	1/11	31	31	mg/kg dw	7.7 U – 80 U	80 U	na	26	yes	asl
TPH - Diesel range	na	11/11	16	270	mg/kg dw	na	270	na	2,800	no	bsl
TPH - Motor oil range	na	11/11	130	2,000	mg/kg dw	na	2,000	na	9,800	no	bsl

[a] Background values are from DEQ (2002).

[b] The residential/recreational sediment RSL is the lowest of EPA residential screening levels (2009d)and DEQ RBCs through soil ingestion, dermal contact, and inhalation; residential exposure through volatilization to outdoor air and vapor intrusion into buildings; and residential exposure through leaching to groundwater (2007). Soil RSLs are used because no sediment-specific RSLs are available. For TPHs, the screening level is the lowest occupational DEQ RBC (2003).

[c] Aromatic and aliphatic TPHs were assumed to be equal to 15% and 85% of the TPH total for each of the three fractions (gasoline, diesel, and motor oil) based on ATSDR (1999). For the purposes of this HHRA, only aliphatic TPHs were carried forward as COPCs when above screening levels because the components of the aromatic TPHs (e.g., various PAHs and VOCs) were already assessed and thus the assessment of aromatic TPHs as an additional chemical group would double count risks.

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – Chemical Abstracts Service
cac – Class A carcinogen (selected as COPC)
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DL – detection limit
dw – dry weight
EDB – 1,2-dibromoethane
HPAH – high-molecular-weight PAH
J – estimated concentration
LPAH – low-molecular-weight PAH
na – not available
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

Table 7: Occurrence and selection of COPCs for Lake Surface Water in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Residential Recreational Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Metals										
Antimony (dissolved)	7440-36-0	0/3	nd	nd	µg/L	0.2 U – 0.2 U	0.2 U	1.5	no	bsl
Antimony (total)	7440-36-0	0/3	nd	nd	µg/L	0.2 U – 0.2 U	0.2 U	1.5	no	bsl
Arsenic (dissolved)	7440-38-2	3/3	0.9	1.0	µg/L	na	1.0	0.018	yes	asl
Arsenic (total)	7440-38-2	3/3	1.1	1.2	µg/L	na	1.2	0.018	yes	asl
Barium (dissolved)	7440-39-3	3/3	26	28	µg/L	na	28	730	no	bsl
Barium (total)	7440-39-3	3/3	30	31	µg/L	na	31	730	no	bsl
Cadmium (dissolved)	7440-43-9	0/3	nd	nd	µg/L	0.2 U – 0.2 U	0.2 U	1.8	no	bsl
Cadmium (total)	7440-43-9	0/3	nd	nd	µg/L	0.2 U – 0.2 U	0.2 U	1.8	no	bsl
Chromium (dissolved)	7440-47-3	0/3	nd	nd	µg/L	5 U – 5 U	5 U	11	no	bsl
Chromium (total)	7440-47-3	0/3	nd	nd	µg/L	5 U – 5 U	5 U	11	no	bsl
Cobalt (dissolved)	7440-48-4	0/3	nd	nd	µg/L	3 U – 3 U	3 U	1.1	yes	asl
Cobalt (total)	7440-48-4	0/3	nd	nd	µg/L	3 U – 3 U	3 U	1.1	yes	asl
Copper (dissolved)	7440-50-8	1/3	4	4	µg/L	2 U – 2 U	4	140	no	bsl
Copper (total)	7440-50-8	1/3	6	6	µg/L	2 U – 2 U	6	140	no	bsl
Lead (dissolved)	7439-92-1	0/3	nd	nd	µg/L	1 U – 1 U	1 U	15	no	bsl
Lead (total)	7439-92-1	0/3	nd	nd	µg/L	1 U – 1 U	1 U	15	no	bsl
Mercury (dissolved)	7439-97-6	0/3	nd	nd	µg/L	0.1 U – 0.1 U	0.1 U	1.1	no	bsl
Mercury (total)	7439-97-6	0/3	nd	nd	µg/L	0.1 U – 0.1 U	0.1 U	1.1	no	bsl
Nickel (dissolved)	7440-02-0	0/3	nd	nd	µg/L	10 U – 10 U	10 U	73	no	bsl
Nickel (total)	7440-02-0	0/3	nd	nd	µg/L	10 U – 10 U	10 U	73	no	bsl
Selenium (dissolved)	7782-49-2	0/3	nd	nd	µg/L	0.5 U – 0.5 U	0.5 U	18	no	bsl
Selenium (total)	7782-49-2	0/3	nd	nd	µg/L	0.5 U – 0.5 U	0.5 U	18	no	bsl
Vanadium (dissolved)	7440-62-2	0/3	nd	nd	µg/L	3 U – 3 U	3 U	18	no	bsl
Vanadium (total)	7440-62-2	0/3	nd	nd	µg/L	3 U – 3 U	3 U	18	no	bsl
Zinc (dissolved)	7440-66-6	0/3	nd	nd	µg/L	10 U – 10 U	10 U	1,100	no	bsl
Zinc (total)	7440-66-6	0/3	nd	nd	µg/L	10 U – 10 U	10 U	1,100	no	bsl
PAHs										
2-Methylnaphthalene	91-57-6	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	15	no	bsl
Acenaphthene	83-32-9	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	37	no	bsl
Acenaphthylene	208-96-8	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	37	no	bsl
Anthracene	120-12-7	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	180	no	bsl
Benzo(a)anthracene	56-55-3	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0038	yes	teq
Benzo(a)pyrene	50-32-8	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0029	yes	teq

Table 7: Occurrence and selection of COPCs for Lake Surface Water in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Residential Recreational Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
Benzo(b)fluoranthene	205-99-2	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0038	yes	teq
Benzo(g,h,i)perylene	191-24-2	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
Benzo(k)fluoranthene	207-08-9	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0038	yes	teq
Total benzofluoranthenes	56832-73-6	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
Chrysene	218-01-9	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0038	yes	teq
Dibenzo(a,h)anthracene	53-70-3	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0029	yes	teq
Dibenzofuran	132-64-9	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
Fluoranthene	206-44-0	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	130	no	bsl
Fluorene	86-73-7	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	24	no	bsl
Indeno(1,2,3-cd)pyrene	193-39-5	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.0038	yes	teq
Naphthalene	91-20-3	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.12	no	bsl
Phenanthrene	85-01-8	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
Pyrene	129-00-0	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	110	no	bsl
Total HPAHs	na	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
Total LPAHs	na	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
cPAH TEQ	na	0/3	nd	nd	µg/L	0.0910 U – 0.0910 U	0.0910 U	0.0029	yes	asl
Total PAHs	na	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	na	no	ntx
Other SVOCs										
1,2,4-Trichlorobenzene	120-82-1	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	0.82	yes	asl
1,2-Dichlorobenzene	95-50-1	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	5	no	bsl
1,3-Dichlorobenzene	541-73-1	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	1.5	no	bsl
1,4-Dichlorobenzene	106-46-7	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.43	yes	asl
Hexachlorobenzene	118-74-1	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.00028	yes	asl
Hexachlorobutadiene	87-68-3	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.44	no	bsl
PCBs										
Aroclor-1016	12674-11-2	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.96	no	sum
Aroclor-1221	11104-28-2	0/3	nd	nd	µg/L	0.10 UJ – 0.10 UJ	0.10 UJ	0.0068	no	sum
Aroclor-1232	11141-16-5	0/3	nd	nd	µg/L	0.10 UJ – 0.10 UJ	0.10 UJ	0.0068	no	sum
Aroclor-1242	53469-21-9	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.034	no	sum
Aroclor-1248	12672-29-6	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.034	no	sum
Aroclor-1254	11097-69-1	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.034	no	sum
Aroclor-1260	11096-82-5	0/3	nd	nd	µg/L	0.10 U – 0.10 U	0.10 U	0.034	no	sum
Total PCBs	1336-36-3	0/3	nd	nd	µg/L	0.10 UJ – 0.10 UJ	0.10 UJ	0.000064	yes	asl
Pesticides										
2,4'-DDD	53-19-0	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum
2,4'-DDE	3424-82-6	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum

Table 7: Occurrence and selection of COPCs for Lake Surface Water in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Residential Recreational Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
2,4'-DDT	789-02-6	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	sum
4,4'-DDD	72-54-8	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.00031	no	sum
4,4'-DDE	72-55-9	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.00022	no	sum
4,4'-DDT	50-29-3	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.00022	no	sum
Total DDTs	na	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.17	no	bsl
Aldrin	309-00-2	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.000049	yes	asl
Dieldrin	60-57-1	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.000052	yes	asl
Total aldrin/dieldrin	na	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	na	no	ntx
alpha-BHC	319-84-6	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.0026	yes	asl
beta-BHC	319-85-7	0/3	nd	nd	µg/L	0.0050 U – 0.024 U	0.024 U	0.0091	yes	asl
gamma-BHC	58-89-9	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.044	no	bsl
delta-BHC	319-86-8	0/3	nd	nd	µg/L	0.0050 U – 0.022 U	0.022 U	0.19	no	bsl
alpha-Chlordane	5103-71-9	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.16	no	bsl
gamma-Chlordane	5103-74-2	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.0008	yes	asl
Total chlordane	57-74-9	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.0008	yes	asl
alpha-Endosulfan	959-98-8	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	22	no	bsl
beta-Endosulfan	33213-65-9	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	22	no	bsl
Endosulfan sulfate	1031-07-8	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	22	no	bsl
Endrin	72-20-8	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.059	no	bsl
Endrin aldehyde	7421-93-4	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	0.29	no	bsl
Endrin ketone	53494-70-5	0/3	nd	nd	µg/L	0.010 U – 0.010 U	0.010 U	1.1	no	bsl
Heptachlor	76-44-8	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.000079	yes	asl
Heptachlor epoxide	1024-57-3	0/3	nd	nd	µg/L	0.0050 U – 0.0050 U	0.0050 U	0.000039	yes	asl
Methoxychlor	72-43-5	0/3	nd	nd	µg/L	0.050 U – 0.050 U	0.050 U	18	no	bsl
Toxaphene	8001-35-2	0/3	nd	nd	µg/L	0.50 U – 0.50 U	0.50 U	0.00028	yes	asl
VOCs										
1,1,1,2-Tetrachloroethane	630-20-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.52	yes	asl
1,1,1-Trichloroethane	71-55-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	84	no	bsl
1,1,2,2-Tetrachloroethane	79-34-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.067	yes	asl
1,1,2-Trichloroethane	79-00-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.24	yes	asl
1,1,2-Trichlorotrifluoroethane	76-13-1	0/3	nd	nd	µg/L	2.0 U – 2.0 U	2.0 U	5,900	no	bsl
1,1-Dichloroethane	75-34-3	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	2	no	bsl
1,1-Dichloroethene	75-35-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	7	no	bsl
1,1-Dichloropropene	563-58-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
1,2,3-Trichlorobenzene	87-61-6	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	na	no	ntx
1,2,3-Trichloropropane	96-18-4	0/3	nd	nd	µg/L	2.0 U – 2.0 U	2.0 U	0.0096	yes	asl

Table 7: Occurrence and selection of COPCs for Lake Surface Water in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Residential Recreational Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
1,2,4-Trimethylbenzene	95-63-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	1.2	no	bsl
1,2-Dibromo-3-chloropropane	96-12-8	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	0.00032	yes	asl
1,2-Dibromoethane (EDB)	106-93-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.0057	yes	asl
1,2-Dichloroethane	107-06-2	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.13	yes	asl
1,2-Dichloropropane	78-87-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.39	yes	asl
1,3,5-Trimethylbenzene	108-67-8	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	1.2	no	bsl
1,3-Dichloropropane	142-28-9	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
2,2-Dichloropropane	594-20-7	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
2-Chlorotoluene	95-49-8	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
2-Hexanone	591-78-6	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	na	no	ntx
4-Chlorotoluene	106-43-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
Acetone	67-64-1	3/3	5.4	6.5	µg/L	na	6.5	2,200	no	bsl
Benzene	71-43-2	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.35	yes	asl
Bromobenzene	108-86-1	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	2	no	bsl
Bromochloromethane	74-97-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
Bromodichloromethane	75-27-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.12	yes	asl
Bromoform	75-25-2	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	4.3	no	bsl
Bromomethane	74-83-9	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.85	yes	asl
Carbon disulfide	75-15-0	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	100	no	bsl
Carbon tetrachloride	56-23-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.17	yes	asl
Chlorobenzene	108-90-7	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	9	no	bsl
Chloroethane	75-00-3	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	3.9	no	bsl
Chloroform	67-66-3	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.18	yes	asl
Chloromethane	74-87-3	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	2.3	no	bsl
cis-1,2-Dichloroethene	156-59-2	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	6.1	no	bsl
cis-1,3-Dichloropropene	10061-01-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.34	yes	asl
p-Cymene	99-87-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
Dibromochloromethane	124-48-1	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.15	yes	asl
Dibromomethane	74-95-3	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
Dichlorodifluoromethane	75-71-8	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	39	no	bsl
Dichloromethane	75-09-2	0/3	nd	nd	µg/L	2.0 U – 2.0 U	2.0 U	4.1	no	bsl
Ethylbenzene	100-41-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	1.2	no	bsl
Isopropylbenzene	98-82-8	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	66	no	bsl
Methyl ethyl ketone	78-93-3	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	710	no	bsl
Methyl isobutyl ketone	108-10-1	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	200	no	bsl
n-Butylbenzene	104-51-8	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx

Table 7: Occurrence and selection of COPCs for Lake Surface Water in the Force Lake Recreational User RME Scenario

Chemical	CAS Number	Detection Frequency	Minimum Detected Conc.	Maximum Detected Conc.	Unit	Range of NDs	Value used for Screening	Residential Recreational Water RSL[a]	COPC Flag?	Rationale for Selection or Exclusion
n-Propylbenzene	103-65-1	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	6.1	no	bsl
sec-Butylbenzene	135-98-8	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	6.1	no	bsl
Styrene	100-42-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	100	no	bsl
tert-Butyl methyl ether	1634-04-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	11	no	bsl
tert-Butylbenzene	98-06-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	na	no	ntx
Tetrachloroethene	127-18-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.11	yes	asl
Toluene	108-88-3	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	230	no	bsl
trans-1,2-Dichloroethene	156-60-5	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	11	no	bsl
trans-1,3-Dichloropropene	10061-02-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.34	yes	asl
Trichloroethene	79-01-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.029	yes	asl
Trichlorofluoromethane	75-69-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	130	no	bsl
Vinyl acetate	108-05-4	0/3	nd	nd	µg/L	5.0 U – 5.0 U	5.0 U	41	no	bsl
Vinyl chloride	75-01-4	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	0.016	yes	asl
o-Xylene	95-47-6	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	21	no	sum
m,p-Xylene	108383/106423	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	21	no	sum
Total xylenes	1330-20-7	0/3	nd	nd	µg/L	1.0 U – 1.0 U	1.0 U	20	no	bsl
Petroleum[b]										
TPH - Diesel range	na	0/1	nd	nd	mg/L	0.25 U – 0.25 U	0.25 U	0.88	no	bsl
TPH - Motor oil range	na	0/1	nd	nd	mg/L	0.50 U – 0.50 U	0.50 U	2.9	no	bsl

[a] The residential/recreational water RSL is the lowest of EPA ambient water quality criteria (AWQC) for human water/ organism consumption and organism consumption (2009b), EPA water screening levels (2009d), EPA MCL or non-zero MCLGs (2009a), and DEQ human health occupational RBCs for the following four pathways: ingestion and inhalation from tap water, volatilization to outdoor air, vapor intrusion into buildings, and leaching to groundwater during excavation (2007). For TPHs, the screening level is the lowest occupational DEQ RBC (2003).

[b] Aromatic and aliphatic TPHs were assumed to be equal to 15% and 85% of the TPH total for each of the three fractions (gasoline, diesel, and motor oil) based on ATSDR (1999). For the purposes of this HHRA, only aliphatic TPHs were carried forward as COPCs when above screening levels because the components of the aromatic TPHs (e.g., various PAHs and VOCs) were already assessed and thus the assessment of aromatic TPHs as an additional chemical group would double count risks.

asl – above screening level (selected as COPC)
BHC – benzene hexachloride
bsl – below screening level
COPC – contaminant of potential concern
CAS – Chemical Abstracts Service
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DL – detection limit
dw – dry weight
EDB – 1,2-dibromoethane
HPAH – high-molecular-weight PAH
J – estimated concentration
LPAH – low-molecular-weight PAH
MCL – maximum contaminant level
MCLG – maximum contaminant level goal
na – not available
ND – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RBC – risk-based concentration
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

Table 8: Occurrence and selection of COPCs for Calculated Fish Tissue in the Force Lake Fish Consumer RME Scenario

Chemical	Unit (dw)	Detection Frequency	Sediment Concentrations				BSAF[a]	Fish Tissue		COPC Flag?	Rationale for Selection or Exclusion
			Minimum Detect	Maximum Detect	RL or Range of RLs	Sediment Screening Value		Calculated Fish Tissue[b] (mg/kg ww)	Fish RSL[c] (mg/kg ww)		
Metals											
Antimony	mg/kg	0/11	nd	nd	0.3 UJ - 1 UJ	1 UJ	1	0.20	0.0541	yes	asl
Arsenic	mg/kg	11/11	2.6	7	na	7	0.12	0.17	0.0021	yes	asl
Barium	mg/kg	11/11	128	220	na	220	1	44	27	yes	asl
Cadmium	mg/kg	8/11	2	2	0.3 U - 0.7 U	2	0.78	0.31	0.135	yes	asl
Chromium	mg/kg	11/11	7.7	34	na	34	0.043	0.29	0.406	no	bsl
Cobalt	mg/kg	11/11	7.3	15	na	15	1	3.0	0.0406	yes	asl
Copper	mg/kg	11/11	16.2	72	na	72	1	14	5.41	yes	asl
Lead	mg/kg	11/11	9	56	na	56	0.18	2.0	0.0000135	yes	asl
Mercury	mg/kg	1/11	0.2 J	0.2 J	0.06 U - 0.3 U	0.3 U	0.38	0.023	0.0135	yes	asl
Nickel	mg/kg	11/11	11	31	na	31	1	6.2	2.7	yes	asl
Selenium	mg/kg	0/11	nd	nd	0.7 U - 4 U	4 U	1	0.80	0.676	yes	asl
Vanadium	mg/kg	11/11	32.7	74	na	74	1	15	0.681	yes	asl
Zinc	mg/kg	11/11	80	229	na	229	1.8	84	40.6	yes	asl
PAHs											
2-Methylnaphthalene	µg/kg	7/11	7.9	31	5.0 U - 30 U	31	0.15	0.0026	0.541	no	bsl
Acenaphthene	µg/kg	5/11	5.0	11 JN	5.0 U - 30 U	30 U	0.031	0.00053	8.11	no	bsl
Acenaphthylene	µg/kg	3/11	5.0	7.0	5.0 U - 30 U	30 U	0.014	0.00023	8.11	no	bsl
Anthracene	µg/kg	6/11	5.9	26	5.0 U - 30 U	30 U	0.0078	0.00013	40.6	no	bsl
Benzo(a)anthracene	µg/kg	11/11	6.9	74	na	74	0.014	0.00057	0.00432	no	teq
Benzo(a)pyrene	µg/kg	11/11	7.9	83	na	83	0.0021	0.000098	0.000432	no	teq
Benzo(b)fluoranthene	µg/kg	11/11	8.4	71	na	71	0.0025	0.000098	0.00432	no	teq
Benzo(g,h,i)perylene	µg/kg	9/11	14	71	5.0 U	71	0.025	0.0010	na	no	ntx
Benzo(k)fluoranthene	µg/kg	11/11	8.4	71	na	71	0.0023	0.000092	0.0432	no	teq
Total benzofluoranthenes	µg/kg	11/11	16.8	142	na	142	1	0.080	na	no	ntx
Chrysene	µg/kg	11/11	9.4	110	na	110	0.010	0.00062	0.432	no	teq
Dibenzo(a,h)anthracene	µg/kg	3/11	5.4	6.5	5.0 U - 30 U	30 U	0.0022	0.000036	0.000432	no	teq
Dibenzofuran	µg/kg	3/11	5.0	7.4	5.0 U - 30 U	30 U	0.026	0.00044	na	no	ntx
Fluoranthene	µg/kg	11/11	20	190	na	190	0.0056	0.00060	5.41	no	bsl

Table 8: Occurrence and selection of COPCs for Calculated Fish Tissue in the Force Lake Fish Consumer RME Scenario

Chemical	Unit (dw)	Detection Frequency	Sediment Concentrations				BSAF[a]	Fish Tissue		COPC Flag?	Rationale for Selection or Exclusion
			Minimum Detect	Maximum Detect	RL or Range of RLs	Sediment Screening Value		Calculated Fish Tissue[b] (mg/kg ww)	Fish RSL[c] (mg/kg ww)		
Fluorene	µg/kg	6/11	5.9	26	5.0 U - 30 U	30 U	0.063	0.0011	5.41	no	bsl
Indeno(1,2,3-cd)pyrene	µg/kg	9/11	11	59	5.0 U	59	0.014	0.00048	0.00432	no	teq
Naphthalene	µg/kg	11/11	5.4	61	na	61	0.13	0.0046	2.7	no	bsl
Phenanthrene	µg/kg	11/11	15	120	na	120	0.024	0.0016	na	no	ntx
Pyrene	µg/kg	11/11	23	180	na	180	0.016	0.0016	4.06	no	bsl
Total HPAHs	µg/kg	11/11	84	910	na	910	1	0.51	na	no	ntx
Total LPAHs	µg/kg	11/11	20	230	na	230	1	0.13	na	no	ntx
cPAH TEQ	µg/kg	11/11	11.6	118	na	118	0.0021	0.00014	0.000432	no	bsl
Total PAHs	µg/kg	11/11	104	1,060	na	1,060	1	0.60	na	no	ntx
Other SVOCs											
1,2,4-Trichlorobenzene	µg/kg	0/11	nd	nd	5.3 U - 41 U	41 U	0.13	0.0030	0.876	no	bsl
1,2-Dichlorobenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	0.11	0.00052	12.2	no	bsl
1,3-Dichlorobenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	0.020	0.000094	na	no	ntx
1,4-Dichlorobenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	0.014	0.000063	0.584	no	bsl
Hexachlorobenzene	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	0.015	0.00010	0.00197	no	bsl
Hexachlorobutadiene	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	0.015	0.00010	0.0404	no	bsl
PCBs											
Aroclor-1016	µg/kg	0/11	nd	nd	32 U - 33 U	33 U	na	na	na	no	sum
Aroclor-1221	µg/kg	0/11	nd	nd	32 U - 33 U	33 U	na	na	na	no	sum
Aroclor-1232	µg/kg	0/11	nd	nd	32 U - 33 U	33 U	na	na	na	no	sum
Aroclor-1242	µg/kg	0/11	nd	nd	32 U - 33 U	33 U	na	na	na	no	sum
Aroclor-1248	µg/kg	0/11	nd	nd	32 U - 33 U	33 U	na	na	na	no	sum
Aroclor-1254	µg/kg	7/11	58	71	32 U - 49 U	71	na	na	0.0016	no	sum
Aroclor-1260	µg/kg	7/11	35	60	32 U - 33 U	60	na	na	na	no	sum
Total PCBs	µg/kg	7/11	93	131	32 U - 49 U	131	6.45	0.48	0.00158	yes	asl
Pesticides											
2,4'-DDD	µg/kg	8/11	8.6 JN	61 JN	4.8 U - 25 U	61 JN	0.045	0.0015	0.0131	no	sum
2,4'-DDE	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	2	0.028	na	no	sum
2,4'-DDT	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1.3	0.018	0.00928	yes	sum
4,4'-DDD	µg/kg	11/11	11 J	47	na	47	0.83	0.022	0.0131	yes	sum

Table 8: Occurrence and selection of COPCs for Calculated Fish Tissue in the Force Lake Fish Consumer RME Scenario

Chemical	Unit (dw)	Detection Frequency	Sediment Concentrations				BSAF[a]	Fish Tissue		COPC Flag?	Rationale for Selection or Exclusion
			Minimum Detect	Maximum Detect	RL or Range of RLs	Sediment Screening Value		Calculated Fish Tissue[b] (mg/kg ww)	Fish RSL[c] (mg/kg ww)		
4,4'-DDE	µg/kg	11/11	9.1	150	na	150	5.0	0.42	na	no	sum
4,4'-DDT	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	6.25	0.088	0.00928	yes	sum
Total DDTs	µg/kg	11/11	22 J	250	na	250	1.96	0.28	0.00928	yes	asl
Aldrin	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1	0.0068	0.000186	yes	asl
Dieldrin	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	2.2	0.031	0.000197	yes	asl
Total aldrin/dieldrin	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1	0.014	na	no	ntx
alpha-BHC	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1	0.0068	0.000501	yes	asl
beta-BHC	µg/kg	0/11	nd	nd	2.4 U - 23 U	23 U	1	0.013	0.00175	yes	asl
gamma-BHC	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1	0.0068	0.00287	yes	asl
delta-BHC	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1	0.0068	na	no	ntx
alpha-Chlordane	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1.5	0.0099	0.00901	yes	asl
gamma-Chlordane	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1.1	0.0077	0.00901	no	bsl
Total chlordane	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	26	0.18	0.00901	yes	asl
alpha-Endosulfan	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	1	0.0068	0.811	no	bsl
beta-Endosulfan	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1	0.014	0.811	no	bsl
Endosulfan sulfate	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1	0.014	0.811	no	bsl
Endrin	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1	0.014	0.0406	no	bsl
Endrin aldehyde	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1	0.014	0.0406	no	bsl
Endrin ketone	µg/kg	0/11	nd	nd	4.8 U - 25 U	25 U	1	0.014	0.0406	no	bsl
Heptachlor	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	0.13	0.00088	0.000701	yes	asl
Heptachlor epoxide	µg/kg	0/11	nd	nd	2.4 U - 12 U	12 U	29	0.20	0.000347	yes	asl
Methoxychlor	µg/kg	0/11	nd	nd	24 U - 120 U	120 U	1	0.068	0.676	no	bsl
Toxaphene	µg/kg	0/11	nd	nd	970 U - 5,000 U	5,000 U	1	2.8	0.00287	yes	asl
VOCs											
1,1,1,2-Tetrachloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.121	no	bsl
1,1,1-Trichloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	270	no	bsl
1,1,2,2-Tetrachloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.0158	no	bsl
1,1,2-Trichloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.0553	no	bsl
1,1,2-Trichlorotrifluoroethane	µg/kg	0/11	nd	nd	2.1 U - 16 U	16 U	1	0.0090	na	no	ntx
1,1-Dichloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.553	no	bsl

Table 8: Occurrence and selection of COPCs for Calculated Fish Tissue in the Force Lake Fish Consumer RME Scenario

Chemical	Unit (dw)	Detection Frequency	Sediment Concentrations				BSAF[a]	Fish Tissue		COPC Flag?	Rationale for Selection or Exclusion
			Minimum Detect	Maximum Detect	RL or Range of RLs	Sediment Screening Value		Calculated Fish Tissue[b] (mg/kg ww)	Fish RSL[c] (mg/kg ww)		
1,1-Dichloroethene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
1,1-Dichloropropene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
1,2,3-Trichlorobenzene	µg/kg	0/11	nd	nd	5.3 U - 41 U	41 U	1	0.023	na	no	ntx
1,2,3-Trichloropropane	µg/kg	0/11	nd	nd	2.1 U - 16 U	16 U	1	0.0090	0.000451	yes	yes
1,2,4-Trimethylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
1,2-Dibromo-3-chloropropane	µg/kg	0/11	nd	nd	5.3 U - 41 U	41 U	1	0.023	0.00394	yes	yes
1,2-Dibromoethane (EDB)	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
1,2-Dichloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.0347	no	bsl
1,2-Dichloropropane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.0876	no	bsl
1,3,5-Trimethylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	6.76	no	bsl
1,3-Dichloropropane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	2.7	no	bsl
2,2-Dichloropropane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
2-Chlorotoluene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
2-Hexanone	µg/kg	0/11	nd	nd	5.3 U - 41 U	41 U	1	0.023	na	no	ntx
4-Chlorotoluene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Acetone	µg/kg	10/11	78 JN	1,100	35 U	1,100	1	0.62	122	no	bsl
Benzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.0574	yes	cac
Bromobenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	2.7	no	bsl
Bromochloromethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Bromodichloromethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 UJ	1	0.0046	0.0509	no	bsl
Bromoform	µg/kg	0/10	nd	nd	1.1 U - 8.2 UJ	8.2 U	1	0.0046	0.399	no	bsl
Bromomethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.189	no	bsl
Carbon disulfide	µg/kg	11/11	4.9	140	na	140	1	0.079	13.5	no	bsl
Carbon tetrachloride	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.0243	no	bsl
Chlorobenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	2.7	no	bsl
Chloroethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Chloroform	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.102	no	bsl
Chloromethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
cis-1,2-Dichloroethene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
cis-1,3-Dichloropropene	µg/kg	0/11	nd	nd	1.1 U - 8.2 UJ	8.2 UJ	1	0.0046	na	no	ntx

Table 8: Occurrence and selection of COPCs for Calculated Fish Tissue in the Force Lake Fish Consumer RME Scenario

Chemical	Unit (dw)	Detection Frequency	Sediment Concentrations				BSAF[a]	Fish Tissue		COPC Flag?	Rationale for Selection or Exclusion
			Minimum Detect	Maximum Detect	RL or Range of RLs	Sediment Screening Value		Calculated Fish Tissue[b] (mg/kg ww)	Fish RSL[c] (mg/kg ww)		
p-Cymene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Dibromochloromethane	µg/kg	0/10	nd	nd	1.1 U - 8.2 UJ	8.2 U	1	0.0046	0.0376	no	bsl
Dibromomethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Dichlorodifluoromethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	27	no	bsl
Dichloromethane	µg/kg	0/11	nd	nd	2.1 U - 16 U	16 U	1	0.0090	na	no	ntx
Ethylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.287	no	bsl
Isopropylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Methyl ethyl ketone	µg/kg	10/11	9.4	140	5.3 U	140	1	0.079	81.1	no	bsl
Methyl isobutyl ketone	µg/kg	0/11	nd	nd	5.3 U - 41 U	41 U	1	0.023	na	no	ntx
n-Butylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
n-Propylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
sec-Butylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Styrene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	27	no	bsl
tert-Butyl methyl ether	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
tert-Butylbenzene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Tetrachloroethene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Toluene	µg/kg	3/11	1.2	17	6.0 U - 8.2 U	17	1	0.0096	10.8	no	bsl
trans-1,2-Dichloroethene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
trans-1,3-Dichloropropene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	na	no	ntx
Trichloroethene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.243	no	bsl
Trichlorofluoromethane	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	40.6	no	bsl
Vinyl acetate	µg/kg	0/10	nd	nd	5.3 U - 43 U	43 U	1	0.024	135	no	bsl
Vinyl chloride	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	0.00438	yes	asl
o-Xylene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	27	no	sum
m,p-Xylene	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	27	no	sum
Total xylenes	µg/kg	0/11	nd	nd	1.1 U - 8.2 U	8.2 U	1	0.0046	27	no	bsl
Petroleum											
TPH - Gasoline range	mg/kg	1/11	31	31	7.7 U - 80 U	80 U	1	45	na	no	ntx
TPH - Diesel range	mg/kg	11/11	16	270	na	270	1	150	na	no	ntx
TPH - Motor oil range	mg/kg	11/11	130	2,000	na	2,000	1	1,100	na	no	ntx

[a] BSAF units are dw/dw for metals, and are lipid/OC for all other chemicals.

[b] Fish tissue concentrations are estimated based on the sediment concentrations and BSAFs presented in this table (see Attachment 2 for additional information regarding the methodology used to calculate tissue concentrations).

[c] Fish RSLs are taken from EPA Region 3 RBC tables (2009c).

asl – above screening level (selected as COPC)
BSAF – biota sediment accumulation factor
BHC – benzene hexachloride
bsl – below screening level
cac – Class A carcinogen (selected as COPC)
COPC – contaminant of potential concern
cPAH – carcinogenic PAH
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
EDB – 1,2-dibromoethane
HPAH – high-molecular-weight PAH
J – estimated concentration
LPAH – low-molecular-weight PAH
na – not available
nd – not detected
ntx – no toxicity information (not selected as COPC)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RL – reporting limit
RSL – regional screening level
sum – chemical included in sum and is not evaluated separately
SVOC – semivolatile organic compound
teq – chemical included in TEQ calculation and is not evaluated separately
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
U – not detected at given concentration
VOC – volatile organic compound

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ATTACHMENT 4 – CALCULATION OF OUTDOOR AIR VAPOR CONCENTRATIONS FOR INHALATION RISKS

This attachment presents the calculation of volatilized contaminants of potential concern (COPC) concentrations in air for the industrial (construction/trenching) worker reasonable maximum exposure (RME) scenario and the future outdoor worker RME scenario. Concentrations in air were calculated using equations based on a series of commonly used models. These models have been compiled in a modeling software package called Risk-Integrated Software for Cleanup (RISC) (Spence and Walden 2001). For convenience, RISC was used to perform these calculations, but these calculations can also be made without this software using the equations presented in this attachment. Additional references for the equations can be found in the RISC user's manual (Spence and Walden 2001).

Section 1.0 presents the equations used to calculate outdoor air concentrations based on soil data, and Section 2.0 presents the equations used to calculate outdoor air concentrations based on groundwater data. Tables in these sections present the necessary COPC-specific parameter values and values calculated using the equations in this attachment for the industrial (construction/trenching) worker RME and the future outdoor worker RME scenarios. Only COPCs that might be expected to volatilize significantly because of their diffusivity in air or water are presented. None of the inorganic COPCs fit these criteria, and thus they are not presented.

1.0 Calculation of Outdoor Air Concentrations from Soil Data

Soil is commonly characterized as a three-part system consisting of solid, gaseous, and aqueous states. Chemical transfer between states typically occurs through the aqueous state, which is often referred to as porewater. Consequently, when starting with soil data, the first step in calculating outdoor air concentrations is to convert the soil concentrations to dissolved-phase concentrations within the porewater (Tables 1 and 2). This is a two-step process because it is necessary to check that the calculated dissolved-phase concentration is not greater than the COPC's solubility.

Table 1. Model Inputs and Outputs for the Prediction of COPC Concentrations in Vapor from Soil for the Industrial (Construction/Trenching) Worker RME Scenario

	Chemical-Specific Inputs[a]						Calculated Values							
Facility Soil COPC	C_s (soil EPC, mg/kg dw)	K_{oc} (organic carbon partitioning coefficient, ml/g)	K_H (Henry's Law constant, unitless)	S_{eff} (effective solubility, mg/L)	D_{air} (molecular diffusion coefficient in air, cm^2/s)	D_{water} (molecular diffusion coefficient in water, cm^2/s)	C_{ws} (dissolved-phase conc., mg/L) (Equation 1a)	Is C_{ws} greater than the COPC's solubility?	C_H^{max} (max source vapor conc., g/cm^3) (Equation 1b)	Selected C_{ws} Value (dissolved-phase conc., mg/L) (Equation 1a)	C_{vs} (vapor conc. at source, g/cm^3) (Equation 2)	D_{eff} (effective diffusion coefficient) (Equation 3)	F (vapor flux rate, $g/cm^2/s$) (Equation 4)	$C_{outdoor}$ (estimated soil vapor EPC, mg/m^3) (Equation 5)
Naphthalene	2.0	2,000	0.0198	31	0.059	7.50×10^{-6}	0.10	no ($C_{ws} < S_{eff}$)	na	0.10	2.0×10^{-9}	0.0046	3.0×10^{-14}	7.5×10^{-7}
cPAH TEQ[b]	0.95	1,000,000	0.0000463	0.00162	0.043	9.00×10^{-6}	0.000095	no ($C_{ws} < S_{eff}$)	na	0.000095	4.4×10^{-15}	0.0052	7.7×10^{-20}	1.9×10^{-12}
Total PCBs	3.4	310,000	0.0111	0.42	0.100	7.95×10^{-6}	0.0011	no ($C_{ws} < S_{eff}$)	na	0.0011	1.2×10^{-11}	0.0078	3.2×10^{-16}	7.9×10^{-9}
Total DDTs[b]	11	2,630,000	0.000332	0.025	0.0137	4.95×10^{-6}	0.00042	no ($C_{ws} < S_{eff}$)	na	0.00042	1.4×10^{-13}	0.0012	5.6×10^{-19}	1.4×10^{-11}
1,1-Dichloroethane	0.68	32	0.23	5,060	0.0742	1.05×10^{-5}	1.5	no ($C_{ws} < S_{eff}$)	na	1.5	3.5×10^{-7}	0.0058	6.7×10^{-12}	1.7×10^{-4}
1,2,4-Trimethylbenzene[b]	5.3	2,000	0.0198	31	0.059	7.50×10^{-6}	0.26	no ($C_{ws} < S_{eff}$)	na	0.26	5.2×10^{-9}	0.0046	8.0×10^{-14}	2.0×10^{-6}
1,3,5-Trimethylbenzene[b]	1.3	2,000	0.0198	31	0.059	7.50×10^{-6}	0.065	no ($C_{ws} < S_{eff}$)	na	0.065	1.3×10^{-9}	0.0046	2.0×10^{-14}	4.9×10^{-7}
Benzene	0.33	59	0.23	1,750	0.088	9.80×10^{-6}	0.46	no ($C_{ws} < S_{eff}$)	na	0.46	1.1×10^{-7}	0.0068	2.4×10^{-12}	6.0×10^{-5}
Chlorobenzene	0.22	22	0.15	472	0.073	8.70×10^{-6}	0.66	no ($C_{ws} < S_{eff}$)	na	0.66	9.9×10^{-8}	0.0057	1.9×10^{-12}	4.7×10^{-5}
cis-1,2-Dichloroethene	8.7	36	0.17	3,500	0.0736	1.13×10^{-5}	18	no ($C_{ws} < S_{eff}$)	na	18	3.1×10^{-6}	0.0057	5.9×10^{-11}	1.5×10^{-3}
Dichloromethane	0.02	12	0.0898	13,000	0.10	1.2×10^{-5}	0.090	no ($C_{ws} < S_{eff}$)	na	0.090	8.1×10^{-9}	0.0078	2.1×10^{-13}	5.2×10^{-6}
Ethylbenzene	1.9	360	0.32	169	0.075	7.80×10^{-6}	0.51	no ($C_{ws} < S_{eff}$)	na	0.51	1.6×10^{-7}	0.0058	3.2×10^{-12}	7.9×10^{-5}
trans-1,2-Dichloroethene	5.5	53	0.39	6,300	0.0707	1.19×10^{-5}	8.1	no ($C_{ws} < S_{eff}$)	na	8.1	3.1×10^{-6}	0.0055	5.8×10^{-11}	1.4×10^{-3}
Trichloroethene	0.16	170	0.42	1,100	0.079	9.10×10^{-6}	0.086	no ($C_{ws} < S_{eff}$)	na	0.086	3.6×10^{-8}	0.0061	7.4×10^{-13}	1.9×10^{-5}
Vinyl chloride	1.2	19	1.11	2,760	0.11	1.20×10^{-6}	2.6	no ($C_{ws} < S_{eff}$)	na	2.6	2.9×10^{-6}	0.0085	8.2×10^{-11}	2.1×10^{-3}
Total xylenes	10	240	0.29	198	0.072	8.50×10^{-6}	3.9	no ($C_{ws} < S_{eff}$)	na	3.9	1.1×10^{-6}	0.0056	2.1×10^{-11}	5.3×10^{-4}
TPH-gasoline (aliphatic)[c]	430	4,000	51	5.4	0.10	1.0×10^{-5}	8.9	yes ($C_{ws} > S_{eff}$)	275	5.7	2.9×10^{-4}	0.0078	7.5×10^{-9}	1.9×10^{-1}

[a] Soil EPCs were calculated as described in Section 3.0 of the HHRA. The values for the other model inputs were from RISC (Spence and Walden 2001) and/or from EPA (1996).

[b] As a health-protective approach, structurally similar chemicals were selected as surrogates (i.e., the surrogate chemical was generally considered to be more toxic than the COPC it was representing). Benzo(a)pyrene was used for cPAH TEQ, 4,4'-DDT was used for total DDTs, and naphthalene was used for trimethylbenzenes.

[c] The estimated soil vapor EPC was based on TPH-gasoline (aliphatic) with 6 to 8 carbon atoms.

COPC – contaminant of potential concern
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
EPA – US Environmental Protection Agency
EPC – exposure point concentration
HHRA – human health risk assessment
na – not applicable
PCB – polychlorinated biphenyl
RISC – Risk-Integrated Software for Cleanup
RME – reasonable maximum exposure
TEQ – toxic equivalent
TPH – total petroleum hydrocarbon

Table 2. Model Inputs and Outputs for the Prediction of COPC Concentrations in Vapor from Soil for the Future Outdoor Worker RME Scenario

	Chemical-Specific Inputs[a]						Calculated Values							
Facility Soil COPC	C_s (soil EPC, mg/kg dw)	K_{oc} (organic carbon partitioning coefficient, ml/g)	K_H (Henry's Law constant, unitless)	S_{eff} (effective solubility, mg/L)	D_{air} (molecular diffusion coefficient in air, cm^2/s)	D_{water} (molecular diffusion coefficient in water, cm^2/s)	C_{ws} (dissolved-phase conc., mg/L) (Equation 1a)	Is C_{ws} greater than the COPC's solubility?	C_H^{max} (max source vapor conc., g/cm^3) (Equation 1b)	Selected C_{ws} Value (dissolved-phase conc., mg/L) (Equation 1a)	C_{vs} (vapor conc. at source, g/cm^3) (Equation 2)	D_{eff} (effective diffusion coefficient) (Equation 3)	F (vapor flux rate, $g/cm^2/s$) (Equation 4)	$C_{outdoor}$ (estimated soil vapor EPC, mg/m^3) (Equation 5)
Naphthalene	2.6	2,000	0.0198	31	0.059	7.50×10^{-6}	0.13	no ($C_{ws} < S_{eff}$)	na	0.13	2.6×10^{-9}	0.0046	3.9×10^{-14}	9.8×10^{-7}
cPAH TEQ[b]	1.1	1,000,000	0.0000463	0.00162	0.043	9.00×10^{-6}	0.00011	no ($C_{ws} < S_{eff}$)	na	0.00011	5.1×10^{-15}	0.0052	8.9×10^{-20}	2.2×10^{-12}
Total PCBs	5.2	310,000	0.0111	0.42	0.100	7.95×10^{-6}	0.0017	no ($C_{ws} < S_{eff}$)	na	0.0017	1.9×10^{-11}	0.0078	4.8×10^{-16}	1.2×10^{-8}
Total DDTs[b]	16	2,630,000	0.000332	0.025	0.0137	4.95×10^{-6}	0.00061	no ($C_{ws} < S_{eff}$)	na	0.00061	2.0×10^{-13}	0.0012	8.1×10^{-19}	2.0×10^{-11}
1,1-Dichloroethane	0.68	32	0.23	5,060	0.0742	1.05×10^{-5}	1.5	no ($C_{ws} < S_{eff}$)	na	1.5	3.5×10^{-7}	0.0058	6.7×10^{-12}	1.7×10^{-4}
1,2,4-Trimethylbenzene[b]	13	2,000	0.0198	31	0.059	7.50×10^{-6}	0.65	no ($C_{ws} < S_{eff}$)	na	0.65	1.3×10^{-8}	0.0046	2.0×10^{-13}	4.9×10^{-6}
1,3,5-Trimethylbenzene[b]	3.0	2,000	0.0198	31	0.059	7.50×10^{-6}	0.15	no ($C_{ws} < S_{eff}$)	na	0.15	3.0×10^{-9}	0.0046	4.5×10^{-14}	1.1×10^{-6}
Benzene	0.51	59	0.228	1,750	0.088	9.80×10^{-6}	0.71	no ($C_{ws} < S_{eff}$)	na	0.71	1.6×10^{-7}	0.0068	3.7×10^{-12}	9.3×10^{-5}
cis-1,2-Dichloroethene	130	36	0.167	3,500	0.074	1.1×10^{-5}	273	no ($C_{ws} < S_{eff}$)	na	273	4.6×10^{-5}	0.0057	8.8×10^{-10}	2.2×10^{-2}
Dichloromethane	0.047	12	0.0898	13,000	0.10	1.2×10^{-5}	0.211	no ($C_{ws} < S_{eff}$)	na	0.21	1.9×10^{-8}	0.0078	4.9×10^{-13}	1.2×10^{-5}
Ethylbenzene	3.1	360	0.32	169	0.075	7.80×10^{-6}	0.83	no ($C_{ws} < S_{eff}$)	na	0.83	2.7×10^{-7}	0.0058	5.1×10^{-12}	1.3×10^{-4}
trans-1,2-Dichloroethene	5.5	53	0.39	6,300	0.0707	1.19×10^{-5}	8.1	no ($C_{ws} < S_{eff}$)	na	8.1	3.1×10^{-6}	0.0055	5.8×10^{-11}	1.4×10^{-3}
Trichloroethene	0.27	170	0.42	1,100	0.079	9.10×10^{-6}	0.15	no ($C_{ws} < S_{eff}$)	na	0.15	6.1×10^{-8}	0.0061	1.2×10^{-12}	3.1×10^{-5}
Vinyl chloride	1.2	19	1.11	2,760	0.011	1.2×10^{-6}	2.6	no ($C_{ws} < S_{eff}$)	na	2.6	2.9×10^{-6}	0.0085	8.2×10^{-11}	2.1×10^{-3}
Total xylenes	16	240	0.29	198	0.072	8.50×10^{-6}	6.3	no ($C_{ws} < S_{eff}$)	na	6.3	1.8×10^{-6}	0.0056	3.4×10^{-11}	8.5×10^{-4}
TPH-gasoline (aliphatic)[c]	660	4,000	51	5.4	0.10	1.0×10^{-5}	13.6	yes ($C_{ws} > S_{eff}$)	275	5.7	2.9×10^{-4}	0.0078	7.5×10^{-9}	1.9×10^{-1}

[a] Soil EPCs were calculated as described in Section 3.0 of the HHRA. The values for the other model inputs were from RISC (Spence and Walden 2001) and/or from EPA (1996).

[b] As a health-protective approach, structurally similar chemicals were selected as surrogates (i.e., the surrogate chemical was generally considered to be more toxic than the COPC it was representing). Benzo(a)pyrene was used for cPAH TEQ, 4,4'-DDT was used for total DDTs, and naphthalene was used for trimethylbenzenes.

[c] The estimated soil vapor EPC was based on TPH-gasoline (aliphatic) with 6 to 8 carbon atoms.

COPC – contaminant of potential concern
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
EPA – US Environmental Protection Agency
EPC – exposure point concentration
HHRA – human health risk assessment
na – not applicable
PCB – polychlorinated biphenyl
RISC – Risk-Integrated Software for Cleanup
RME – reasonable maximum exposure
TEQ – toxic equivalent
TPH – total petroleum hydrocarbon

First, Equation 1a is used to calculate the initial dissolved-phase concentration at the source from the input soil concentration using the equilibrium partitioning theory.

$$C_{ws} = \frac{C_s \rho_b}{\theta_a K_H + \theta_w + \rho_b F_{oc} K_{oc}}$$ **Equation 1a**

Where:

C_{ws}	=	dissolved-phase concentration at the source (mg/L)
C_s	=	COPC concentration in soil, equal to the soil EPC presented in Tables 1 and 2 (mg/kg)
ρ_b	=	soil bulk density of the source area (1.7 g/cm^3)
K_H	=	COPC-specific Henry's Law constant [(mg/L vapor)/(mg/L water)]
θ_a	=	vadose zone air-filled porosity (0.28 cm^3 of air/cm^3 total soil volume)
θ_w	=	vadose zone water-filled porosity (0.15 cm^3 of water/cm^3 total soil volume)
F_{oc}	=	fraction organic carbon in soil (0.01 g organic carbon/g soil)
K_{oc}	=	COPC-specific organic carbon partition coefficient (ml/g)

The values for soil bulk density (1.7) and fraction organic carbon (0.01) used in this equation were default values from the RISC model that are typical of soil (Spence and Walden 2001). Region-specific values for air-filled porosity (0.28) and water-filled porosity (0.15) in the vadose zone were taken from the US Environmental Protection Agency (EPA) (1996).

Next, the dissolved-phase concentration at the source (C_{ws}) calculated using Equation 1a is compared with the COPC-specific effective solubility (Tables 1 and 2) to determine whether the calculated dissolved-phase concentration is greater than the COPC's solubility.

- **Source concentration less than effective solubility**: If the C_{ws} is lower than the COPC-specific effective solubility, C_{ws} (from Equation 1a) is used in Equation 2 to calculate the vapor concentration at the source.
- **Source concentration greater than effective solubility**: If the C_{ws} is greater than the COPC-specific effective solubility, the C_{ws} must be re-calculated because it is not possible for a COPC to be present in the dissolved phase at a concentration greater than its solubility.

If the source concentration (C_{ws}) is greater than the effective solubility, Equation 1b is used to calculate the maximum source vapor concentration (C_H^{max}), which reflects the highest soil concentration that can be dissolved in water.

$$C_H^{max} = E_{sol} K_H$$ **Equation 1b**

Where:

C_H^{max}	=	maximum source vapor concentration (g/cm^3)
S_{eff}	=	COPC-specific effective solubility presented in Tables 1 and 2 (mg/L)
K_H	=	COPC-specific Henry's Law constant [(mg/L vapor)/(mg/L water)]

The C_H^{max} value calculated using Equation 1b is then used in place of the COPC concentration in soil (C_s) in Equation 1a to determine the dissolved-phase concentration at the source (C_{ws}) to be used in Equation 2.

Once the appropriate dissolved-phase concentration at the source (C_{ws}) is determined, Equation 2 is used to calculate the initial vapor concentration at the source using Henry's Law, which states that the solubility of a gas in a liquid at a particular temperature is proportional to the pressure of that gas above the liquid.

$$C_{vs} = K_H C_{ws} \left(\frac{l}{1{,}000\ cm^3} \right) \left(\frac{g}{1{,}000\ mg} \right) \qquad \textbf{Equation 2}$$

Where:

C_{vs}	=	vapor concentration at the source (g/cm^3)
K_H	=	COPC-specific Henry's Law constant [(mg/L vapor)/(mg/L water)]
C_{ws}	=	dissolved-phase concentration at the source calculated using Equation 1a (mg/L)

Next, Equation 3 is used to calculate the effective diffusion coefficient within the soil vadose zone, which describes the tendency of individual molecules or ions to migrate through soil.

$$D_{eff} = D_{air} \left(\frac{\theta_a^{10/3}}{\theta_t^{2}} \right) + D_{water} \frac{1}{K_H} \left(\frac{\theta_w^{10/3}}{\theta_t^{2}} \right) \qquad \textbf{Equation 3}$$

Where:

D_{eff}	=	effective diffusion coefficient (cm^2/s)
D_{air}	=	COPC-specific molecular diffusion coefficient in air (cm^2/s)
θ_a	=	vadose zone air-filled porosity (0.28 cm^3 of air/cm^3 total soil volume)
θ_t	=	total porosity (0.43 cm^3 of pores/cm^3 total soil volume)
D_{water}	=	COPC-specific molecular diffusion coefficient in water (cm^2/s)
K_H	=	COPC-specific Henry's Law constant [(mg/L vapor)/(mg/L water)]
θ_w	=	vadose zone water-filled porosity (0.15 cm^3 of water/cm^3 total soil volume)

COPC-specific values for molecular diffusion coefficients in air (D_{air}) and water (D_{water}) were taken from EPA (1996) (Tables 1 and 2). The value used for total porosity (0.43) is the sum of the values used for air-filled and water-filled porosity for the vadose zone defined for Equation 1a.

Equation 4 is then used to calculate the volatile flux rate (i.e., change in mass per area over time) of COPCs from soil.

$$F = D_{eff} \left(\frac{C_{vs} - C_{amb}}{X_{diff}} \right) \qquad \textbf{Equation 4}$$

Where:

F	=	vapor flux rate (g/cm^2-s)
D_{eff}	=	effective diffusion coefficient calculated using Equation 3 (cm^2/s)
C_{vs}	=	vapor concentration at the source calculated using Equation 2 (g/cm^3)
C_{amb}	=	ambient vapor concentration (0 g/cm^3)
X_{diff}	=	diffusion distance (300 cm)

For this human health risk assessment (HHRA), the ambient vapor concentration (C_{amb}) was assumed to be zero as a health-protective assumption. The diffusion distance (X_{diff}) was 300 cm, which is the sum of the depth of a shallow trench (~120 cm) and the height of an average-sized person (180 cm).

The last step is to calculate the outdoor air concentration using Equation 5. Outdoor air concentrations are calculated using a simple model that describes the wind-driven flux of COPCs through an imaginary box above the contaminated soil in what is considered the "breathing zone."

$$C_{outdoor} = \frac{F \times L}{u \times H}\left(\frac{m}{100\ cm}\right)\left(\frac{1{,}000\ mg}{g}\right)\left(\frac{10^6\ cm^3}{m^3}\right) \qquad \textbf{Equation 5}$$

Where:

$C_{outdoor}$	=	concentration in outdoor air (mg/m^3)
F	=	vapor flux rate calculated using Equation 4 (g/cm^2-s)
L	=	length of box in the direction of air flow (parallel to the wind) (10 m)
H	=	height of box (2 m)
u	=	wind speed (2 m/s)

The default parameters values provided in RISC were used to calculate outdoor air concentrations (Spence and Walden 2001). Box length was equal to 10 m, box height was equal to 2 m (height of a person rounded to one significant figure), and the wind speed was equal to 2 m/s.

Tables 1 and 2 present the outdoor air concentrations calculated from soil concentrations for the industrial (construction/trenching) worker RME scenario and the future outdoor worker RME scenario. These concentrations were used in the HHRA to calculate risks based on exposure to Facility soil for these scenarios.

2.0 Calculation of Outdoor Air Concentrations from Groundwater Data

Air concentrations can also be calculated based on groundwater data. When starting with groundwater data, the first step is to compare the COPC-specific effective solubility with the groundwater concentration (Table 3). The lower of these values is then used in Equation 6 (i.e., a COPC cannot be present in the dissolved phase at a concentration higher than its effective solubility).

Table 3. Model Inputs and Outputs for the Prediction of COPC Concentrations in Vapor from Groundwater for the Industrial (Construction/Trenching) Worker RME Scenario

	Chemical-Specific Inputs[a]					Calculated Values						
Groundwater COPC	C_{ws} (ground-water EPC, mg/L)	Effective Solubility (mg/L)	K_H (Henry's Law constant, unitless)	D_{air} (molecular diffusion coefficient in Air, cm^2/s)	D_{water} (molecular diffusion coefficient in water, cm^2/s)	Selected C_{ws} Value (greater of C_{ws} and effective solubility concentration, mg/L)	C_{vs} (vapor conc. at source, g/cm^3) (Equation 6)	D_{eff-v} (effective diffusion coefficient for the vadose zone, cm^2/s) (Equation 7a)	$D_{eff-cap}$ (effective diffusion coefficient for the capillary fringe, cm^2/s) (Equation 7b)	D_{eff} (effective diffusion coefficient within groundwater cm^2/s) (Equation 8)	F (vapor flux rate, g/cm^2-s) (Equation 4)	$C_{outdoor}$ (estimated groundwater vapor EPC, mg/m^3) (Equation 5)
Naphthalene	0.00033	31	0.0198	0.059	7.50×10^{-6}	0.00033	6.5×10^{-12}	4.6×10^{-3}	1.2×10^{-4}	0.00063	1.4×10^{-17}	3.4×10^{-10}
1,4-Dichlorobenzene[b]	0.0014	31	0.23	0.088	9.80×10^{-6}	0.0014	3.2×10^{-10}	6.8×10^{-3}	1.3×10^{-5}	0.000079	8.5×10^{-17}	2.1×10^{-9}
Total DDTs[b]	0.000049	0.025	0.000332	0.0137	4.95×10^{-6}	0.000049	1.6×10^{-14}	1.2×10^{-3}	4.7×10^{-3}	0.00138	7.5×10^{-20}	1.9×10^{-12}
1,2,4-Trimethylbenzene[b]	0.0072	31	0.0198	0.059	7.50×10^{-6}	0.0072	1.4×10^{-10}	4.6×10^{-3}	1.2×10^{-4}	0.00063	3.0×10^{-16}	7.5×10^{-9}
1,3,5-Trimethylbenzene[b]	0.003	31	0.0198	0.059	7.50×10^{-6}	0.0030	5.9×10^{-11}	4.6×10^{-3}	1.2×10^{-4}	0.00063	1.2×10^{-16}	3.1×10^{-9}
Benzene	0.039	1,750	0.23	0.088	9.80×10^{-6}	0.039	9.0×10^{-9}	6.8×10^{-3}	1.3×10^{-5}	0.000079	2.4×10^{-15}	5.9×10^{-8}
Chlorobenzene	0.080	472	0.15	0.073	8.70×10^{-6}	0.080	1.2×10^{-8}	5.7×10^{-3}	1.8×10^{-5}	0.00011	4.3×10^{-15}	1.1×10^{-7}
n-Propylbenzene[b]	0.011	169	0.323	0.075	7.80×10^{-6}	0.011	3.6×10^{-9}	5.8×10^{-3}	7.5×10^{-6}	0.000045	5.3×10^{-16}	1.3×10^{-8}
tert-Butyl methyl ether	0.028	48,000	0.024	0.0728	8.95×10^{-6}	0.028	6.7×10^{-10}	5.7×10^{-3}	1.2×10^{-4}	0.00063	1.4×10^{-15}	3.6×10^{-8}
Vinyl chloride	0.0005	2,760	1.1	0.106	1.23×10^{-6}	0.00050	5.5×10^{-10}	8.2×10^{-3}	3.6×10^{-7}	0.0000022	4.0×10^{-18}	9.9×10^{-11}

[a] Groundwater EPCs were calculated as described in Section 3.0 of the HHRA. The values for the other model inputs were from RISC (Spence and Walden 2001) and/or from EPA (1996).

[b] As a health-protective approach, structurally similar chemicals were selected as surrogates (i.e., the surrogate chemical was generally considered to be more toxic than the COPC it was representing). Benzene was used for 1,4-dichlorobenzene, 4,4'-DDT was used for total DDTs, naphthalene was used for the trimethylbenzenes, and ethylbenzene was used for n-propylbenzene.

COPC – contaminant of potential concern
DDT – dichlorodiphenyltrichloroethane
EPA – US Environmental Protection Agency
EPC – exposure point concentration
HHRA – human health risk assessment
RISC – Risk-Integrated Software for Cleanup
RME – reasonable maximum exposure

Equation 6 (similar to Equation 2 presented above) calculates the initial vapor concentration at the source using Henry's Law.

$$C_{vs} = K_H C_{ws} \left(\frac{l}{1{,}000\ cm^3} \right) \left(\frac{g}{1{,}000\ mg} \right) \qquad \textbf{Equation 6}$$

Where:

C_{vs}	=	vapor concentration at the source (g/cm^3)
K_H	=	COPC-specific Henry's Law constant [(mg/L vapor)/(mg/L water)]
C_{ws}	=	COPC-specific dissolved-phase concentration at the source, equal to the groundwater EPC presented in Table 3 (mg/L)

Next, Equations 7a and 7b are used to calculate the effective diffusion coefficients for the vadose zone ($D_{eff\text{-}v}$) and the capillary fringe ($D_{eff\text{-}cap}$), respectively. Diffusion coefficients describe the tendency of individual molecules or ions to migrate through the vadose zone or capillary fringe.

$$D_{eff-v} = D_{air} \left(\frac{\theta_{a-v}^{10/3}}{\theta_t^{\,2}} \right) + D_{water} \frac{1}{K_H} \left(\frac{\theta_{w-v}^{10/3}}{\theta_t^{\,2}} \right) \qquad \textbf{Equation 7a}$$

$$D_{eff-cap} = D_{air} \left(\frac{\theta_{a-cap}^{10/3}}{\theta_t^{\,2}} \right) + D_{water} \frac{1}{K_H} \left(\frac{\theta_{w-cap}^{10/3}}{\theta_t^{\,2}} \right) \qquad \textbf{Equation 7b}$$

Where:

$D_{eff\text{-}v}$	=	effective diffusion coefficient for the vadose zone (cm^2/s)
$D_{eff\text{-}cap}$	=	effective diffusion coefficient for the capillary fringe (cm^2/s)
D_{air}	=	COPC-specific molecular diffusion coefficient in air (cm^2/s)
D_{water}	=	COPC-specific molecular diffusion coefficient in water (cm^2/s)
K_H	=	COPC-specific Henry's Law constant [(mg/L vapor)/(mg/L water)]
θ_t	=	total porosity (0.43 cm^3 of pores/cm^3 total soil volume)
$\theta_{a\text{-}v}$	=	vadose zone air-filled porosity (0.28 cm^3 of air/cm^3 total soil volume)
$\theta_{w\text{-}v}$	=	vadose zone water-filled porosity (0.15 cm^3 of water/cm^3 total soil volume)
$\theta_{a\text{-}cap}$	=	capillary fringe air-filled porosity (0.005 cm^3 of air/cm^3 total soil volume)
$\theta_{w\text{-}cap}$	=	capillary fringe water-filled porosity (0.425 cm^3 of water/cm^3 total soil volume)

The porosity values used for the vadose zone are the same as those specified for Equation 1a. Within the capillary fringe, the air-filled porosity value used was 0.005, which is typical of many different soil types (Spence and Walden 2001). The water-filled porosity value for the capillary fringe of 0.425 was calculated as the difference between the total porosity (0.43) and the air-filled porosity value.

Using the results of Equations 7a and 7b, Equation 8 calculates the effective diffusion coefficient within groundwater, using a depth-weighted average of effective diffusion coefficients within the vadose and capillary fringe zones. Default model values provided in RISC were used for the depth of the capillary fringe (50 cm) and the depth of the vadose zone (250 cm) (Spence and Walden 2001).

$$D_{eff} = (d_{cap} + d_v)\left[\left(\frac{d_{cap}}{D_{eff-cap}}\right) + \left(\frac{d_v}{D_{eff-v}}\right)\right]^{-1}$$ **Equation 8**

Where:

D_{eff}	=	effective diffusion coefficient (cm^2/s)
d_{cap}	=	depth of capillary fringe (50 cm)
d_v	=	depth of vadose zone (250 cm)
$D_{eff-cap}$	=	effective diffusion coefficient within capillary fringe calculated using Equation 7b (cm^2/s)
D_{eff-v}	=	effective diffusion coefficient within vadose zone calculated using Equation 7a (cm^2/s)

The final two steps in the process to calculate outdoor air concentrations from groundwater concentrations are the same as those used for soil. First, Equation 4 is used to calculate the volatile flux using the effective diffusion coefficient (D_{eff}) from Equation 8 and the vapor concentration at the source (C_{vs}) from Equation 6. Then, Equation 5 is used to calculate the outdoor air concentration using the vapor flux rate calculated using Equation 4.

Table 3 presents the outdoor air concentrations calculated from groundwater concentrations for the industrial (construction/trenching) worker RME scenario. These concentrations were used in the HHRA to calculate risks based on exposure to groundwater for this scenario.

3.0 References

EPA. 1996. Soil screening guidance: User's guide. Second edition. 9355.4-23. Office of Solid Waste and Emergency Response, US Environmental Protection Agency, Washington, DC.

Spence LR, Walden T. 2001. RISC 4 user's manual. Spence Engineering, Pleasant, CA.

ATTACHMENT 5 – CDI RATES, INHALATION ECS, AND DERMALLY ABSORBED DOSES FOR CONTAMINANTS OF POTENTIAL CONCERN

This attachment to the Harbor Oil baseline HHRA presents the chronic daily intake (CDI) rates and inhalation exposure concentrations (ECs) for contaminants of potential concern (COPCs) identified for the various scenarios. CDI rates represent the estimated daily COPC dose for an individual averaged over the exposure duration for each scenario and are applicable for risks via dermal absorption or ingestion. ECs represent the COPC concentrations in air used to assess risks to humans based on inhalation and are applicable to the industrial (construction/trenching) worker reasonable maximum exposure (RME) scenario. Separate CDIs and ECs were calculated for COPCs with carcinogenic and non-carcinogenic effects because the averaging times over which the doses are calculated are different. Additionally, this attachment presents the additional parameters needed to calculate the dermally absorbed dose for exposure to Force Lake surface water and groundwater in the recreational user and industrial (construction/trenching) worker scenarios, respectively.

Tables 1 through 7 of this attachment present the results of CDI, EC, and dermally absorbed dose calculations performed using Equations 3-1 through 3-9 in Section 3.3.1 and the exposure parameters given in Tables 3-8 through 3-18 of the main document. The CDI and EC results were used in the risk characterization and uncertainty analysis (Sections 5 and 6, respectively). The CDIs and ECs are expressed in scientific notation (e.g., 1.0×10^{-5} is equivalent to 0.000010).The following tables present the CDIs, ECs, and dermally absorbed doses:

- Table 1: CDIs and ECs for the Industrial (Construction/Trenching) Worker RME Scenario based on Exposure to Facility Soil
- Table 2: Dermally Absorbed Dose for the Industrial (Construction/Trenching) Worker RME Scenario based on Exposure to Groundwater
- Table 3: CDIs and ECs for the Industrial (Construction/Trenching) Worker RME Scenario based on Exposure to Groundwater
- Table 4: CDIs for the Future Outdoor Worker RME Scenario based on Exposure to Facility Soil
- Table 5: Dermally Absorbed Doses for the Recreational User RME Scenario based on Exposure to Surface Water
- Table 6: CDIs for the Force Lake Recreational User RME Scenario based on Lifetime Exposure and for Exposure to Children Ages 0 to 6
- Table 7: CDIs for the Force Lake Fish Consumer RME Scenario

In addition, the electronic data supplement to this attachment provides the data tables, ProUCL input files, and ProUCL output files to assist in the review of UCL calculations for COPCs, as used in CDI and EC calculations.

Table 1. CDIs and ECs for the Industrial (Construction/Trenching) Worker RME Scenario based on Exposure to Facility Soil

COPC	Cancer CDI (mg/kg-day)		Cancer EC for Inhalation ($\mu g/m^3$)	Non-Cancer CDI (mg/kg-day)		Non-Cancer EC for Inhalation ($\mu g/m^3$)
	Incidental Ingestion	Dermal Absorption		Incidental Ingestion	Dermal Absorption	
Arsenic	3.8×10^{-7}	1.1×10^{-7}	5.1×10^{-9}	2.7×10^{-5}	8.0×10^{-6}	3.6×10^{-7}
Cobalt	6.0×10^{-7}	6.0×10^{-8}	8.0×10^{-9}	4.2×10^{-5}	na[a]	5.6×10^{-7}
Copper	na	na	na	8.7×10^{-4}	na[a]	1.2×10^{-5}
Naphthalene	9.2×10^{-8}	1.2×10^{-7}	6.1×10^{-7}	6.5×10^{-6}	8.4×10^{-6}	4.3×10^{-5}
cPAH TEQ	4.4×10^{-8}	5.7×10^{-8}	5.9×10^{-10}	na	na	na
Total PCBs	1.6×10^{-7}	2.2×10^{-7}	8.5×10^{-9}	1.1×10^{-5}	1.5×10^{-5}	6.0×10^{-7}
Total DDTs	5.1×10^{-7}	1.5×10^{-7}	6.8×10^{-9}	3.6×10^{-5}	1.1×10^{-5}	4.8×10^{-7}
1,1-Dichloroethane	3.1×10^{-8}	na[a]	1.4×10^{-4}	2.2×10^{-6}	na[a]	9.7×10^{-3}
1,2,4-Trimethylbenzene	na	na	na	1.7×10^{-5}	na[a]	1.1×10^{-4}
1,3,5-Trimethylbenzene	na	na	na	4.2×10^{-6}	na[a]	2.8×10^{-5}
Benzene	1.5×10^{-8}	na[a]	4.9×10^{-5}	1.1×10^{-6}	na[a]	3.4×10^{-3}
Chlorobenzene	na	na	na	7.1×10^{-7}	na[a]	2.7×10^{-3}
cis-1,2-Dichloroethene	na	na	na	2.8×10^{-5}	na[a]	8.6×10^{-2}
Dichloromethane	9.2×10^{-10}	na[a]	4.2×10^{-6}	6.5×10^{-8}	na[a]	3.0×10^{-4}
Ethylbenzene	8.8×10^{-8}	na[a]	na	6.1×10^{-6}	na[a]	4.5×10^{-3}
trans-1,2-Dichloroethene	na	na	na	1.8×10^{-5}	na[a]	8.0×10^{-2}
Trichloroethene	7.4×10^{-9}	na[a]	1.5×10^{-5}	na	na	na
Vinyl chloride	5.5×10^{-8}	na[a]	1.7×10^{-3}	3.9×10^{-6}	na[a]	1.2×10^{-1}
Total xylenes	na	na	na	3.2×10^{-5}	na[a]	3.0×10^{-2}
TPH-gasoline (aliphatic)	2.0×10^{-5}	na	1.5×10^{-1}	1.4×10^{-3}	na[a]	1.1×10^{1}

[a] No dermal absorption factor is available for this COPC. Dermal exposure for this COPC is discussed in the uncertainty analysis (Section 6.0).

CDI – chronic daily intake
COPC – contaminant of potential concern
cPAH – carcinogenic polyaromatic hydrocarbons
EC – exposure concentration
DDT – dichlorodiphenyltrichloroethane
na – not applicable
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons

Table 2. Dermally Absorbed Dose for the Industrial (Construction/ Trenching) Worker RME Scenario based on Exposure to Groundwater

COPC	Kp (cm/hr)	FA	t* (hrs)	B (ratio)	T (hrs)	ET (hrs/day)	DA_{event} (mg/cm^2-event)
Inorganic COPCs							
Arsenic	0.001	na	na	na	na	2	3.0×10^{-8}
Lead	0.0001	na	na	na	na	2	6.0×10^{-10}
Manganese	0.001	na	na	na	na	2	8.0×10^{-6}
Organic COPCs							
1,4-Dichlorobenzene	0.042	1.0	1.71	0.2	0.71	2	2.0×10^{-7}
Naphthalene	0.047	1.0	1.34	0.2	0.56	2	2.0×10^{-7}
Total DDTs	0.27	0.7	42.51	1.9	10.5	2	1.2×10^{-7}
1,2,4-Trimethylbenzene[a]	0.047	1.0	1.34	0.2	0.56	2	1.0×10^{-6}
1,3,5-Trimethylbenzene[a]	0.047	1.0	1.34	0.2	0.29	2	4.2×10^{-7}
Benzene	0.015	1.0	0.7	0.1	0.29	2	1.4×10^{-6}
Chlorobenzene	0.028	1.0	1.09	0.1	0.46	2	6.3×10^{-6}
n-Propylbenzene[b]	0.015	1.0	0.7	0.1	0.29	2	4.1×10^{-7}
tert-Butyl methyl ether	na	na	na	na	na	2	na
Vinyl chloride	0.0056	1.0	0.57	0	0.24	2	6.9×10^{-9}

Source: EPA RAGS Part E, Appendix B (EPA 2004).

[a] Naphthalene was used as a surrogate.

[b] Benzene was used as a surrogate.

B – dimensionless ratio of the permeability coefficient across the viable epidermis (ve)

COPC – contaminant of potential concern

DA_{event} – dermally absorbed dose per event

ET – exposure time

FA – fraction absorbed from water

Kp – dermal permeability coefficient of compound in water

na – not applicable or available

t* – time to reach steady state

T – lag time per event

Table 3. CDIs and ECs for the Industrial (Construction/Trenching) Worker RME Scenario based on Exposure to Groundwater

COPC	Cancer CDI (mg/kg-day)		Cancer EC for Inhalation (µg/m3)	Non-Cancer CDI (mg/kg-day)		Non-Cancer EC for Inhalation (µg/m3)
	Incidental Ingestion	Dermal Absorption		Incidental Ingestion	Dermal Absorption	
Arsenic (total)	na	2.9×10^{-8}	na[a]	na	2.1×10^{-6}	na[a]
Manganese (total)	na	na	na	na	na[b]	na[a]
Naphthalene	na	1.9×10^{-7}	2.8×10^{-10}	na	1.4×10^{-5}	1.9×10^{-8}
1,4-Dichlorobenzene	na	1.9×10^{-7}	1.7×10^{-9}	na	1.4×10^{-5}	1.2×10^{-7}
Total DDTs	na	1.1×10^{-7}	1.5×10^{-12}	na	8.0×10^{-6}	1.1×10^{-10}
1,2,4-Trimethylbenzene	na	na	na	na	na[b]	4.3×10^{-7}
1,3,5-Trimethylbenzene	na	na	na	na	na[b]	1.8×10^{-7}
Benzene	na	na[b]	4.8×10^{-8}	na	na[b]	3.4×10^{-6}
Chlorobenzene	na	na	na	na	na[b]	6.3×10^{-6}
n-Propylbenzene	na	na	na	na	na[b]	7.4×10^{-7}
tert-Butyl methyl ether	na	na[b]	2.9×10^{-8}	na	na[b]	2.1×10^{-6}
Vinyl chloride	na	na[b]	8.1×10^{-11}	na	na[b]	5.7×10^{-9}

[a] This COPC is not expected to volatilize significantly because of its diffusivity in air or water, and thus risks based on inhalation are not assessed here.

[b] No dermal absorption factor is available for this COPC. Dermal exposure for this COPC is discussed in the uncertainty analysis (Section 6.0).

CDI – chronic daily intake

COPC – contaminant of potential concern

DDT – dichlorodiphenyltrichloroethane

EC – exposure concentration

na – not applicable

RME – reasonable maximum exposure

Table 4. CDIs for the Future Outdoor Worker RME Scenario based on Exposure to Facility Soil

COPC	Cancer CDI (mg/kg-day)		Cancer EC for Inhalation ($\mu g/m^3$)	Non-Cancer CDI (mg/kg-day)		Non-Cancer EC for Inhalation ($\mu g/m^3$)
	Incidental Ingestion	Dermal Absorption		Incidental Ingestion	Dermal Absorption	
Arsenic	3.8×10^{-6}	3.8×10^{-7}	6.8×10^{-7}	1.1×10^{-5}	1.1×10^{-6}	1.9×10^{-6}
Cobalt	na	na	na	1.4×10^{-5}	na[a]	2.4×10^{-6}
Copper	na	na	na	1.5×10^{-4}	na[a]	2.6×10^{-5}
Naphthalene	na	na	na	2.5×10^{-6}	1.1×10^{-6}	2.2×10^{-4}
cPAH TEQ	3.8×10^{-7}	1.6×10^{-7}	6.8×10^{-7}	na	na	na
Total PCBs	1.8×10^{-6}	8.4×10^{-7}	1.3×10^{-6}	5.1×10^{-6}	2.4×10^{-6}	3.6×10^{-6}
Total DDTs	5.6×10^{-6}	5.5×10^{-7}	9.9×10^{-7}	1.6×10^{-5}	1.5×10^{-6}	2.8×10^{-6}
1,1-Dichloroethane	2.4×10^{-7}	na[a]	1.4×10^{-2}	6.7×10^{-7}	na[a]	3.9×10^{-2}
1,2,4-Trimethylbenzene	na	na	na	1.3×10^{-5}	na[a]	1.1×10^{-3}
1,3,5-Trimethylbenzene	na	na	na	2.9×10^{-6}	na[a]	2.5×10^{-4}
Benzene	1.8×10^{-7}	na[a]	7.6×10^{-3}	5.0×10^{-7}	na[a]	2.1×10^{-2}
cis-1,2-Dichloroethene	na	na	na	1.3×10^{-4}	na[a]	$5.0 \times 10^{+0}$
Dichloromethane	1.6×10^{-8}	na[a]	9.8×10^{-4}	4.6×10^{-8}	na[a]	2.7×10^{-3}
Ethylbenzene	1.1×10^{-6}	na[a]	1.1×10^{-2}	3.0×10^{-6}	na[a]	3.0×10^{-2}
trans-1,2-Dichloroethene	na	na	na	5.4×10^{-6}	na[a]	3.2×10^{-1}
Trichloroethene	9.4×10^{-8}	na[a]	2.5×10^{-3}	na	na	na
Vinyl chloride	4.2×10^{-7}	na[a]	1.7×10^{-1}	1.2×10^{-6}	na[a]	4.8×10^{-1}
Total xylenes	na	na	na	1.6×10^{-5}	na[a]	1.9×10^{-1}
TPH-gasoline (aliphatic)	2.3×10^{-4}	na[a]	1.5×10^{1}	6.5×10^{-4}	na[a]	4.3×10^{1}

[a] No dermal absorption factor is available for this COPC. Dermal exposure for this COPC is discussed in the uncertainty analysis (Section 6.0).

CDI – chronic daily intake
COPC – contaminant of potential concern
cPAH – carcinogenic polyaromatic hydrocarbons
DDT – dichlorodiphenyltrichloroethane
na – not applicable
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons

Table 5. Dermally Absorbed Doses for the Recreational User RME Scenario based on Exposure to Surface Water

COPC	Age Group	Kp (cm/hr)	ET (hrs/day)	DA_{event} (mg/cm^2-event)
Arsenic (total)	child (aged 0 to 6)	0.001	1.7	2.0×10^{-9}
Arsenic (total)	older child (aged 7 to 16)	0.002	2.35	2.8×10^{-9}
Arsenic (total)	Adult (aged 17 to 30)	0.002	3.3	4.0×10^{-9}

Source: EPA RAGS Part E, Appendix B (EPA 2004).

COPC – contaminant of potential concern
DA_{event} – dermally absorbed dose per event
ET – exposure time
Kp – dermal permeability coefficient of compound in water

Table 6. CDIs for the Force Lake Recreational User RME Scenario based on Lifetime Exposure and for Exposure to Children Ages 0 to 6

COPC	Lifetime Exposure (aged 0 to 30)				Children (aged 0 to 6)	
	Cancer CDI (mg/kg-day)		Non-Cancer CDI (mg/kg-day)		Non-Cancer CDI (mg/kg-day)	
	Incidental Ingestion	Dermal Absorption	Incidental Ingestion	Dermal Absorption	Incidental Ingestion	Dermal Absorption
Wetland Soil						
Aluminum	na	na	3.7×10^{-3}	na[a]	1.1×10^{-2}	na[a]
Antimony	na	na	3.4×10^{-7}	na[a]	9.9×10^{-7}	na[a]
Arsenic	1.3×10^{-6}	1.5×10^{-7}	3.0×10^{-6}	3.6×10^{-7}	8.6×10^{-6}	5.2×10^{-7}
Chromium	na	na	1.1×10^{-5}	na[a]	3.3×10^{-5}	na[a]
Cobalt	na	na	3.7×10^{-6}	na[a]	1.1×10^{-5}	na[a]
Copper	na	na	5.0×10^{-5}	na[a]	1.4×10^{-4}	na[a]
Iron	na	na	1.8×10^{-2}	na[a]	5.1×10^{-2}	na[a]
Manganese	na	na	3.4×10^{-4}	na[a]	9.9×10^{-4}	na[a]
Vanadium	na	na	2.4×10^{-5}	na[a]	6.8×10^{-5}	na[a]
Naphthalene	na	na	2.0×10^{-7}	1.0×10^{-7}	5.7×10^{-7}	1.5×10^{-7}
cPAH TEQ	1.5×10^{-7}	7.7×10^{-8}	na	na	na	na
Total PCBs	1.0×10^{-7}	5.8×10^{-8}	2.4×10^{-7}	1.3×10^{-7}	6.9×10^{-7}	1.9×10^{-7}
Total DDTs	1.2×10^{-6}	1.5×10^{-7}	2.8×10^{-6}	3.4×10^{-7}	8.2×10^{-6}	4.9×10^{-7}
Benzene	1.0×10^{-9}	na[a]	2.4×10^{-9}	na[a]	6.9×10^{-9}	na[a]
Trichloroethene	1.0×10^{-9}	na[a]	na	na	na	na
TPH-gasoline (aliphatic)	na	na	7.8×10^{-6}	na[a]	2.2×10^{-5}	na[a]
TPH-diesel (aliphatic)	na	na	2.4×10^{-4}	na[a]	7.0×10^{-4}	na[a]
Lake Sediment						
Arsenic	8.5×10^{-7}	1.0×10^{-7}	2.0×10^{-6}	2.4×10^{-7}	5.7×10^{-6}	3.4×10^{-7}
Chromium	na	na	9.3×10^{-6}	na[a]	2.7×10^{-5}	na[a]
Cobalt	na	na	4.3×10^{-6}	na[a]	1.3×10^{-5}	na[a]
Vanadium	na	na	2.1×10^{-5}	na[a]	6.0×10^{-5}	na[a]
cPAH TEQ	1.1×10^{-8}	5.6×10^{-9}	na	na	na	na
TPH-gasoline (aliphatic)	na	na	1.1×10^{-5}	na[a]	3.1×10^{-5}	na[a]
Lake Surface Water						
Arsenic (total)	9.3×10^{-8}	8.1×10^{-9}	2.2×10^{-7}	1.9×10^{-8}	4.6×10^{-7}	1.8×10^{-8}

[a] No dermal absorption factor is available for this COPC. Dermal exposure for this COPC is discussed in the uncertainty analysis (Section 6.0).

CDI – chronic daily intake
COPC – contaminant of potential concern
cPAH – carcinogenic polyaromatic hydrocarbons
DDT – dichlorodiphenyltrichloroethane
na – not applicable
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons

Table 7. CDIs for the Force Lake Fish Consumer RME Scenario

COPC	Fish Tissue Consumption CDIs (mg/kg-day)		
	Lifetime Exposure		Child (age 0 to 6)
	Cancer CDI	Non-Cancer CDI	Non-Cancer CDI
Arsenic	5.0×10^{-6}	1.2×10^{-5}	1.7×10^{-5}
Barium	na	3.0×10^{-3}	4.5×10^{-3}
Cadmium	na	2.3×10^{-5}	3.4×10^{-5}
Cobalt	na	2.1×10^{-4}	3.1×10^{-4}
Copper	na	1.2×10^{-3}	1.7×10^{-3}
Mercury	na	1.1×10^{-6}	1.6×10^{-6}
Nickel	na	4.1×10^{-4}	6.0×10^{-4}
Vanadium	na	1.0×10^{-3}	1.5×10^{-3}
Zinc	na	5.3×10^{-3}	7.8×10^{-3}
Total PCBs	7.5×10^{-6}	1.7×10^{-5}	2.6×10^{-5}
Total DDTs	6.8×10^{-6}	1.6×10^{-5}	2.3×10^{-5}

CDI – chronic daily intake
COPC – contaminant of potential concern
DDT – dichlorodiphenyltrichloroethane
na – not applicable
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure

References

EPA. 2004. Risk assessment guidance for Superfund: volume 1—Human health evaluation manual (Part E, supplemental guidance for dermal risk assessment). Final, July 2004. EPA/540/R/99/005. Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC.

ATTACHMENT 6 – TOXICOLOGICAL PROFILES FOR CONTAMINANTS OF POTENTIAL CONCERN

The following sections provide toxicological information for each of the contaminants that were identified as COPCs in this human health risk assessment (HHRA). The toxicity values used in this risk assessment are in bold type. Toxicity information was obtained primarily from:

- US Environmental Protection Agency (EPA's) Integrated Risk Information System (IRIS) (EPA 2006b)
- EPA's 1997 Health Effects Summary Tables (HEAST) (EPA 1997b)
- Toxicological profiles presented in *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories* (EPA 2000)
- EPA's Office of Ground Water and Drinking Water (OGWDW) (EPA 2006)
- Agency for Toxic Substance and Disease Registry (ATSDR; 2006e)
- ToxFAQs (ATSDR 2006a)
- Hazardous Substance Data Bank (HSDB) (TOXNET 2006)

Since quantitative estimates of toxicity potential have been developed by EPA and other agencies, it is necessary to establish a hierarchy to determine which toxicity values should be used. EPA (2003) has developed a hierarchical order of toxicity values for use in HHRAs:

- Tier 1 – EPA's IRIS
- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs), Office of Research and Development/National Center for Environmental Assessment
- Tier 3 – Other toxicity values. Tier 3 includes additional EPA and non-EPA sources of toxicity information. Priority is given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed. Sources include EPA Regional offices, EPA HEAST values, Cal/EPA, and ATSDR minimal risk levels (MRLs)

Online versions of IRIS, HSDB, and ToxFAQs are cited by acronym only in the sections below. These databases were accessed between February and April 2006. Other citations are presented in standard form. The carcinogenic evaluation of chemicals by the International Agency for Research on Cancer (IARC) and toxicity evaluations by the National Center for Environmental Assessment (NCEA, a division of EPA), as cited in other documents, are also referred to by their acronyms.

Toxicological Profiles

Toxicological profiles for COPCs indentified in this HHRA are provided in this section. These profiles include information concerning the COPC's pharmacokinetics, acute toxicity, chronic toxicity, and carcinogenicity.

1. 1,1-Dichloroethane

1,1-Dichloroethane is manufactured and does not exist naturally in the environment. 1,1-Dichloroethane was formerly used as a surgical anesthetic but is not currently used for this purpose (ATSDR 1990a). 1,1-Dichloroethene is currently used in the fabrication of other chemicals and to dissolve substances such as paint, varnish, and finish removers. It is also used to remove grease (ATSDR 1990a).

Acute Toxicity

There is very little information on the acute effects of 1,1-dichloroethane but during use as a surgical anesthetic, effects on the heart were reported, such as irregular heartbeats (ATSDR 1990a).

Chronic Toxicity

1,1-Dichloroethane has been found to cause kidney disease in animals after long-term exposure to elevated levels in the air. Delayed growth was also observed in the offspring of animals who were exposed to 1,1-dichloroethane in the air during pregnancy (ATSDR 1990a). EPA's PPRTV provides an **RfD for 1,1-dichloroethane of 0.2 mg/kg-day.** RAIS provides an inhalation **RfC for 1,1-dichloroethane of 0.5 mg/m^3.**

Carcinogenicity

1,1-Dichloroethane has been found to cause cancer in rats and mice when fed large doses throughout their lifetime (ATSDR 1990a). EPAs IRIS has classified 1,1-dichloroethane as a possible (Group C) human carcinogen. California EPA has established an **oral cancer slope of 0.0057 kg/mg-day^{-1}** and an **inhalation unit risk of 1.60E-06 (µg/m^3)$^{-1}$.**

2. 1,2,4-Trimethylbenzene and 1,3,5-Trimethylbenzene

Acute Toxicity

Exposure to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene can cause irritation of the eyes, skin, and respiratory tract; and can cause effects on the central nervous system. Ingestion of 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene can cause chemical pneumonitis (NIOSH 2004, 2005).

Chronic Toxicity

Long term exposure to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene may result in chronic bronchitis and may have effects on the central nervous system and blood (NIOSH 2004, 2005).

EPA's PPRTV provides an **RfD for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene of 0.05 mg/kg-day.**

EPA's PPRTV provides an **RfC for 1,3,5-trimethylbenzene of 0.006 mg/m^3.** IRIS provides an **RfC for 1,2,4-trimethylbenzene of 0.007 mg/m^3.**

Carcinogenicity

The carcinogenicity of 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene is not well documented. RAIS has identified 1,3,5-trimethylbenzene as not classifiable as to human carcinogenicity (Group D).

3. 1,4-Dichlorobenzene

1,4-Dichlorobenzene is currently used as a restroom or garbage deodorant and for moth control. It has also been used as an insecticide on fruits and as a method of control for mold and mildew on tobacco seeds, leather and fabrics. 1,4-Dichlorobenzene has a strong odor of moth-balls and typically sublimes at room temperatures. 1,4-Dichlorobenzene is also an important component in the fabrication of resins (ATSDR 2006b).

Acute Toxicity

Inhaling 1,4-dichlorobenzene at very high concentrations can cause irritation to and burning in the eyes and nose. Inhalation may also cause tearing of the eyes, coughing, difficult breathing, and an upset stomach. One study reported a decrease in lung function after inhalation. High levels of 1,4-dichlorobenzene have also been reported to cause dizziness, headaches, and liver problems. Inhalation or ingestion of 1,4-dichlorobenzene has been found to cause liver problems in test animals (ATSDR 2006b).

Chronic Toxicity

Inhalation or ingesting 1,4-dichlorobenzene over a lifetime has been found to cause liver cancer in mice. Humans who ingested 1,4-dichlorobenzene regularly over time were found to develop skin blotches and problems with red blood cells such as anemia (ATSDR 2006b). ATSDR provides an **RfD for 1,4-dichlorobenzene of 0.07 mg/kg-day**. EPAs IRIS provides an **RfC of 0.8 mg/m^3**.

Carcinogenicity

1,4-Dichlorobenzene has been found to cause liver cancer in test animals when ingested (ATSDR 2006b). RAIS classifies 1,4-dichlorobenzene as a possible (Group C) human carcinogen. California EPA has established an **oral cancer slope factor of 5.40E-03 kg/mg-day^{-1}** and an **inhalation unit risk of 0.00001 (µg/m^3)$^{-1}$.**

4. Aluminum

Aluminum is the most abundant metal and the third most abundant element, after oxygen and silicon, in the earth's crust. It is widely distributed and constitutes approximately 8% of the earth's surface layer. However, aluminum is a very reactive element and is never found as free metal in nature. It is found combined with other elements, most commonly with oxygen, silicon, and fluorine. High concentrations in the environment can be caused by the mining and processing of its ores and by the production of aluminum metal, alloys, and compounds. Small amounts of aluminum are released into the environment from coal-fired power plants and incinerators (ATSDR 1999a).

Acute Toxicity

Low-level exposure to aluminum from food, air, water, or contact with skin is not thought to harm your health (ATSDR 1999a). Aluminum, however, is not a necessary substance for our bodies and too much may be harmful. People who are exposed to high levels of aluminum in air may have respiratory problems including coughing and asthma from breathing dust.

Chronic Toxicity

Some studies show that people with Alzheimer's disease have more aluminum than usual in their brains. Data are inconclusive on whether aluminum causes the disease or whether the buildup of aluminum happens to people who already have the disease. Aluminum is known to cause additional neurological problems such as memory loss and impaired motor skills. Infants and adults who received large doses of aluminum as a treatment for another problem developed bone diseases, which suggests that aluminum may cause skeletal problems. Some sensitive people develop skin rashes from using aluminum chlorohydrate deodorants (ATSDR 1999a). EPA's PPRTV provides an **RfD for aluminum of 1 mg/kg-day** (EPA 2004).

Carcinogenicity

EPA has not conducted a complete evaluation and determination of the carcinogenicity of aluminum (IRIS). Available data suggest that this element is not carcinogenic (ATSDR 1999a). RAIS has identified aluminum as not classifiable as to human carcinogenicity (Group D).

5. Antimony

Antimony is naturally present in the earth's crust. The release of antimony into the environment occurs primarily through anthropogenic sources such as non-ferrous metal mining, smelting, refining, and production, the use and disposal of antimony alloys and compounds, coal combustion, and refuse and sludge combustion. Antimony exposure occurs through inhalation, ingestion of food containing antimony, and through dermal contact (IRIS).

Acute Toxicity

Violent vomiting, diarrhea, lowered respiratory rate, myocardial edema, hyperemia, and capillary engorgement are major results of acute exposure to antimony. Seventy people became acutely ill after ingesting lemonade containing 0.013% antimony. Fifty-six of the victims were treated for burning stomach pains, colic, nausea, and vomiting. Most recovered after approximately three hours, while some required hospitalization for a few days (IRIS).

Chronic Toxicity

Dyspnea, weight and hair loss, popular eruptions on the skin, jaundice, damage to the heart and liver, and spleen, kidney damage, abnormal increase in erythrocytes, and a decrease in leukocytes are reported from long-term exposure to antimony. Chronic inhalation results in damage to the lungs, liver and heart (HSDB). EPA developed an **RfD for antimony of 0.0004 mg/kg-day** based on a study in which rats were exposed to potassium antimony tartrate hemi.

Carcinogenicity

EPA has not conducted a complete evaluation and determination of the carcinogenicity of antimony (IRIS).

6. Arsenic

Arsenic is a naturally occurring element in the earth's crust that is usually found combined with other elements. Arsenic combined with elements such as oxygen, chlorine, and sulfur is referred to as inorganic arsenic; arsenic combined with carbon and hydrogen is referred to as organic arsenic. Arsenic in seafood is more commonly in the organic form (EPA 1997a). Most of the common organic forms, such as arsenobetaine and arsenocholine, are non-toxic, but other forms that may also occur to some extent, such as dimethylated and monomethylated arsenic acids, are more toxic (EPA 1997a). Some seafood may also contain arseno-sugars, which may be metabolized to dimethyl arsenic (ICF Kaiser 1996).

Acute Toxicity

Arsenicals have been recognized as a human poison since ancient times, and large doses, approximately 600 µg/kg-day or higher, taken orally have resulted in death (EPA 2000). Oral exposure to lower levels of arsenic has resulted in effects on the gastrointestinal system (nausea, vomiting); central nervous system (headaches, weakness, delirium); cardiovascular system (hypotension, shock); and the liver, kidney, and blood (anemia, leucopoenia). Because significant information is available on the acute effects of arsenic poisoning in humans, few animal studies have been carried out. The limited available data have shown arsenic to have low to moderate acute toxicity to animals, based on LD50s between 50 and 5,000 mg/kg (ATSDR 2005a).

Chronic Toxicity

The primary effects noted in humans from chronic exposure to arsenic are effects on the skin. Oral exposure has resulted in a pattern of skin changes that include the formations of warts or corns on the palms and soles, along with areas of darkened skin on the face, neck, and back (EPA 2000). Blackfoot disease, a disease characterized by a progressive loss of circulation in the hands and feet, leading ultimately to necrosis and gangrene, is associated with arsenic (ATSDR 2005a). Other effects noted from chronic oral exposure include peripheral neuropathy, cardiovascular disorders, and liver and kidney disorders.

EPA's IRIS database provides an **RfD for inorganic arsenic of 0.0003 mg/kg-day**, based on a no observed adverse effects level (NOAEL) (adjusted to include arsenic exposure from food) of 0.0008 mg/kg-day. The RfD was based on two studies that showed that the prevalence of blackfoot disease increased with both age and dose for individuals exposed to high levels of arsenic in drinking water. California EPA also provides an **RfC of 0.000015 mg/m^3.**

Carcinogenicity

There is clear evidence that chronic exposure of humans to inorganic arsenic increases the risk of cancer. Ingestion of arsenic has been associated with an increased risk of non-melanoma skin cancer, and bladder, liver, and lung cancer. In addition, studies have reported that inhalation of arsenic results in an increased risk of lung cancer (EPA 2000). Dimethyl arsenic may be a promoter of

various forms of cancer in rats and mice (Kenyon and Hughes 2001). EPA has classified inorganic arsenic in Group A—Known Human Carcinogen, based on the increased incidence in humans of lung cancer through inhalation exposure and the increased risk of skin, bladder, liver, and lung cancer through drinking water exposure.

The **oral cancer slope factor for arsenic is 1.5 mg/kg-day^{-1}** (IRIS). EPA used data from Taiwan concerning skin cancer incidence, age, and level of exposure via drinking water. In 37 villages that had obtained drinking water for 45 years from artesian wells with various elevated levels of arsenic, 40,421 individuals were examined for hyperpigmentation, keratosis, skin cancer, and blackfoot disease. The local well waters were analyzed for arsenic, and the age-specific cancer prevalence rates were correlated with both local arsenic concentrations and duration of exposure. **EPAs IRIS database also identifies an inhalation unit risk of 0.0043 (µg/m^3)$^{-1}$**.

7. Barium

Barium metal does not occur in nature. The most common barium ores are sulfate, barite, carbonate, and witherite. The largest use of barium is in the removal of traces of gases from vacuum and television picture tubes. Barium is released into the environment through the disposal of drilling waste, copper smelting, manufacture of motor vehicle parts, combustion of coal and oil, and the mining, refining, and production of barium and barium-based chemicals (OGWDW).

Acute Toxicity

Exposure to large quantities of barium can cause gastrointestinal disturbances and muscular weakness. No Health Advisories have been established for short-term exposure to barium (OGWDW).

Chronic Toxicity

Chronic exposure to barium can cause hypertension (ODWDW). Populations with pulmonary diseases are especially at risk. Barium is not considered an industrial health hazard (HSDB). EPA has established an oral **RfD for barium of 0.2 mg/kg-day (IRIS)**.

Carcinogenicity

No suitable bioassays or epidemiological studies are available to assess the carcinogenicity of barium (IRIS). EPA has placed barium in weight-of-evidence group D, not classifiable as to human carcinogenicity.

8. Benzene

Benzene is widely used in the Untied States and can be made from natural processed or as a result of human activity. Benzene is used to make lubricants, dyes, detergents, drugs, pesticides, rubbers, plastics, resins, nylon, and other synthetic fibers. Benzene is found in emissions from volcanoes and forest fires. It is also found in crude oil, gasoline, and cigarette smoke.

Acute Toxicity

Inhalation of benzene can cause drowsiness, dizziness, and unconsciousness. Inhalation of high volumes can cause death, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Ingestion can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate and death (ATSDR 2007b).

Chronic Toxicity

Long term exposure to benzene has been found to cause effects on the bone marrow and anemia and leukemia. Benzene can reduce the amount of red blood cells and can cause excessive bleeding. Benzene can also affect the immune system. Women who inhaled benzene over time were found to have irregular menstrual periods and a decrease in ovary size, although it is not certain that benzene was the cause of the effects (ATSDR 2007b). EPAs IRIS database provides an **RfD for benzene of 0.004 mg/kg-day and an RfC of 0.03 mg/m^3**.

Carcinogenicity

Long term exposure has been found to cause acute myelogenous leukemia, a cancer of the blood-forming organs (ATSDR 2007b). EPA has classified benzene as a human carcinogen (Class A). EPAs IRIS database provides an **oral cancer slope factor of 0.055 kg/mg-day^{-1} and an inhalation unit risk of 7.80E-06 (µg/m^3)$^{-1}$**.

9. Cadmium

Cadmium is a heavy metal that is released through a wide variety of industrial and agricultural activities. The accumulation of cadmium in human and other biological tissue has been evaluated in both epidemiological and toxicological studies. ATSDR (1999b) has determined that exposure conditions of most concern are long-term exposure to elevated levels in the diet.

Acute Toxicity

Effects of acute oral exposure to cadmium include gastrointestinal irritation, nausea, vomiting, abdominal pain, cramps, salivation, and diarrhea. Lethal doses in humans caused massive fluid loss, edema, and widespread organ destruction. The ingested doses were 25 and 1,500 mg/kg (ATSDR 1999b; FDA 1993).

Chronic Toxicity

Kidney toxicity is the main concern with cadmium exposure, with the critical effect being significant proteinuria (an indicator of kidney toxicity). The **RfD for cadmium in food was calculated to be 0.001 mg/kg-day** (IRIS). The RfD was calculated using a toxicokinetic model to determine the highest level of cadmium in the human renal cortex not associated with significant proteinuria (EPA 2000).

Cadmium causes many other types of toxic effects in addition to kidney toxicity, such as reducing the gastrointestinal uptake of iron, bone disorders, and increased calcium excretion. Some human studies have shown cardiovascular toxicity and elevated blood pressure, but the results are conflicting (ATSDR 1999b). In addition, animal studies indicate that cadmium causes a wide variety of alterations in the function of the immune system.

Carcinogenicity

No animal or human oral exposure studies suggest that cadmium is carcinogenic via the oral exposure route, although cadmium is classified as a probable human carcinogen (B1) by EPA based on inhalation studies in humans (EPA 2000). ATSDR has concluded that there is minimal evidence of an association between cadmium exposure and increased cancer risk in humans but that the statistical power of the studies examined to detect an effect was not high. They determined that neither the human nor the animal studies provided enough evidence to agree on the carcinogenic status of cadmium by the oral route (ATSDR 1999b).

10. cPAH TEQ

PAHs are a group of organic chemicals that have a fused ring structure of two or more benzene rings, and are formed during the incomplete combustion of organic materials. Industrial activities which produce PAHs include: coal coking, production of carbon blacks, creosote, coal tar, petroleum refining, synfuel production from coal, and the use of Soderberg electrodes in aluminum smelters and ferrosilicum and iron works (EPA 2000). Domestic activities which produce PAHs include: cigarette smoke, burning of wood and fossil fuels, waste incineration, broiling and smoking foods, and the use of combustion engines. Benzo(a)pyrene is the PAH with the most available health effects data.

Acute Toxicity

There are little data describing acute toxicity of PAHs after inhalation, oral, or dermal exposure in humans or animals. However, benzo(a)pyrene is fatal to mice following ingestion, and the liver and the skin have been identified as target organs in animals after oral or dermal exposure, respectively (ATSDR 1995). The intraperitoneal LD50 values (injected dose which kills ½ of the animals being tested) in mice for pyrene, anthracene, and benzo(a)pyrene are 514, >430, and 232 mg/kg, respectively.

Chronic Toxicity

PAHs have a high chronic exposure toxicity characterized by chronic dermatitis and hyperkeratosis (ATSDR 1995). Chronic studies in animals exposed to PAHs via ingestion, intratracheal installation, or skin-painting have not as yet identified adverse health effects other than cancer. RfDs have not been developed for any of the carcinogenic PAHs being evaluated in this Phase 1 HHRA.

Carcinogenicity

Occupational studies of workers exposed to mixtures containing PAHs have shown that mixtures of PAHs are carcinogenic to humans. Cancer associated with exposure to PAH containing mixtures in humans occurs mainly in the lung and skin following inhalation and dermal exposure.

The EPA and California EPA describe the cancer causing ability of individual cPAHs relative to the cancer causing ability of a reference compound, benzo(a)pyrene (EPA 1993; California EPA 1994). This approach is described in greater detail in Sections B.2.2 and B.4 of the risk assessment. The oral cancer slope factor developed by EPA for carcinogenicity of benzo(a)pyrene is **7.3 mg/kg-day^{-1}** (IRIS). EPA has classified benzo(a)pyrene as a probable human carcinogen (B2) based on observations of significant dose-related increases in

multiple studies of rats and mice of both sexes (IRIS). The oral cancer potency factor was applied to the sum of cPAHs, using the PEFs described in Section B.2.2.

11. Chlorobenzene

Chlorobenzene is manufactured and does not exist naturally in the environment. Production of chlorobenzene reached its peak in 1960 and has declined by more than half. Chlorobenzene was used in the fabrication of other chemicals such as phenol and DDT. It is currently used as solvent for pesticides, as a degreaser and is used to make other chemicals (ATSDR 1990b).

Acute Toxicity

Inhalation of high levels of chlorobenzene may cause headaches, nausea, sleepiness, numbness, and vomiting. It is not certain that chlorobenzene is the cause of these symptoms because the study involved workers who may have been exposed to other chemicals at the same time. Animal studies have found that chlorobenzene affects the liver, kidney, and the central nervous system. Inhalation can cause unconsciousness, tremors, restlessness, and death (ATSDR 1990b).

Chronic Toxicity

Exposure over time to chlorobenzene has been found to cause liver and kidney damage (ATSDR 1990b). EPAs IRIS database provides an **RfD for chlorobenzene of 0.02 mg/kg-day** and EPAs PPRTV database provides an **RfC of 0.05 mg/m^3**.

Carcinogenicity

Chlorobenzene has been found to cause the production of liver nodules in male rats which can lead to cancer. It is not known whether chlorobenzene causes cancer in humans (ATSDR 1990b). EPAs IRIS database identifies chlorobenzene as not classifiable as to human carcinogenicity (Group D).

12. Chromium

Trivalent chromium is naturally occurring with low toxicity. Hexavalent chromium, however, is released into the environment through industrial emissions and is highly toxic due to its strong oxidation characteristics and membrane permeability. Hexavalent chromium is used in chromate manufacturing, ferrochromium industries, and in metal alloys (HSDB). Because there is no evidence to suggest that hexavalent chromium is present at the Study Area, toxicity values used in this HHRA are based on trivalent chromium.

Acute Toxicity

The acute toxic effects of hexavalent chromium were studied in 1965 when 155 people were exposed to 20 mg/L hexavalent chromium in their drinking water. The victims suffered from mouth sores, diarrhea, stomachaches, indigestion, vomiting, increased white blood cell counts, and a higher per capita cancer rate. Acute exposure to hexavalent chromium may also affect fetal development. Dermal exposure to hexavalent chromium can cause skin irritation and allergic contact dermatitis (IRIS).

Chronic Toxicity

Chronic exposure to chromium can cause damage to the liver, kidney, and circulatory system, as well as cause nerve tissue damage and dermatitis (OGWDW). **EPA has developed RfDs of 1.5 and 0.003 mg/kg-day for trivalent and hexavalent chromium, respectively** (IRIS). The RfD for trivalent chromium will be applied to all chromium data in this HHRA as discussed above.

Carcinogenicity

EPA has classified trivalent chromium as Group D, not classifiable as to human carcinogenicity. Hexavalent chromium is a Group A known human carcinogen via the inhalation pathway (IRIS).

13. cis-1,2-Dichloroethene and trans-1,2-Dichloroethene

1,2- Dichloroethene has two isomers; *cis*-1,2-dichloroethene and *trans*-1,2-dichloroethene. 1,2- Dichloroethene is currently used to produce solvents and is also used in chemical mixtures (ATSDR 1996a).

Acute Toxicity

Inhalation of 1,2- dichloroethene can cause nausea, drowsiness, fatigue and death. Animal studies found that inhalation of high levels of *trans*-1,2-dichloroethene caused liver and lung damage. Inhalation of very high levels caused heart damage in animals. Ingestion of high levels of 1,2- Dichloroethene caused death in animals. Lower levels of *cis*-1,2-dichloroethene caused a decrease in the count of red blood cells and had effects on the live (ATSDR 1996a).

Chronic Toxicity

There is limited information on the long term effects of exposure to 1,2-dichloroethene. One animal study found that exposure may cause a decrease in fetus growth. EPAs PPRTV database provides an **RfD for cis-1,2-dichlororethene of 0.01 mg/kg-day**. EPAs IRIS database provides an **RfD for trans-1,2-dichloroethene of 0.02 mg/kg-day**. EPAs PPRTV database provides an **RfC for trans-1,2-dichloroethene of 0.06 mg/m^3.**

Carcinogenicity

EPAs IRIS database has identified cis-1,2-dichlororethene as not classifiable as to human carcinogenicity (Group D).

14. Cobalt

Cobalt occurs naturally in elemental form and is found in rocks, soil, water, plants, and animals. Cobalt is part of vitamin B12, which is beneficial to humans. Cobalt is currently used to produce alloys which are used to manufacture aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints. Cobalt can also be used to add color to glass, ceramics and paints, and is also used as a drier for porcelain enamel and paints. Radioactive cobalt is used to sterilize medical equipment and other products, radiation therapy for treating cancer patients, manufacturing plastics, irradiating food and in medical and scientific research (ATSDR 2004a).

Acute Toxicity

Cobalt has been found to affect the lungs and heart and can cause dermatitis. Cobalt affected the liver and kidneys of animals exposed to high levels of cobalt. Radioactive cobalt can cause cell damage if exposed to high levels. Radioactive cobalt can also cause nausea, vomiting, diarrhea, bleeding, coma, and even death but these symptoms are not common (ATSDR 2004a).

Chronic Toxicity

The chronic toxicity of cobalt is not well documented. EPAs PPRTV provides an **RfD for cobalt of 0.0003 mg/kg-day and an RfC of 6.0E-6 mg/m^3**.

Carcinogenicity

Cobalt has been found to cause cancer in animals that inhaled cobalt and in animals that had cobalt placed in the muscle or under the skin. Ingestion of cobalt has not been linked to cancer. High levels of radioactive cobalt has been found to alter the genetic material in cells and could result in cancer (ATSDR 2004a). RAIS classifies cobalt as a probable (Group B1) human carcinogen.

15. Copper

Copper occurs naturally in elemental form and as a component of many minerals. Because of its high electrical and thermal conductivity, it is widely used in the manufacture of electrical equipment. Common copper salts, such as the sulfate, carbonate, cyanide, oxide, and sulfide are used as fungicides, as components of ceramics and pyrotechnics, for electroplating, and for numerous other industrial applications (Faust 1992). Copper can be absorbed by the oral, inhalation, and dermal routes of exposure.

Acute Toxicity

In humans, ingestion of gram quantities of copper salts may cause gastrointestinal, hepatic, and renal effects with symptoms such as severe abdominal pain, vomiting, diarrhea, hemolysis, hepatic necrosis, hematuria, proteinuria, hypotension, tachycardia, convulsions, coma, and death (Faust 1992). Acute inhalation exposure to copper dust or fumes at concentrations of 0.075 to 0.12 mg Cu/m^3 may cause metal fume fever with symptoms such as cough, chills, and muscle ache (Faust 1992). Among the reported effects in workers exposed to copper dust are gastrointestinal disturbances, headache, vertigo, drowsiness, and increase in liver size.

Chronic Toxicity

Gastrointestinal disturbances and liver toxicity have resulted from long-term exposure to drinking water containing 2.2 to 7.8 mg Cu/L (Faust 1992). The chronic toxicity of copper has been characterized in patients with Wilson's disease, a genetic disorder causing copper accumulation in tissues. Vineyard workers chronically exposed to Bordeaux mixture (copper sulfate and lime) exhibit degenerative changes of the lungs and liver. Dermal exposure to copper may cause contact dermatitis in some individuals (ATSDR 2004b). Additionally, high levels of copper are known to cause kidney and liver damage (ATSDR 2004b).

EPA has not developed an oral RfD for elemental copper. EPA's HEAST proposed a provisional value of **0.04 mg/kg-day** (EPA 2005). Provisional RfDs have greater uncertainty than RfDs certified by EPA.

Carcinogenicity

No suitable bioassays or epidemiological studies are available to assess the carcinogenicity of copper (Faust 1992). EPA has placed copper in weight-of-evidence group D, not classifiable as to human carcinogenicity.

16. DDTs

DDT is an organochlorine pesticide that has not been marketed in the United States since 1972 but is ubiquitous due to its widespread use in previous decades and its relatively long half-life. DDT's close structural analogs, DDE and DDD, are metabolites of DDT and have also been formulated as pesticides in the past (EPA 2000). DDT is very widely distributed; it has been found in wildlife all over the world and in many human samples as well.

Although some use of DDT continues throughout the tropics, it remains of human health concern in the United States primarily due to its presence in water, soil, and food. Because individuals are typically exposed to a mixture of DDE, DDT, and DDD and their degradation and metabolic products, the sum of the 4,4' and 2,4' isomers of DDT, DDE, and DDD will be evaluated together in this HHRA.

Acute Toxicity

The low effect dose for severe effects (acute pulmonary edema) in infants has been reported to be 150 mg/kg. In adults, behavioral effects were noted at 5 to 6 mg/kg and seizures at 16 mg/kg (HSDB). Evidence from acute exposure studies of dogs indicates that DDT may sensitize the myocardium to epinephrine. This was observed for both injected epinephrine and epinephrine released by the adrenal glands during a seizure and resulted in ventricular fibrillation. DDT may concurrently act on the CNS, in a manner similar to that of other halogenated hydrocarbons, to increase the likelihood of fibrillation. Chronic exposure to 10 mg/kg-day did not produce increased incidence of arrhythmias in rats or rabbits (EPA 2000).

DDD is considered less toxic than DDT in animals. Symptoms develop more slowly and have a longer duration with DDD than with DDT exposure. Lethargy is more significant and convulsions are less common than with DDT exposure (HSDB).

Chronic Toxicity

Extensive research has been conducted on chronic and sub-chronic exposure effects of DDT in animals and in humans working with DDT. These studies have primarily focused on carcinogenic effects, which are discussed in the following section. Studies have also identified liver damage, and there is limited evidence that DDT may cause an increase in the number of white blood cells and decreased hemoglobin level (EPA 2000). Immunological effects have been associated with exposure to DDT.

IRIS lists an **oral RfD of 0.0005 mg/kg-day** for DDT based on liver effects with a NOAEL of 0.05 mg/kg-day from a 27-week rat feeding study conducted in 1950 (IRIS).

Carcinogenicity

DDE, DDT, and DDD are all considered probable human carcinogens (category B2) based on animal studies, with **oral cancer slope factors of 0.24, 0.34, and 0.34 per mg/kg-day^{-1}**, respectively (IRIS). Liver tumors were associated with each chemical. The occupational studies of workers exposed to DDT are of insufficient duration to assess carcinogenicity (IRIS). Elevated leukemia incidence, particularly chronic lymphocytic leukemia, was noted in two studies of workers. Lung cancer has also been implicated in one study. Bone marrow cells in experimental animals have also been affected by exposure, including an increase in chromosomal fragments in the cells (HSDB). The **oral cancer slope factor for DDT (0.34) is used for total DDTs in this HHRA**, in accordance with EPA (2000) recommendations. EPAs IRIS database also provides an **inhalation unit risk of 9.70E-05 (µg/m^3)$^{-1}$**.

17. Dichloromethane

Acute Toxicity

Inhalation of large amounts of dichloromethane can cause dizziness, nausea and numbness in fingers and toes. Inhalation of small amounts can cause a loss of focus and hand-eye coordination. Dermal exposure can cause burning and redness of the skin (ATSDR 2000b).

Chronic Toxicity

The chronic toxicity of dichloromethane is not well documented. EPAs IRIS database provides an **RfD for dichloromethane of 0.06 mg/kg-day**.

Carcinogenicity

Inhalation of large amounts over time of dichloromethane has been found to cause cancer in mice (ATSDR 2000b). EPAs IRIS database classifies dichloromethane as a probable (Group B2) human carcinogen. The IRIS database provides an **oral cancer slope factor of 0.0075 kg/mg-day^{-1} and an inhalation unit risk of 4.70E-07 µg/m^3**.

18. Ethylbenzene

Ethylbenzene occurs naturally in coal tar and petroleum. Ethylbenzene is also used in products such as inks, pesticides, and paints but is most commonly used to make styrene. It can also be used as a solvent, in fuels and to fabricate other chemicals (ATSDR 2007c).

Acute Toxicity

Inhalation of high levels of ethylbenzene can cause irritation of the eyes and throat and dizziness. Animals that inhaled low concentrations of ethylbenzene for several days to weeks exhibited inner ear damage and hearing loss (ATSDR 2007c).

Chronic Toxicity

Long-term (months to years) exposure to ethyl benzene via inhalation had been found to cause kidney damage in animals (ATSDR 2007c).EPAs IRIS database provides an **RfD for ethylbenzene of 0.1 mg.kg-day** and an **RfC of 1 mg/m^3**.

Carcinogenicity

EPAs IRIS database identifies ethylbenzene as not classifiable as to human toxicity (Group D). The California EPA provides an **oral cancer slope factor for ethylbenzene of 0.011 kg/mg-day^{-1}** and an **inhalation unit risk of 2.50E-06 µg/m^3**.

19. Iron

Iron is the second most abundant metal in the earth's crust. The most common iron ores include hematite, magnetite, limonite, and siderite (HSDB). Iron salts are used as fertilizer micronutrients, herbicides, electrolytes in dry cell batteries, animal feed additives, galvanizers, and as emulsion breakers. The major route of exposure to iron is through the mining and handling of iron ores (HSDB).

Acute Toxicity

Acute iron toxicity is the main cause of pediatric poisoning death in the United States. The hallmark feature of iron overdose is gastrointestinal bleeding. Iron is an extremely corrosive substance in the gastrointestinal tract. The absorption of excessive quantities of ingested iron will result in systemic iron toxicity. Severe overdose causes impaired mitochondrial dysfunction, which can result in cellular death. One of the most affected organs is the liver, but other organs, such as the heart, kidneys, lungs and the hematologic systems may be impaired (Spanierman 2001).

Chronic Toxicity

Chronic exposure to iron oxide fume or dust can cause the appearance of a pulmonary condition called siderosis. This is considered a benign condition and does not ordinarily cause significant physiologic impairments (HSDB). Iron is also suspected to be a cardiovascular or blood toxicant, gastrointestinal or liver toxicant, neurotoxicant, and respiratory toxicant (HSDB). EPA's NCEA has developed a **provisional RfD for iron of 0.7 mg/kg-day** (EPA 2005). Provisional RfDs have greater uncertainty than RfDs published by EPA in the IRIS database.

Carcinogenicity

At this time, there is no information regarding the carcinogenicity of iron to humans or animals.

20. Lead

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead's most important industrial use is in the production of some types of batteries. It is also used in the production of ammunition, in some kinds of metal products (such as sheet lead, solder, some brass and bronze products, and pipes), and in ceramic glazes. Human activities (such as the former use of "leaded" gasoline) have spread lead and substances that contain lead to all parts of the environment. Before the use of leaded gasoline was banned, most of the lead released into the US environment came from car exhaust. Other sources of lead released to the air include burning fuel, such as coal or oil, industrial processes, and burning solid waste.

Sources of lead in dust and soil include lead that falls to the ground from the air, and weathering and chipping of lead-based paint from buildings and other

structures. Lead in dust may also come from windblown soil. Disposal of lead in municipal and hazardous waste dump sites may also add lead to soil. Mining wastes that have been used for sandlots, driveways, and roadbeds can also be sources of lead (ATSDR 1999c).

People living near hazardous waste sites may be exposed to lead and chemicals that contain lead by breathing air, drinking water, eating foods, or swallowing or touching dust or dirt that contains lead. For people who do not live near hazardous waste sites, exposure to lead may occur in several ways: 1) by eating foods or drinking water that contain lead, 2) by spending time in areas where leaded paints have been used and are deteriorating, 3) by working in jobs where lead is used, 4) by using health-care products or folk remedies that contain lead, and 5) by having hobbies in which lead may be used such as sculpturing (lead solder) and staining glass.

Acute Toxicity

Lead can affect almost every organ and system in your body. The most sensitive is the central nervous system, particularly in children. Studies have shown that children exposed to low levels of lead have lower IQs, reduced motor skills, developmental problems, hyperactivity, and increased aggression (Canfield et al. 2003; Pattee and Pain 2003).

Lead also damages kidneys and the reproductive system. The toxic effects of lead are the same regardless of the route of entry into the body, and they are correlated with internal exposure as blood lead level.

Chronic Toxicity

At high levels over long periods of time, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can also damage the male reproductive system. Even low levels of exposure to lead may have significant effects.

Since most of the toxicity data for lead is based on an internal dose, a reference dose, which is based on an external dose (i.e., mg/kg-day) has not been developed. Data on external exposure (i.e., mg/kg-day) are available from animal studies, but these data are generally not used to assess human health impacts because of the large database available using blood levels. Risks from lead exposure were evaluated using the IEUBK model for young children and the adult lead model for risks to fetal development, as described in Section B.3.4.4. EPA and the Centers for Disease Control and Prevention have determined that child or fetal blood lead concentrations at or above 10 µg/dL present risks to children's health.

Carcinogenicity

The Department of Health and Human Services has determined that lead acetate and lead phosphate may reasonably be anticipated to be carcinogens based on studies in animals. There is inadequate information to clearly determine lead’s carcinogenicity in people (ToxFAQs). EPAs IRIS database classifies lead as a probable (Group B2) human carcinogen.

21. Manganese

Manganese is an element considered essential to human health. However, divalent manganese is about 2.5 to 3 times more toxic than trivalent manganese, and the anions of manganese salts influence the overall manganese toxicity. Industrial activities which use manganese include steel manufacturing, nonferrous alloys, purifying and scavenging agent in metal production, manufacturing of aluminum, ceramics, matches, glass, and welding rods (HSDB).

Acute Toxicity

Acute manganese poisoning has effects similar to other heavy metals if dust or fumes are inhaled in sufficient quantity. The minimum dose that produces effects on the central nervous system is not known and, with few exceptions, such effects have been observed only in occupationally exposed individuals. Sixteen cases of manganese poisoning have been described for a small Japanese community, three of which were fatal (including one suicide). The manganese content of the water was about 14 mg/L and concentrations of about 8 and 11 mg/L were found in two other wells. The subjects exhibited psychological and neurological disorders associated with manganese poisoning and high manganese and zinc levels were found in organs at autopsy (WHO 1981).

Chronic Toxicity

The usual form of chronic manganese poisoning primarily involves the central nervous system. Early symptoms include, languor, sleepiness, and weakness in legs, emotional disturbances such as uncontrollable laughter and a tendency to fall while walking (ACGIH 1986). Long-term exposure to manganese is known to cause a condition with symptoms that are similar to Parkinson's disease and are debilitating and permanent. Exposure to this metal has also been linked to reproductive problems and reduced red and white blood cell counts (ATSDR 2000a).

Experimental studies have suggested that populations at greatest risk of adverse effects due to manganese exposure are the very young and those with an iron deficiency, and workers exposed to manganese at or near the recommended threshold limit value. EPA has established an **RfD of 0.14 mg/kg-day** for a 70 kg adult (IRIS). EPAs IRIS database also provides an **RfC of 0.00005 mg/m^3.**

Carcinogenicity

Manganese is not classified as a carcinogen to humans (a Group D chemical) because existing studies are inadequate to assess the carcinogenicity of manganese to humans and animals (ToxFAQs).

22. Mercury

Mercury is widely distributed in the environment due to both natural and anthropogenic processes. It is released generally as elemental mercury (Hg^0) or divalent mercury (Hg^{2+}). It can be converted between these forms and may form mercury compounds by chemical processes in air, water, and soil. Biological processes in other media, primarily soil and sediment, can convert inorganic mercury into organic mercury, primarily methylmercury. In fish tissue, the majority of mercury is in the form of methylmercury (EPA 2000). Because mercury is only

a COPC for the fish consumer scenario, the toxicity values for methylmercury were used in this HHRA.

Acute Toxicity

Acute high-level exposures to methylmercury may result in kidney damage and failure, gastrointestinal damage, cardiovascular collapse, shock, and death. The estimated lethal dose is 10 to 60 mg/kg-day (ATSDR 1999d).

Chronic Toxicity

Neurotoxicity is the chronic effect of greatest concern, both to the developing embryo or fetus and to adults and children (EPA 2000). Neurotoxicological effects include tremors, decreased IQ, and decreased motor function. In addition, damage to the liver and kidney can occur with chronic exposure (ATSDR 1999d). Effects to humans from consumption of contaminated food have been documented in Japan and Iraq.

The current IRIS **RfD for methylmercury of 0.0001 mg/kg-day** was originally based on data on neurological changes in 81 Iraqi children who had been exposed *in utero*. This value was subsequently updated using data from a population in the Faroe Islands who were exposed to methylmercury and PCBs through consumption of fish and pilot whale. In deriving the RfD, EPA used a benchmark dose (BMD) approach to quantify a dose-effect relationship between methylmercury in cord blood and a neurological endpoint. A BMD limit of 58 µg/L cord blood was estimated based on findings from the Boston Naming Test, a neuropsychological evaluation. A methylmercury intake level associated with a blood level of 58 µg/L was then calculated to be 1.0 µg/kg-day. The current RfD of 0.1 µg/kg-day (i.e., 0.0001 mg/kg-day) derived from the Faroe Islands data, is thus unchanged from the previous RfD derived from the Iraqi data. The RfD for methylmercury is used for mercury in this HHRA.

Carcinogenicity

Methylmercury is currently a Group C chemical, a possible carcinogen based on inadequate data in humans and limited evidence in animals. Dietary exposure of mice to methylmercury resulted in significant increases in the incidences of kidney tumors in males but not in females (EPA 1997c). Evidence points to a mode of action for methylmercury carcinogenicity that operates at high doses certain to produce other types of toxicity in humans. Given the relatively low levels of exposure, even among consumers of highly contaminated fish, methylmercury is not likely to present a carcinogenic risk to the US population (EPA 2000). An oral slope factor is currently not available for methylmercury.

23. Naphthalene

Naphthalene can be found in petroleum and coal, and is produced from burning wood or tobacco. Currently naphthalene is used to manufacture polyvinyl chloride (PVC) plastics. It is also used as a moth repellant and as a toilet deodorizer (ATSDR 2005b).

Acute Toxicity

Exposure to high levels of naphthalene can destroy red blood cells which can lead to hemolytic anemia. A decrease in the amount of red blood cells can lead to fatigue, loss of appetite, restlessness, and pale skin. Exposure to high levels of

naphthalene can also cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. Ingestion of high levels of naphthalene has been associated with cloudy eyes in animals (ATSDR 2005b).

Chronic Toxicity

Irritation and inflammation of the nose and lungs occurred when mice and rats inhaled naphthalene for long periods of time. Ingestion of naphthalene. Abnormal materials accumulated in the lungs of mice when they ingested naphthalene related compounds over a lifetime (ATSDR 2005b). EPAs IRIS database provides on **oral RfD for naphthalene of 0.02 mg/kg-day and an RfC of 0.003 mg/m^3**.

Carcinogenicity

Mice that inhaled naphthalene over a lifetime developed tumors in their lungs. Rats that inhaled naphthalene over a lifetime also developed tumors in their noses (ATSDR 2005b). EPAs IRIS database classifies naphthalene as a possible (Group C) human carcinogen. California EPA provides an **inhalation unit risk of 0.000034 (µg/m^3)$^{-1}$**.

24. Nickel

Nickel is used in a wide variety of industries. Occupational exposure is the predominant cause of harmful exposure to nickel.

Acute Toxicity

Dermal contact with nickel causes contact dermatitis. Nickel poisoning occurred in 23 dialyzed patients when nickel leached in dialysate from a nickel-plated stainless steel water heater. The victims experienced nausea, vomiting, weakness, headache, and palpitation (HSDB).

Chronic Toxicity

Nasal and lung cancer have resulted from chronic inhalation of nickel particles (IRIS). Damage to the nasal mucosa, asthma, pneumoconiosis, and conjunctivitis have also been observed after long term exposure (HSDB). EPA has developed an **RfD of 0.02 mg/kg-day for nickel** based on decreased body and organ weights in a long-term rat feeding study (IRIS).

Carcinogenicity

EPA has classified nickel refinery dust as a known (Group A) carcinogen, but the soluble salts of nickel on which the oral RfD is based are not classified as carcinogenic. This classification was based on a study of sulfide nickel matte refinery workers who developed lung and nasal tumors after being exposed to nickel refinery dust, and also on data collected from nickel carcinogenicity studies with rats (IRIS).

25. n-Propylbenzene

There is limited information on the toxicity of n-propylbenzene. Ethylbenzene was used a surrogate in the HHRA. N-propylbenzene occurs naturally in petroleum and bituminous coal. N-propylbenzene has been used in dyeing and printing (ATSDR 2007a).

Acute Toxicity

There is limited information on the acute effects of exposure to n-propylbenzene. N-propylbenzene is a respiratory irritant. It can be toxic to internal organs if absorbed through the skin (LookChem 2008).

Chronic Toxicity

There is limited information on the chronic effects of exposure to n-propylbenzene. N-propylbenzene can cause lung damage and death from aspiration (LookChem 2008). EPA has derived an **RfD of 0.1 mg/kg-day** for n-propylbenzene's surrogate ethylbenzene based on liver and kidney toxicity in a long-term rat feeding study (IRIS). EPAs IRIS database also provides an RfC for ethylbenzene of 1 mg/m^3 based on developmental inhalation studies in rats and rabbits.

Carcinogenicity

There is limited information on the chronic effects of exposure to n-propylbenzene.

26. Polychlorinated biphenyls (PCBs)

Although the production and use of PCBs were banned in this country in 1979, this chemical group is extremely persistent in the environment and bioaccumulates through the food chain (EPA 2000). There is evidence that some dioxin-like PCB congeners, which are assumed to be the most toxic, preferentially accumulate in organisms higher on the food chain, including humans. As a result, the composition of PCB mixtures in fish tissue may differ significantly from the environmental PCB source. Often the mixtures of interest are not those that have been used in studies of laboratory animals to determine toxicity (EPA 2000).

Acute Toxicity

Studies in animals have shown that exposure to very high doses of PCBs can cause death. However, doses of such magnitude are unlikely in environmental exposures and current industrial settings. There have been no reports of deaths in humans after exposure to PCBs even where exposures were much higher than those typically identified with environmental exposures (ATSDR 2000c).

Chronic Toxicity

Numerous effects have been documented in animal studies including hepatic, gastrointestinal, hematological, dermal, body weight, endocrine, immunological, neurological, reproductive, developmental, and liver cancer (ATSDR 2000c). One of the most distinct effects associated with PCB exposure is the skin condition chloracne, which is generally associated with high levels of exposure (ATSDR 2000c). Evidence of other chronic effects in humans is not nearly as definitive. Several studies in humans have suggested that PCB exposure, particularly via in utero exposure through maternal fish consumption, may cause adverse effects in children and in developing fetuses (ATSDR 2000c). Neurobehavioral effects in such children with a range of PCB exposure levels have been documented by Fein et al. (1984), Jacobson and Jacobson (1996, 1997), and Schantz (1996). A review of exposure evaluation in 10 more recent studies associating neurodevelopmental effects with PCBs is also available (Longnecker et al. 2003).

This will facilitate future comparisons across studies and future updates to neurodevelopmental toxicity metrics. PCBs have also been associated with immunological effects in several epidemiological studies (Dallaire et al. 2006).

Over intermediate durations (i.e., less than 10% of an organism's lifetime), learning problems have been noted in monkeys fed PCB mixtures similar in composition to human breast milk (ATSDR 2000c). Some studies also indicate a possible connection between PCB exposure and cardiovascular effects; although this has been better demonstrated in assessments of dioxins, which share a similar chemical structure to PCBs (see structure activity relationships at the end of the PCB section).

EPA has derived an **RfD of 0.00002 mg/kg-day** for Aroclor 1254 (IRIS). The RfD was based on a LOAEL of 0.005 mg/kg-day for ocular and immunological effects in monkeys. This RfD is considered to be protective of developmental effects as well, and is used for total PCBs in this HHRA.

Carcinogenicity

PCBs are classified by EPA as Group B2, probable human carcinogens. This designation is based on studies that have found liver tumors in rats exposed to Aroclors 1260, 1254, 1242, and 1016. Occupational mortality data indicate that exposures to PCBs during capacitor manufacturing and repairing were associated with cancer of the liver, biliary tract and/or gall bladder, intestinal cancer, and skin melanoma (Brown and Jones 1981; Brown 1987); however, previous reviews of human epidemiological studies of PCBs have not yielded conclusive results (Silberhorn et al. 1990). Some more recent studies have indicated an increase in melanoma, brain, prostate, or liver cancer mortality in populations occupationally exposed to PCBs (Prince et al. 2006a; Prince et al. 2006b; Ruder et al. 2006). Elevated risk of non-Hodgkin lymphoma has been associated with detection of PCBs in carpet dust (Colt et al. 2005) and in elevated PCB concentrations in blood (De Roos et al. 2005).

EPA has developed a range of slope factors for PCBs (EPA 1996). Using information on environmental processes, they have provided guidance for choosing an appropriate slope factor based on the class of the mixture and the exposure pathway. Because bioaccumulated PCBs appear to be more toxic and more persistent in the body than commercial PCBs, **the upper bound slope factor associated with high risk and persistence (2.0 per mg/kg-day) was used in this HHRA** (IRIS). EPAs IRIS database also provides an **inhalation unit risk of 0.0001 ($\mu g/m^3)^{-1}$**.

When assessing PCB mixtures, it is important to recognize that both dioxin-like and non-dioxin-like modes of action contribute to overall PCB toxicity. It is possible that concentrations of dioxin-like congeners are increased in an environmental mixture. When congener concentrations are available, the mixture-based approach based on Aroclor analyses can be supplemented by analysis of dioxin TEQs to evaluate the PCB congeners with dioxin-like toxicity. In the TEQ approach, all PCB congeners with dioxin-like properties are analyzed in order to assess their impact on the overall risk from PCBs. For the analysis of dioxin-like PCB congeners, the **dioxin slope factor of 150,000 per mg/kg-day** (EPA 2005) is used with the estimated dioxin toxic equivalency (Van den Berg et al. 2006). Details of the structure activity relationship are presented below. The TEFs for PCBs are presented in Section B.2.2.

Structure Activity Relationships

Some non- and mono-ortho substituted PCBs may adapt a planar conformation and activate the aryl hydrocarbon (Ah) receptor. These PCBs are thought to share a common mode of toxic action with dioxin (2,3,7,8-TCDD) and are sometimes referred to as dioxin-like PCBs (Van den Berg et al. 2006). Some polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are also capable of activating the Ah receptor and also have TEFs (see Section B.2.2). The mono-ortho substituted PCBs have higher TEFs because they are structurally better able to take on the planar conformation needed to activate the Ah receptor.

A recent study assessed cancer in rodents exposed to an equal TEQ quantity from either one PCB, one PCDF, a mixture (equal parts of one PCB, one PCDF, and TCDD), or TCDD (Walker et al. 2005). The results of this study supported the use of the TEF approach for the estimation of PCB cancer risk.

PCBs used in most laboratory studies and found in the environment are complex mixtures, and it is not known exactly what portion of observed effects is attributable to dioxin-like or non-dioxin-like PCBs. The EPA Science Advisory Board cited the van der Plas et al. (2000) study of rats exposed to Aroclor 1260, which suggested that most of the tumor promotion potential of PCB mixtures is attributable to the non-dioxin-like fraction (EPA 2001). Because this fraction is not included in the TEQ calculation, van der Plas et al. (2000) concluded that the tumor promotion potential of PCBs might be underestimated by the TEQ approach alone. This is also supported by estimates of TEQs for the different Aroclors. Although EPA's SF included consideration of several Aroclors, the SFs for 1260, followed by 1254, were the highest in the studies evaluated and were used for the development of the SF for total PCBs (EPA 1996). The TEQ potency for Aroclor 1260 on a mass basis is lower than the potencies for several other Aroclors (Rushneck et al. 2004; Van den Berg et al. 2006). This also suggests that some of its carcinogenic potency is not attributable to dioxin-like PCB congeners.

Another recent review also supports PCB carcinogenicity as acting through an indirect mechanism, such as tumor promotion (rather than initiation) (Knerr and Schrenk 2006). Across the carcinogenicity studies evaluated, the TEQ dose (but not the total PCB dose) was found to be primarily responsible for the development of neoplasms in rats. However, tumor promotion experiments in rodents have shown that both dioxin-like and non-dioxin-like PCB congeners may act as liver tumor promoters. In the case of the van der Plas (2000) study, Knerr and Schrenk (2006) asserted that the purity data provided in that study were not sufficient to exclude the potential contribution of some dioxin-like PCB congeners to the observed toxicity (Knerr and Schrenk 2006). Although the dioxin-like PCB congeners showed much greater potency, some weak carcinogenic potency of non-dioxin-like PCBs cannot be excluded (Knerr and Schrenk 2006). For this reason, some scientists have suggested that the carcinogenic evaluation of PCBs based solely on PCB TEQ evaluation is not sufficient (Safe 1994). Research and debate is active on the most appropriate methods to evaluate carcinogenic potential of environmental PCB mixtures.

The contribution of dioxin-like and non-dioxin-like PCBs to non-cancer effects is also an area of active research and discussion. Unlike carcinogenicity, health

risks from PCBs associated with these effects are not evaluated on a TEQ basis. For these endpoints, non-dioxin-like PCBs may play a greater role than they do in carcinogenicity. The mechanisms of action for PCB neurotoxicity are not thought to be mediated by the Ah receptor, suggesting that non-dioxin-like PCBs may be important. However, the specific PCB congeners involved have not been well-characterized. It is possible that the most potent congeners for these endpoints may be enhanced or diluted in environmental mixtures relative to mixtures used to develop toxicity metrics. For example, environmental mixtures of PCBs may have more- or less-potent immunological effects than do the Aroclor 1254 mixture used in the study that is the basis for the reference dose.

27. tert-Butyl methyl ether (MTBE)

Tert-Butyl methyl ether (MTBE) is not naturally occurring and can be made by blending chemicals such as isobutylene and methanol. MTBE is added to unleaded gasolines, which results in more efficient burning of the gasoline. MTBE has been used for this purpose since the 1980s. It is also used medically to dissolve gallstones (ATSDR 1996b).

Acute Toxicity

Inhalation of small amounts of MTBE can cause nose and throat irritation. Symptoms such as headaches, nausea, dizziness, and mental confusion have been reported after inhalation of gasoline fumes but it is not clear whether these effects are directly associated with MTBE or other chemicals. Ingestion of MTBE by mice and rats caused gastrointestinal irritation, liver and kidney damage, and nervous system effects (ATSDR 1996b).

Chronic Toxicity

The chronic toxicity of MTBE is not well documented. EPAs IRIS database provides an RfC for tert-Butyl methyl ether of 3 mg/m^3.

Carcinogenicity

One study with rats concluded that inhalation of high levels of MTBE caused kidney cancer. Another study with mice found that inhalation of high levels of MTBE caused liver cancer (ATSDR 1996b). California EPA provides an **oral cancer slope factor of 0.0018 $kg/mg\text{-}day^{-1}$ and an inhalation unit risk of 2.60E-07 $(\mu g/m^3)^{-1}$**.

28. Total petroleum hydrocarbons

Total petroleum hydrocarbons (TPH) describe a broad list of hundreds of related chemical compounds that originally come from crude oil.TPH have widespread use and can be found in petroleum products including gasoline, kerosene, fuel oil, mineral oil, and asphalt (ATSDR 1999e). Health effects of TPH are typically classified based on TPH fraction or based on whole petroleum products (complex mixtures such as fuel oils or gasoline).

Acute Toxicity

Acute exposure to gasoline via various routes (i.e., inhalation, oral, or dermal exposure) has been associated with skin irritation, headache, nausea, dizziness, euphoria, and drowsiness. Ingestion of large amounts of gasoline can cause

respiratory effects such as pneumonitis and pulmonary edema due to the aspiration of gasoline (ATSDR 1999e).

Chronic Toxicity

PPRTV provides an **oral RfD of 0.3 mg/kg-day for TPH-gasoline (aliphatic)** based on reduced nerve connection velocity and **inhalation RfC of 0.6 mg/m^3** based on nasal epithelial cell hyperplasia. PPRTV also provides an **oral RfD of 0.01 mg/kg-day for TPH-diesel (aliphatic)** based on liver, kidney, and hematologic effects.

Carcinogenicity

PPRTV provides an **inhalation unit risk of 0.00000019 µg/m^3** for TPH-gasoline (aliphatic)**.**

29. Trichloroethene

Trichloroethene (TCE) does not occur naturally and is most commonly used as a solvent to remove grease from metal. TCE is also used in adhesives, paint removers, typewriter correction fluids, and spot removers (ATSDR 1997).

Acute Toxicity

Inhalation of small amounts of TCE can cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Inhalation of larger amounts can cause impaired heart function, unconsciousness, and death. Ingestion of large amounts of TCE can cause nausea, liver damage, unconsciousness, impaired heart function, or death. Dermal exposure can cause skin rashes (ATSDR 1997).

Chronic Toxicity

Inhalation of TCE over time can cause nerve, kidney, and liver damage. Ingestion of small amounts of TCE over time can cause damage to the liver and kidney, reduced immune system function, and reduced fetal development in pregnant women.

Carcinogenicity

Exposure to high levels of TCE caused liver, kidney and lung cancer in mice and rats. Studies that looked at humans exposed to TCE in drinking water found that they were more likely to develop cancer that humans who were not exposed (ATSDR 1997). California EPA provides an **oral cancer slope factor for trichloroethene of 0.13 kg/mg-day^{-1} and an inhalation unit risk of 0.00002 µg/m^3.**

30. Vanadium

Vanadium compounds are widely distributed in the earth's crust. Elemental vanadium does not occur in nature, but its compounds exist in over 50 different mineral ores and in association with fossil fuels (HSDB). The route of entry of vanadium compounds most commonly seen in industrial exposures is through the respiratory system. Exposures are usually limited to areas where vanadium pentoxide is produced, in steel mills where vanadium pentoxide is used, and in cleaning boilers fired by oil containing vanadium (HSDB).

Acute Toxicity

Vanadium and its compounds are principally eye and respiratory tract irritants that result in conjunctivitis, coughing, wheezing, difficulty in breathing, and industrial bronchitis. A metallic taste and throat irritation may occur. Greenish discoloration of the fingers, scrotum, and upper legs may also be present. A greenish black discoloration of the tongue indicates heavy exposure (HSDB).

Chronic Toxicity

Some studies suggest exposure to vanadium may impair the lung resistance to respiratory infection, although the available data on chronic respiratory effects of vanadium are still inconclusive. EPA's RSL table provides an **RfD of 0.005 mg/kg-day** for vanadium and compounds (based on a molecular weight-based adaptation of the vanadium pentaoxide RfD of 0.009 mg/kg-day from IRIS).

Carcinogenicity

At this time, there is no information regarding the carcinogenicity of vanadium to humans or animals.

31. Vinyl chloride

Vinyl chloride does not occur naturally in the environment but can be formed as a result of degradation of other chemicals such as trichloroethane, trichloroethylene, and tetrachloroethylene. Vinyl chloride is currently used to make PVC (ATSDR 2006c).

Acute Toxicity

Inhalation of high levels of vinyl chloride can cause dizziness, sleepiness, unconsciousness or death. Vinyl chloride can also cause nerve damage, liver damage, and immune reaction, but the concentrations needed for these affects to occur are unknown. Humans exposed to high levels of vinyl chloride observed low blood flow in their hands and their fingers developed a while color and were sensitive to cold. Dermal exposure can cause numbness, redness and blisters (ATSDR 2006c).

Chronic Toxicity

Humans who have inhaled vinyl chloride over time have observed changes in their liver. Animals that were exposed over time had damage to the sperm and testes (ATSDR 2006c).EPAs IRIS database provides an **RfD for vinyl chloride of 0.003 mg/kg-day and an RfC of 0.1 mg/m^3.**

Carcinogenicity

Humans who inhaled vinyl chloride over time developed an increased risk of liver, brain, lung cancer, and cancers of the blood (ATSDR 2006c). EPAs IRIS database has classified vinyl chloride as a human (Group A) carcinogen. EPAs IRIS database provides an **oral cancer slope factor for non-occupational exposure to vinyl chloride of 1.5 kg/mg-day^{-1}** and an **inhalation unit risk factor of 0.0000088 µg/m^3**. IRIS also provides an **oral cancer slope factor for occupational exposure to vinyl chloride of 0.72 kg/mg-day^{-1}** and an **inhalation unit risk factor of 0.0000044 µg/m^3**.

32. Xylenes

Xylenes are composed of three different isomers *m*-, *o*-, and *p*-xylene. Xylenes are naturally occurring in petroleum and coal tar. It is one of the 30 most produced chemicals by volume in the United States. It is currently used as a solvent and in the printing, rubber, and leather industries. Xylene is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It can also be found in airplane fuel and gasoline (ATSDR 2006d).

Acute Toxicity

High levels of Xylene can cause headaches; a reduction in muscle coordination; dizziness; confusion; disruption of the sense of balance; irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys and death (ATSDR 2006d).

Chronic Toxicity

The chronic toxicity of xylenes is not well documented. EPA's IRIS database provides an **RfD for xylenes of 0.2 mg/kg-day and an RfC of 0.1 mg/m^3.**

Carcinogenicity

The carcinogenicity of xylenes is not well documented. RAIS identifies xylenes as not classifiable as to human carcinogenicity (Group D).

33. Zinc

Zinc is an essential trace element that plays a necessary role in enzymatic functions, protein synthesis, and carbohydrate metabolism. Small doses of zinc are necessary for normal growth and development in birds and mammals. Zinc also has many industrial uses. It is used as a galvanizing agent, component in brass, bronze alloys, light metal alloys, and in wet batteries (HSDB). The most common route of high-level exposure to zinc is through consumption of liquid contained in galvanized metal containers or by water contaminated with industrial zinc waste (ToxFAQs).

Acute Toxicity

In humans, ingestion of gram quantities of zinc may cause pancreatic derangement, light-headedness, and mild derangement of cerebellar function. Acute exposure to zinc can also cause dizziness, nausea, tightness in the throat, diarrhea, and vomiting. Metal fume fever has been observed after inhalation of zinc oxide fumes (HSDB).

Chronic Toxicity

Prolonged exposure to drinking water that contained 40 mg/L of zinc triggered symptoms such as irritability, muscular stiffness and pain, loss of appetite, and nausea (HSDB). EPA has established an **RfD of 0.3 mg/kg-day for zinc** based on a human diet supplement study in which adult females experienced a 47% decline in erythrocyte superoxide dismutase (ESOD) after 10 weeks of exposure (IRIS).

Carcinogenicity

EPA has placed zinc in Group D, not classifiable as to human carcinogenicity (IRIS).

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ATTACHMENT 7 – BACKGROUND AND REFERENCE AREA CONCENTRATIONS

1.0 Introduction

US Environmental Protection Agency (EPA) guidance discusses two types of background concentrations, natural and anthropogenic. Natural background is defined as "naturally occurring substances present in the environment in forms that have not been influenced by human activity." Anthropogenic background is defined as "natural and human-made substances present in the environment as a result of human activities (not specifically related to the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] site in question)" (EPA 2002). As recommended in EPA (2002) guidance, background concentrations of COPCs at the Harbor Oil Study Area (when available) are discussed in the human health risk assessment (HHRA) after the initial risk estimates for these COPCs are presented (Section 5.3).

This attachment discusses background concentrations for metals that were available from Oregon Department of Environmental Quality (DEQ) and reference area concentrations for organic compounds. The term reference area is used instead of background for organic compounds because no specific background concentrations that are representative of anthropogenic background have been selected or approved by EPA. Instead, concentrations from reference areas (urban areas within the vicinity of the Study Area) are presented for comparison with Study Area concentrations.

This attachment to the Harbor Oil baseline HHRA presents the background or reference area concentrations used in the risk characterization section of the HHRA. Sources of background or reference area concentrations for the Harbor Oil HHRA include the following:

- DEQ's Memorandum from Toxicology Workgroup to DEQ Cleanup Program Managers Regarding Default Background Concentrations for Metals (DEQ 2002). This memorandum presents regional soil and sediment background concentrations for metals, including arsenic.
- DEQ's *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment* (DEQ 2007). This document presents regional soil and sediment background concentrations for metals, including arsenic.
- Radio Tower Site (URS 2000). Five samples were collected as part of a preliminary soil investigation at the Radio Tower Site across North Force Avenue from Harbor Oil. One of these samples was designated as a "background location" for the sampling event, but because concentrations at this location were generally similar to the other four samples, all samples from the Radio Tower Site were used to represent reference area concentrations for the HHRA. Samples were analyzed for hydrocarbons, metals, pesticides, herbicides, and semi-volatile organic compounds (SVOCs).

- DEQ's Columbia Slough Sediment Project (DEQ 2005). Baseline sediment concentrations for the Columbia Slough, which drains over 30,000 acres of urban land in the City of Portland, were used to represent reference area concentrations for the HHRA. These baseline maxima concentrations are calculated values meant to reflect the upper end of the range of concentrations throughout the slough (i.e., maximum concentrations excluding those associated with a particular source). These concentrations are relevant because they indicate the concentrations of chemicals present in the watershed associated with historical and current land uses (e.g., urban activities such runoff from roads, agricultural runoff). Concentrations were developed from samples taken since the early 1990s, and are available for volatile organic compounds (VOCs), phthalates, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and metals.

The Radio Tower Site and the Columbia Slough are shown on Figure 1 to provide information regarding the proximity of these regional sources to the Harbor Oil Study Area.

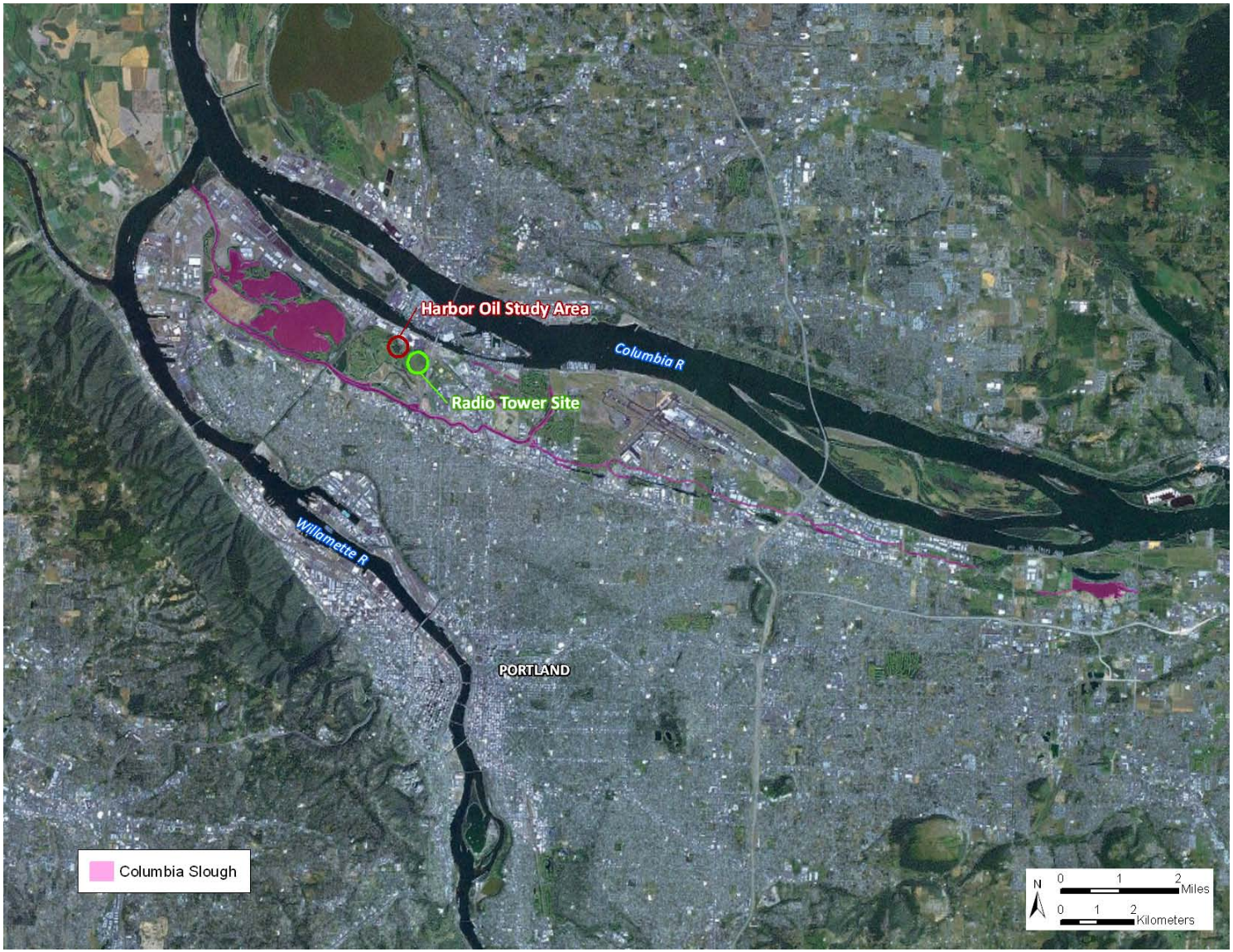

Figure 1. Locations of regional studies used to define reference area concentrations

This attachment discusses the background or reference area concentrations for only those COPCs with risk estimates greater than either an excess cancer risk of 1×10^{-6} or a non-cancer HQ of 1. These COPCs include arsenic, cPAH toxic equivalent (TEQ), total PCBs, total DDTs, and aliphatic gasoline-range total petroleum hydrocarbons (TPH), which are discussed in the following sections.

2.0 Arsenic

Arsenic occurs naturally in all sediments and soils worldwide. Background arsenic concentrations of 7 mg/kg dw in soil/sediment and 7.9 mg/kg dw in sediment are provided in DEQ's Memorandum from the Toxicology Workgroup to DEQ Cleanup Program Managers Regarding Default Background Concentrations for Metals (DEQ 2002) and DEQ's *Guidance for assessing bioaccumulative chemicals of concern in sediment* (DEQ 2007). Ambient concentrations are also available from other sources, but the value from this DEQ source was given priority because it is recommended for use at cleanup sites. Table 1 presents a comparison of arsenic concentrations in the Harbor Oil Study Area with background concentrations.

Table 1. Arsenic Concentrations at the Harbor Oil Study Area Compared with Background

Medium	Unit	Harbor Oil Study Area		Background Concentration
		Concentration Range	EPC	
Facility soil[a]	mg/kg dw	0.7 to 20.6	8.3 to 11	7
Groundwater[a]	µg/L	0.2 U to 32.2	15	na
Wetland soil	mg/kg dw	1.5 to 53.1	9.6	7
Lake sediment	mg/kg dw	1.5 to 7	6.4	7 to 7.9
Lake surface water	µg/L	0.9 to 1.2	1.2	na
Fish tissue[b]	mg/kg ww	0.050 to 0.24	0.22	0.24 to 0.27

[a] The range of EPCs from the worker RME scenarios is presented here.
[b] Fish tissue concentrations were estimated using BSAFs (see Attachment 2).

BSAF – biota-sediment accumulation factor
dw – dry weight
EPC – exposure point concentration
na – not available
RME – reasonable maximum exposure
U – not detected at given concentration
ww – wet weight

As noted in Table 1, arsenic concentrations at the Harbor Oil Study Area were generally similar to the background concentrations of 7 mg/kg dw for soil and 7.9 mg/kg dw for sediment. The lake sediment and fish tissue EPCs were less than the background concentrations, and both the wetland soil and Facility soil EPCs were less than 2 times the background concentration.

3.0 cPAH TEQ

Reference area cPAH TEQs are available as follows:

- A range of 134 to 149 µg/kg dw from DEQ's Columbia Slough Sediment Project (2005), which represents calculated baseline maxima concentrations meant to reflect the upper end of the range of sediment concentrations throughout the slough that are not associated with a particular source
- A range of 8.2 to 56.4 µg/kg dw from five samples taken at the Radio Tower Site (URS 2000)

These ranges were used to represent reference area cPAH TEQs for comparison with Harbor Oil sediment and soil data, respectively (Table 2). Specific background cPAH TEQs have not been established by EPA or DEQ.

Table 2. cPAH TEQs at the Harbor Oil Study Area Compared to Reference Area Concentrations

Medium	Unit	Harbor Oil Study Area		Reference Area Concentration Range
		Concentration Range	EPC	
Facility soil[a]	µg/kg dw	4.2 U to 5,200	950 to 1,100	8.2 to 56.4
Groundwater	µg/L	0.091 U to 1.5 U	not a COPC	na
Wetland soil	µg/kg dw	4.3 U to 5,200	1,100	8.2 to 56.4
Lake sediment	µg/kg dw	4.2 U to 118	81	134 to 149
Lake surface water	µg/L	0.091 U	not a COPC	na
Fish tissue	µg/kg dw	nc	not a COPC	nc

[a] The range of EPCs from the worker RME scenarios is presented here.

cPAH – carcinogenic polycyclic aromatic hydrocarbon
COPC – contaminant of potential concern
dw – dry weight
EPC – exposure point concentration
na – not available
nc – not calculated
RME – reasonable maximum exposure
TEQ – toxic equivalent
U – not detected at given concentration

As shown in Table 2, the lake sediment EPC was less than the range of reference area concentrations for cPAH TEQs. The Facility soil and wetland soil EPCs were approximately one order of magnitude higher than the high end of the reference area concentration range.

4.0 Total PCBs

Reference area concentrations of total PCBs are available from one source, DEQ's Columbia Slough Sediment Project (2005). A range of 23 to 24 µg/kg dw (Aroclor 1254) was calculated from the data, which represents calculated baseline maxima concentrations meant to reflect the upper end of the range of sediment concentrations throughout the slough that are not associated with a particular source.

This range was used to represent reference area total PCB concentrations for comparison to Harbor Oil data for both sediment and soil because no soil concentrations were available (Table 3). Total PCBs were not analyzed in the samples collected from the Radio Tower Site. Specific background concentrations for total PCBs have not been established by EPA or DEQ.

Table 3. Total PCB Concentrations at the Harbor Oil Study Area Compared with Reference Area Concentrations

Medium	Unit	Harbor Oil Study Area		Reference Area Concentration Range
		Concentration Range	EPC	
Facility soil[a]	µg/kg dw	4.9 to 32,000	3,400 to 5,200	23 to 24
Groundwater	µg/L	0.10 U to 0.96 U	not a COPC	na
Wetland soil	µg/kg dw	31 U to 4,200	770	23 to 24
Lake sediment	µg/kg dw	32 U to 131	not a COPC	23 to 24[b]
Lake surface water	µg/L	0.10 UJ	not a COPC	na
Fish tissue[c]	µg/kg ww	77 to 440	330	78 to 81

[a] The range of EPCs from the worker RME scenarios is presented here.
[b] No soil background value is available; soil background value is based on sediment.
[c] Fish tissue concentrations were estimated using BSAFs (see Attachment 2).

BSAF – biota-sediment accumulation factor
COPC – contaminant of potential concern
dw – dry weight
EPC – exposure point concentration
J – estimated concentration
na – not available
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
U – not detected at given concentration
ww – wet weight

As shown in Table 3, both the wetland soil and the Facility soil EPCs were higher than the range of reference area concentrations for total PCBs. For fish tissue, the EPC was approximately 4 times greater than the high-end reference area concentration for total PCBs.

5.0 Total DDTs

Reference area concentrations of total DDTs are available as follows:

- A range of 16 to 19 µg/kg dw from DEQ's Columbia Slough Sediment Project (2005), which represents calculated baseline maxima concentrations meant to reflect the upper end of the range of sediment concentrations throughout the slough that are not associated with a particular source.
- A range of 15 to 355 µg/kg dw from five samples taken at the Radio Tower Site (URS 2000). It should be noted that the highest concentration (355 µg/kg ww) was substantially higher than the next highest concentration (55 µg/kg ww). However, because of the patchy nature of DDT concentrations in the region and because there was no indication that the maximum concentration was linked to a specific source, all five samples were determined to be acceptable to represent total DDT reference area concentrations in this HHRA.

These ranges were used to represent reference area total DDT concentrations for comparison with Harbor Oil sediment and soil data, respectively (Table 4). Specific background concentrations for total DDTs have not been established by EPA or DEQ.

Table 4. Total DDT Concentrations at the Harbor Oil Study Area Compared to Reference Area Concentrations

Medium	Unit	Harbor Oil Study Area		Reference Area Range
		Concentration Range	EPC	
Facility soil[a]	µg/kg dw	0.6 U to 78,000	11,000 to 16,000	15[b] to 355
Groundwater[a]	µg/L	0.0071 J to 0.24 J	0.049	na
Wetland soil	µg/kg dw	1.9 UJ to 46,000	9,100	15[b] to 355
Lake sediment	µg/kg dw	2.0 U to 250	not a COPC	16 to 19
Lake surface water	µg/L	0.010 U	not a COPC	na
Fish tissue[c]	µg/kg ww	81 to 407	300	25 to 30

[a] The range of EPCs from the worker RME scenarios is presented here.
[b] The low end of this range is the reporting limit; the concentration was not detected.
[c] Fish tissue concentrations were estimated using BSAFs (see Attachment 2).

BSAF – biota-sediment accumulation factor
COPC – contaminant of potential concern
dw – dry weight
EPC – exposure point concentration
J – estimated concentration
na – not available
RME – reasonable maximum exposure
U – not detected at given concentration

As shown in Table 4, both the wetland soil and the Facility soil EPCs were higher than the range of reference area concentrations for total DDTs. Fish tissue concentrations were estimated from sediment concentrations using literature BSAFs (see Attachment 2) for both the Study Area and reference area conditions. Based on this analysis, the Study Area fish tissue EPC was higher than the range of reference area concentrations for total DDTs.

6.0 Aliphatic Gasoline-Range TPH

No background or reference area information for TPH was available from any of the sources used for other metals or organic chemicals discussed in this attachment (listed in Section 1.0). Thus, background or reference area concentrations of TPH are not presented in the HHRA.

7.0 References

DEQ. 2002. Memorandum from Toxicology Workgroup to DEQ Cleanup Program Managers regarding default background concentrations for metals, October 28, 2002. Oregon Department of Environmental Quality, Portland, OR.

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DEQ. 2007. Guidance for assessing bioaccumulative chemicals of concern in sediment. 07-LQ-023A. April 3, 2007. Environmental Cleanup Program, Oregon Department of Environmental Quality, Portland, OR.

EPA. 2002. Guidance for comparing background and chemical concentrations in soil for CERCLA sites. EPA 540-R-01-003. OSWER 9285.7-41. Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC.

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