Table 7-1. Area A Ecological Soil Benchmark Screening for the Former Wood-treating Area and North Storage Area

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Dioxins/Furans											
1,2,3,4,6,7,8-HpCDD	2.06E-04	2.62E-01	AB4-5-0-4	104 (104)					--	Addressed by dioxin TEQ	--
1,2,3,4,6,7,8-HpCDF	3.30E-05	5.98E-02	SS-J28-29	104 (104)					--	Addressed by dioxin TEQ	--
1,2,3,4,7,8,9-HpCDF	3.26E-06	5.44E-03	AB4-5-0-4	102 (104)	8.50E-04	1.42E-03			--	Addressed by dioxin TEQ	--
1,2,3,4,7,8-HxCDD	7.55E-07	1.38E-03	AB4-5-0-4	103 (104)	4.76E-07	4.76E-07			--	Addressed by dioxin TEQ	--
1,2,3,4,7,8-HxCDF	2.85E-06	9.16E-03	J26-27 0-4	104 (104)					--	Addressed by dioxin TEQ	--
1,2,3,6,7,8-HxCDD	7.19E-06	7.62E-03	AB4-5-0-4	104 (104)					--	Addressed by dioxin TEQ	--
1,2,3,6,7,8-HxCDF	1.16E-06	1.49E-03	J26-27 0-4	104 (104)					--	Addressed by dioxin TEQ	--
1,2,3,7,8,9-HxCDD	1.08E-06	2.31E-03	AB4-5-0-4	104 (104)					--	Addressed by dioxin TEQ	--
1,2,3,7,8,9-HxCDF	2.17E-07	2.45E-03	SS-B4-5	66 (104)	1.09E-07	4.64E-04			--	Addressed by dioxin TEQ	--
1,2,3,7,8-PCDD	5.49E-07	3.17E-04	AB4-5-0-4	103 (104)	1.70E-07	1.70E-07			--	Addressed by dioxin TEQ	--
1,2,3,7,8-PCDF	2.36E-07	1.03E-03	SS-B4-5	101 (104)	1.60E-07	1.10E-05			--	Addressed by dioxin TEQ	--
2,3,4,6,7,8-HxCDF	2.53E-06	2.45E-03	J26-27 0-4	104 (104)					--	Addressed by dioxin TEQ	--
2,3,4,7,8-PCDF	2.97E-07	2.81E-03	SS-B4-5	103 (104)	1.08E-05	1.08E-05			--	Addressed by dioxin TEQ	--
2,3,7,8-TCDD	4.20E-07	2.40E-05	AB4-5-0-4	76 (104)	1.11E-07	6.77E-06			--	Addressed by dioxin TEQ	--
2,3,7,8-TCDF	3.96E-07	2.68E-04	SS-B4-5	92 (104)	7.38E-08	1.19E-06			--	Addressed by dioxin TEQ	--
OCDD	1.42E-03	2.73E+00	AB4-5-0-4	104 (104)					--	Addressed by dioxin TEQ	--
OCDF	1.34E-04	3.52E-01	AB4-5-0-4	104 (104)					--	Addressed by dioxin TEQ	--
TEQDF-WHO98 (ND = 1/2 DL)	6.42E-06	5.74E-03	AB4-5-0-4	104 (104)				104	2.00E-06	Washington State MTCA	Y
Metals											
Aluminum	2,140	4,650	E18-19 4-12	50 (50)				50	50	U.S. EPA 2004a	Y
Antimony	0.14	1.8	SS-A2-3	16 (50)	0.920	13.400	34	15	0.3	U.S. EPA 2003b	Y
Arsenic	0.75	6.2	SS-FPA-02	46 (50)	3.000	3.300			37	U.S. EPA 2000a	N
Barium	17.2	82.3	C3-4 4-12	50 (50)					330	U.S. EPA 2003c	N
Beryllium	0.057	0.21	SS-A4-5	50 (50)					35	U.S. EPA 2003d	N
Cadmium	0.11	0.19	SS-B1-2	4 (50)	0.065	1.100			0.38	U.S. EPA 2003e	N
Calcium	725	9,290	SS-E28-29	47 (50)	1080.000	1090.000			NR	Essential nutrient	--
Chromium	3.8	15.0	FOA1-COMP4 0-4	50 (50)				39	5	U.S. EPA 2000a	Y
Cobalt	2.1	5.5	FOA2-COMP2 4-12	50 (50)					13	U.S. EPA 2003f	N
Copper	1.5	18.0	SS-B4-5	50 (50)					61	U.S. EPA 2000a	N
Iron	3,580	12,900	SS-SEEP	50 (50)				50	NR	Essential nutrient; EPA 2003g	NR
Lead	2.1	70.9	SS-B1-2	50 (50)				9	16	U.S. EPA 2003h	Y
Magnesium	537	5,410	SS-E28-29	40 (50)	998.000	1050.000			NR	Essential nutrient	NR
Manganese	147	508	C3-4 4-12	50 (50)				50	100	U.S. EPA 2004a	Y

Table 7-1. Area A Ecological Soil Benchmark Screening for the Former Wood-treating Area and North Storage Area

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Mercury	0.0059	0.087	SS-FPA-02	25 (41)	0.006	0.100			0.1	U.S. EPA 2004a	N
Nickel	3.4	19	SS-FPA-01	50 (50)					30	U.S. EPA 2004a	N
Potassium	130	451	SS-SEEP	50 (50)					NR	Essential nutrient	NR
Selenium	0.53	1.3	FOA1-COMP4 0-4	3 (50)	0.300	7.800	21	2	0.81	U.S. EPA 2004a	Y
Silver	0.08	0.23	SS-G9-10	4 (50)	0.130	2.200	13		2	U.S. EPA 2004a	N
Sodium	34.6	279	SS-SEEP	38 (50)	58.600	1110.000			NR	Essential nutrient	--
Thallium	0.057	0.99	SS-B4-5	13 (50)	0.120	5.600	23		1	U.S. EPA 2004a	N
Vanadium	6.0	14.6	E18-19 4-12	50 (50)				50	2	U.S. EPA 2004a	Y
Zinc	7.9	45.5	I19-20 0-4	50 (50)					120	U.S. EPA 2000a	N
Polycyclic Aromatic Hydrocarbons (PAHs)											
2-Methylnaphthalene	0.006	0.200	A20-22 0-4	45 (93)	0.004	3.500	38	3	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Acenaphthene	0.004	0.190	FOA-02-1-0-4	18 (113)	0.003	3.500			20	U.S. EPA 2004a	N
Acenaphthylene	0.003	0.550	DE8-9 0-4	60 (113)	0.003	3.400	35	14	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Anthracene	0.005	1.400	DE8-9 0-4	74 (113)	0.003	3.400	26	31	0.1	U.S. EPA 2004a	Y
Benzo(a)anthracene	0.005	6.100	DE8-9 0-4	93 (113)	0.003	3.400	16	42	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Benzo(a)pyrene	0.003	7.700	DE8-9 0-4	100 (113)	0.004	2.100	10	51	0.1	U.S. EPA 2004a	Y
Benzo(b)fluoranthene	0.010	18.000	DE8-9 0-4	88 (93)	0.005	0.380	4	61	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Benzo(g,h,i)perylene	0.004	2.700	DE8-9 0-4	70 (113)	-99.999	3.400	33	39	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Benzo(k)fluoranthene	0.004	15.000	DE8-9 0-4	104 (113)	0.004	2.100	7	65	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Chrysene	0.003	14.000	DE8-9 0-4	106 (113)	0.005	0.700	6	68	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Dibenz(a,h)anthracene	0.002	0.980	DE8-9 4-12	57 (113)	-99.999	3.400	38	15	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Fluoranthene	0.006	6.900	C23-24 0-4	99 (113)	0.005	0.700	11	67	0.1	U.S. EPA 2004a	Y
Fluorene	0.003	0.096	FOA-02-1-0-4	25 (113)	0.003	3.500	53		0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	N
Indeno(1,2,3-cd)pyrene	0.003	4.800	DE8-9 0-4	94 (113)	0.004	3.400	17	53	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Naphthalene	0.006	0.190	A20-22 0-4	43 (93)	0.004	3.500	40	4	0.1	U.S. EPA 2004a	Y

Table 7-1. Area A Ecological Soil Benchmark Screening for the Former Wood-treating Area and North Storage Area

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Phenanthrene	0.003	1.200	C23-24 0-4, SS-B1-2	75 (113)	0.003	3.500	28	21	0.1	U.S. EPA 2004a	Y
Pyrene	0.005	16.000	SS-J28-29	98 (113)	0.005	0.700	12	67	0.1	U.S. EPA 2004a	Y
Total Polynuclear Aromatic Hyd	0.970	0.970	SS-SEEP	1 (1)					1	U.S. EPA 2004a	N
Pesticides											
4,4`-DDD	0.001	0.004	DE8-9 4-12	3 (12)	0.003	0.004	9	1	0.0025	U.S. EPA 2004a	Y
4,4`-DDE	0.001	0.002	I19-20 0-4	6 (12)	0.003	0.003	6		0.0025	U.S. EPA 2004a	N
4,4`-DDT	0.001	0.009	I19-20 0-4	9 (12)	0.003	0.004	3	5	0.0025	U.S. EPA 2004a	Y
Semivolatile Organic Compounds (SVOCs)											
2,4-Dimethylphenol	0.014	0.014	F27-29 4-12	1 (49)	0.033	3.500	48	1	0.01	U.S. EPA 2004b	Y
2,4-Dinitrotoluene	2.000	2.000	SS-E21-22	1 (49)	-99.999	3.500	5	1	1.28	U.S. EPA 2004a	Y
4-Nitrophenol	2.900	2.900	SS-E21-22	1 (37)	-99.999	8.700	1		7	U.S. EPA 2004a	N
Benzaldehyde	0.034	1.000	SS-SEEP	7 (48)	-99.999	3.500			NA		--
Biphenyl	0.012	0.012	A12-14 4-12	1 (49)	0.022	3.500			60	U.S. EPA 2004a	N
Bis(2-ethylhexyl)phthalate	0.011	0.390	SS-SEEP	7 (49)	0.330	3.500			100	U.S. EPA 2004a; diethylphthalate used as surrogate	N
Butyl benzyl phthalate	0.041	0.041	SS-G9-10	1 (49)	0.003	3.500			100	U.S. EPA 2004a; diethylphthalate used as surrogate	N
Carbazole	0.011	0.120	F27-29 4-12	13 (22)	0.340	3.500			NA		--
Carbon disulfide	0.002	0.002	SS-FPA-02	1 (27)	0.009	0.031			0.0941	U.S. EPA 2004b	N
Dibenzofuran	0.003	0.040	A12-14 4-12	9 (69)	0.003	3.500			NA		--
Di-n-octyl phthalate	0.015	0.071	C23-24 0-4	2 (41)	-99.999	3.500			100	U.S. EPA 2004a; diethylphthalate used as surrogate	N
p-Cresol	0.012	0.019	F27-29 4-12	2 (49)	0.330	3.500	9		0.5	U.S. EPA 2004a; cresols used as surrogate	N
Pentachlorophenol	0.009	49.000	SS-J28-29	88 (109)	0.051	8.700	21	88	0.002	U.S. EPA 2004a	Y
Volatile Organic Compounds (VOCs)											
1,1,2,2-Tetrachloroethane	0.001	0.003	SS-FPB-01, SS-G16-17, SS-A2-3, SS-SEEP	12 (27)	0.010	0.019			0.127	U.S. EPA 2004b	N
1,1,2-Trichloroethane	0.001	0.009	SS-FSIL-02, SS-FPB-01	19 (27)	0.011	0.014			0.518	U.S. EPA 2004b	N
1,2-Dichloroethane	0.001	0.006	SS-C14-16	6 (27)	0.009	0.031			21.2	U.S. EPA 2004b	N
1,2-Dichloroethylene, cis-	0.002	0.003	SS-FSIL-02	2 (27)	0.009	0.031			0.784	U.S. EPA 2004b; trans-1,2-dichloroethylene used as surrogate	N
Acetone	0.043	0.180	SS-G9-10	24 (27)	0.011	0.011			2.5	U.S. EPA 2004b	N
Chlorobenzene	0.002	0.002	SS-E21-22	1 (27)	0.009	0.031			13.1	U.S. EPA 2004b	N
Chloromethane	0.006	0.016	SS-FPB-01	3 (27)	0.009	0.031			10.4	U.S. EPA 2004b	N

Table 7-1. Area A Ecological Soil Benchmark Screening for the Former Wood-treating Area and North Storage Area

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Methyl acetate	0.012	0.065	SS-G9-10	5 (27)	0.009	0.015			NA		--
Methyl ethyl ketone	0.006	0.024	SS-B4-5	5 (27)	0.010	0.031			89.6	U.S. EPA 2004b	N
Tetrachloroethylene	0.001	0.002	SS-FSIL-02, SS-FPB-01	3 (27)	0.009	0.031			9.92	U.S. EPA 2004b	N
Toluene	0.001	0.007	SS-SEEP	3 (27)	0.009	0.019			0.05	U.S. EPA 2004a	N
Trichloroethylene	0.001	0.007	SS-FSIL-02	8 (27)	0.009	0.031			12.4	U.S. EPA 2004b	N

(1) Only those analytes detected at least once are presented.

(2) The number in parentheses is the total number of samples; the number not in parentheses is the number of samples with detected concentrations.

(3) Sources of benchmarks:

Washington State Model Toxics Control Act (MTCA) (173-340 WAC; Table 749-3)

U.S. EPA. 2004a. U.S. EPA Region 4 Recommended Ecological Screening Values for Soil, http://www.epa.gov/region4/waste/ots/epatab4.pdf

U.S. EPA. 2004b. U.S. EPA Region 5 RCRA Ecological Screening Levels, http://www.epa.gov/reg5rcra/ca/ESL.pdf

NA - not available

NR - not required; calcium, iron, magnesium, potassium, and sodium are essential nutrients that are toxic only at very high doses (U.S. EPA 1989) and were not included in the COPEC selection process

Table 7-2. Summary of Qualitative Screening of Chemicals and Identification of COPECs for the Former Wood-treating Area and North Storage Area

Chemical	Qualitative Screening Summary	COPEC (Y/N)
Aluminum	Site level is comparable to background	N
Antimony	Site level is comparable to background and not associated with wood-treating operations	N
Chromium	Several samples exceeded background levels, and many exceeded the ecological benchmark	Y
Lead	Several samples exceeded ecological benchmarks and background levels	Y
Manganese	Site level is comparable to background	N
Selenium	Site level is comparable to background and not associated with wood-treating operations	N
Vanadium	Site level if comparable to background and not associated with wood-treating operations	N
Dioxins	Frequently exceeded ecological benchmark and background levels	Y
PAHs	Frequently exceeded ecological benchmarks and background levels	Y
Pentachlorophenol	Frequently exceeded ecological benchmarks and background levels	Y
4,4'-DDD, 4,4'-DDT	Ubiquitous in the environment, relatively low site levels unlikely to pose risk to birds and mammals	N
2,4-Dimethylphenol	Low detection frequency and low persistence	N
2,4-Dinitrotoluene	Low detected frequency and low persistence	N
Benzaldehyde	No benchmark available; natural sources and low potential toxicity	N
Carbazole	No benchmark available; natural sources and low potential toxicity	N
Dibenzofuran	No benchmark available; natural sources and low relative levels	N
Methyl acetate	No benchmark available; natural sources and low potential toxicity	N

Table 7-3. Summary of Toxic Effects of COPECs in Soil at the Former Wood-treating Area and North Storage Area

Chemical	Soil Toxicity Threshold for Plants (ppm)	Soil Toxicity Threshold for Soil Invertebrates (ppm)	Dose Threshold to Birds and Mammals (mg/kg/day)
Chromium	1.8	2.0	5
Lead	100	500	11
Pentachlorophenol	3	6	0.67
PAHs	25	unknown	10.8
Chlorinated dioxins/furans	Not expected to adversely affect plants	Not expected to adversely affect soil invertebrates	0.0000011

Table 7-4. Summary of Fate and Transport Characteristics for COPECs in the Terrestrial Habitat at the Former Wood-treating Area and North Storage Area

Chemical	Fate and Transport	Bioaccumulation Potential
Chromium	• Mainly present as insoluble oxide • Cr (III) and Cr (VI) are more soluble, but solubility dependent on clay, Fe_2O_3, and organic matter content	Plants – low Soil invertebrates – moderate
Lead	• Low mobility, but increases with decreasing pH and coarser texture	Plants – low Soil invertebrates – high
Pentachlorophenol	• Low water solubility, but co-solvents may increase mobility • Readily degraded by chemical, microbial, and photochemical processes	Plants – high Soil invertebrates – high
PAHs	• Low molecular weight PAHs more soluble and mobile • Adsorption increase with increasing organic matter • Volatilization and biodegradation are important fate processes	Plants – moderate Soil invertebrates – unknown
Dioxins	• Low water solubility • Persistent and strongly adsorbed to soil	Plants – low Soil invertebrates - high

Table 7-5. Surrogate Wildlife Species Selected by EPA to Derive Ecological Soil Screening Levels

Receptor Group	Surrogate Species
Mammalian Herbivore	Meadow Vole
Mammalian Ground Insectivore	Short-tailed Shrew
Mammalian Carnivore	Weasel
Avian Granivore	Mourning Dove
Avian Ground Insectivore	American Woodcock
Avian Carnivore	Red-tailed Hawk

Table 7-6. Ecological Receptors of Concern, Exposure Routes, and Potentially Contaminated Media—Terrestrial Habitat of Areas A and B

Species Assemblage	Receptors of Concern	Trophic Level/Feeding Guild	Route of Exposure	Exposure Media			
				Soil	Soil Porewater	Surface Water	Terrestrial Biota
Terrestrial Plants	Grasses[a]	Primary Producer	Respiration[c]	☐	--	--	--
			Ingestion	--	--	--	--
			Dermal Contact	●	●	--	--
Soil-dwelling Invertebrates	Worms, grubs[a]	Herbivore, Detritovore	Respiration[c]	☐	--	--	--
			Ingestion	●	--	--	●
			Dermal Contact	●	●	--	--
Terrestrial Birds	American Robin	Omnivore	Inhalation[b]	☐	--	--	--
			Ingestion	●	--	●	●
			Dermal Contact	☒	--	☒	--
Terrestrial Mammals	Meadow Vole	Herbivore	Inhalation[b]	☐	--	--	--
			Ingestion	●	--	●	●
			Dermal Contact	☒	--	☒	--
	Northern Short-tailed Shrew	Insectivore	Inhalation[b]	☐	--	--	--
			Ingestion	●	--	●	●
			Dermal Contact	☒	--	☒	--

[a] These receptors will be evaluated for bioaccumulation and as vectors for chemical exposure to higher trophic levels.
[b] Inhalation of soil refers to inhalation of chemicals associated with fugitive dust and inhalation of volatile chemicals released from soil.
[c] Respiration of soil refers to exchange of volatile chemicals released from soil.
Symbols:

- ● = Primary pathway
- ❑ = Secondary pathway
- ☒ = Complete, but too uncertain to evaluate
- --= Incomplete/inapplicable pathway

Table 7-7. Area B Ecological Soil Benchmark Screening for the Southwest Area and Former City Dump

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Dioxins/Furans											
1,2,3,4,6,7,8-HpCDD	1.04E-03	1.73E-01	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,4,6,7,8-HpCDF	2.57E-04	2.08E-02	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,4,7,8,9-HpCDF	2.02E-05	1.93E-03	SS-SW7	11 (13)	6.64E-04	1.04E-03			--	Addressed by dioxin TEQ	--
1,2,3,4,7,8-HxCDD	6.84E-06	6.00E-04	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,4,7,8-HxCDF	3.48E-05	5.46E-04	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,6,7,8-HxCDD	4.50E-05	4.71E-03	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,6,7,8-HxCDF	1.33E-05	2.43E-04	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,7,8,9-HxCDD	1.26E-05	1.24E-03	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,7,8,9-HxCDF	4.12E-06	1.95E-04	SS-SW32	8 (13)	1.56E-05	2.21E-05			--	Addressed by dioxin TEQ	--
1,2,3,7,8-PCDD	2.44E-06	2.61E-04	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
1,2,3,7,8-PCDF	4.53E-06	1.23E-04	SS-SW37	13 (13)					--	Addressed by dioxin TEQ	--
2,3,4,6,7,8-HxCDF	1.55E-05	6.18E-04	SS-SW7	13 (13)					--	Addressed by dioxin TEQ	--
2,3,4,7,8-PCDF	8.20E-06	1.23E-04	SS-SW37	13 (13)					--	Addressed by dioxin TEQ	--
2,3,7,8-TCDD	6.04E-07	2.11E-05	SS-SW37	6 (13)	3.59E-07	8.10E-07			--	Addressed by dioxin TEQ	--
2,3,7,8-TCDF	6.74E-07	1.73E-05	SS-FCDP-01	11 (13)	1.01E-06	6.06E-06			--	Addressed by dioxin TEQ	--
OCDD	7.43E-03	5.17E-01	SW-41 0-4	13 (13)					--	Addressed by dioxin TEQ	--
OCDF	5.50E-04	6.01E-02	SW-7 4-12	13 (13)					--	Addressed by dioxin TEQ	--
TEQDF-WHO98 (ND = 1/2 DL)	4.20E-05	3.14E-03	SS-SW7	13 (13)				13	2.00E-06	Washington State MTCA	Y
Metals											
Aluminum	2,440	3,060	SS-SW1	7 (7)				7	50	U.S. EPA 2004a	Y
Antimony	1.2	2.7	SS-SW37	4 (7)	0.840	1.500	3	4	0.29	U.S. EPA 2000a	Y
Arsenic	0.63	2.7	SS-SW1	7 (7)					37	U.S. EPA 2000a	N
Barium	24.1	104	SS-SW32	7 (7)					330	U.S. EPA 2000a	N
Beryllium	0.081	0.14	SS-SW1	7 (7)					36	U.S. EPA 2000a	N
Cadmium	0.12	0.73	SS-SW32	4 (7)	0.081	0.088		1	0.38	U.S. EPA 2000a	Y
Calcium	635	25,700	SS-FCDP-01	7 (7)					NR	Essential nutrient	--
Chromium	4.8	40.6	SS-SW35	7 (7)				5	5	U.S. EPA 2000a	Y
Cobalt	2.5	3.6	SS-SW1	7 (7)					13	U.S. EPA 2000a	N
Copper	3.1	10.7	SS-FCDP-01	7 (7)					61	U.S. EPA 2000a	N
Iron	4,340	5,690	SS-FCDP-01	7 (7)				7	NR	Essential nutrient	--
Lead	5.7	190	SS-SW35	7 (7)				4	16	U.S. EPA 2000a	Y
Magnesium	596	8,120	SS-FCDP-01	7 (7)					NR	Essential nutrient	--
Manganese	163	508	SS-SW32	7 (7)				7	100	U.S. EPA 2004a	Y

Table 7-7. Area B Ecological Soil Benchmark Screening for the Southwest Area and Former City Dump

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Mercury	0.0088	0.044	SS-SW32	7 (7)					0.1	U.S. EPA 2004a	N
Nickel	3.9	5.6	SS-FCDP-01	7 (7)					30	U.S. EPA 2004a	N
Potassium	267	916	SS-FCDP-01	7 (7)					NR	Essential nutrient	--
Sodium	89.1	158	SS-SW32	7 (7)					NR	Essential nutrient	--
Thallium	0.45	1.1	SS-SW32	5 (7)	0.150	0.420		1	1	U.S. EPA 2004a	Y
Vanadium	6.7	8.6	SS-SW1 SS-FCDP-01	7 (7)				7	2	U.S. EPA 2004a	Y
Zinc	14.5	225	SS-SW35	7 (7)				1	120	U.S. EPA 2000a	Y
Polycyclic Aromatic Hydrocarbons (PAHs)											
2-Methylnaphthalene	0.009	0.024	SS-FCDP-01	2 (9)	0.330	0.370	7		0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	N
Acenaphthene	0.001	0.010	SW-44 0-4	3 (14)	0.001	0.670			20	U.S. EPA 2004a	N
Acenaphthylene	0.002	0.100	SS-SW3	8 (14)	0.330	0.670	6		0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	N
Anthracene	0.004	0.250	SS-SW32	9 (14)	0.340	0.670	5	3	0.1	U.S. EPA 2004a	Y
Benzo(a)anthracene	0.007	0.670	SW-44 0-4	13 (14)	0.370	0.370	1	7	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Benzo(a)pyrene	0.009	0.750	SS-SW32	13 (14)	0.370	0.370	1	6	0.1	U.S. EPA 2004a	Y
Benzo(b)fluoranthene	0.041	3.200	SS-SW32	9 (9)				7	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Benzo(g,h,i)perylene	0.003	0.440	SW-44 0-4	6 (14)	0.004	0.670	7	1	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Benzo(k)fluoranthene	0.008	1.600	SS-SW32	13 (14)	0.370	0.370	1	8	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Chrysene	0.011	1.300	SS-SW32	13 (14)	0.370	0.370	1	8	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Dibenz(a,h)anthracene	0.002	0.110	SW-44 0-4	5 (14)	-99.999	0.670	5	1	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y
Fluoranthene	0.025	1.500	SW-44 0-4	11 (14)	0.370	0.820	3	9	0.1	U.S. EPA 2004a	Y
Fluorene	0.002	0.015	SW-44 0-4	4 (14)	0.004	0.670	9		0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	N
Indeno(1,2,3-cd)pyrene	0.005	0.740	SW-44 0-4	13 (14)	0.370	0.370	1	5	0.1	U.S. EPA 2004a; benzo(a)pyrene used as surrogate	Y

Table 7-7. Area B Ecological Soil Benchmark Screening for the Southwest Area and Former City Dump

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Detection Frequency (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Benchmark	Frequency Detected Concentration Exceeds Benchmark	Screening Benchmark	Source (3)	Maximum Detect Exceeds Benchmark (Y/N)
Naphthalene	0.019	0.020	SS-FCDP-01	2 (9)	0.330	0.370	7		0.1	U.S. EPA 2004a	N
Phenanthrene	0.010	0.350	SW-44 0-4	11 (14)	0.340	0.670	3	2	0.1	U.S. EPA 2004a	Y
Pyrene	0.049	1.200	SW-44 0-4	9 (14)	0.013	1.000	3	6	0.1	U.S. EPA 2004a	Y
Total PAHs	1.000	1.000	SS-FCDP-01	1 (1)					1		N
Semivolatile Organic Compounds (SVOCs)											
2,4-Dinitrotoluene	1.500	1.500	SS-SW37	1 (7)	-99.999	0.340		1	1.28	U.S. EPA 2004a	Y
4-Chloro-3-methylphenol	2.400	2.400	SS-SW37	1 (7)	0.330	0.370			NA		--
4-Nitrophenol	3.500	3.500	SS-SW37	1 (7)	-99.999	0.860			7	U.S. EPA 2004a	N
Benzaldehyde	0.034	0.920	SS-SW32	5 (7)	-99.999	0.340			NA		--
Bis(2-ethylhexyl)phthalate	0.038	0.059	SS-FCDP-01	2 (7)	0.330	0.370			100	U.S. EPA 2004a; diethylphthalate used as surrogate	N
Carbon disulfide	0.003	0.003	SS-FCDP-01	1 (7)	0.012	0.033			0.0941	U.S. EPA 2004b	N
Dibenzofuran	0.002	0.006	SS-FCDP-01	2 (12)	0.004	0.670			NA		--
Pentachlorophenol	0.038	23.000	SS-SW7	11 (11)				11	0.002	U.S. EPA 2004a	Y
Volatile Organic Compounds (VOCs)											
1,1,2,2-Tetrachloroethane	0.001	0.006	SS-SW32	4 (7)	0.012	0.022			0.127	U.S. EPA 2004b	N
1,1,2-Trichloroethane	0.003	0.004	SS-SW32	4 (7)	0.012	0.017			0.518	U.S. EPA 2004b	N
Acetone	0.048	0.290	SS-SW32	7 (7)					2.5	U.S. EPA 2004b	N
Benzene	0.002	0.002	SS-FCDP-01	1 (7)	0.012	0.033			0.05	U.S. EPA 2004a	N
Methyl acetate	0.005	0.005	SS-SW1	1 (7)	0.012	0.033			NA		--
Methyl ethyl ketone	0.011	0.034	SS-SW32	4 (7)	0.012	0.022			89.6	U.S. EPA 2004b	N
Toluene	0.005	0.005	SS-FCDP-01	1 (7)	0.012	0.033			0.05	U.S. EPA 2004a	N

(1) Only those analytes detected at least once are presented.

(2) The number in parentheses is the total number of samples; the number not in parentheses is the number of samples with detected concentrations.

(3) Sources of benchmarks:

Washington State Model Toxics Control Act (MTCA) (173-340 WAC; Table 749-3)

U.S. EPA. 2004a. U.S. EPA Region 4 Recommended Ecological Screening Values for Soil, http://www.epa.gov/region4/waste/ots/epatab4.pdf

U.S. EPA. 2004b. U.S. EPA Region 5 RCRA Ecological Screening Levels, http://www.epa.gov/reg5rcra/ca/ESL.pdf

Table 7-8. Summary of Qualitative Screening and Identification of COPECs in Soil for Area B

Chemical	Qualitative Screening Summary	COPEC (Y/N)
Aluminum	Site level comparable to background	N
Antimony	Site level is comparable to background and not associated with wood-treating operation	N
Cadmium	Low magnitude and frequency of exceedence of benchmark and not associated with wood-treating operations	N
Chromium	Several samples exceeded background levels and many exceeded the ecological benchmark	Y
Lead	Lead levels in 2 of 7 soil samples exceeded the ecological benchmark and background levels	Y
Manganese	Site levels comparable to background	N
Thallium	Site level comparable to background, not associated with wood-treating activities, and relatively low detected levels	N
Vanadium	Site level comparable to background and not associated with wood-treating operations	N
Zinc	Frequently exceeded ecological benchmark and background levels	Y
Dioxins	Frequently exceeded ecological benchmark and background levels	Y
PAHs	Frequently exceeded ecological benchmarks and background levels	Y
Pentachlorophenol	Frequently exceeded ecological benchmarks and background levels	Y
2,4-Dinitrotoluene	Low detection frequency and low persistence	N
Benzaldehyde	No benchmark available; natural sources and low potential toxicity	N
3-Methyl-4-chlororphenol	No benchmark available; low potential toxicity, short soil half-life, and not associated with wood-treating operations	N
Dibenzofuran	No benchmark available; natural sources and low relative levels	N
Methyl acetate	No benchmark available; natural sources and low potential toxicity	N

Table 7-9. Area B Ecological Sediment Benchmark Screening

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Frequency of Detection (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Screening Benchmark	Frequency Detected Concentration Exceeds Screening Benchmark	Ecological Screening Benchmark		
									Concentration	Type	Source
Dioxins/Furans (mg/kg)											
1,2,3,4,6,7,8-HpCDD	1.70E-06	3.29E-03	SD-FCCD-01	26 (26)							
1,2,3,4,6,7,8-HpCDF	2.37E-07	4.41E-04	SD-FCCD-01	26 (26)							
1,2,3,4,7,8,9-HpCDF	1.75E-06	3.11E-05	SD-FCCD-01	14 (26)	1.16E-07	2.01E-06					
1,2,3,4,7,8-HxCDD	9.05E-07	2.50E-05	SD-FCCD-01	15 (26)	2.19E-07	3.53E-06					
1,2,3,4,7,8-HxCDF	1.55E-06	4.09E-05	SD-FCCD-01	16 (26)	2.07E-07	5.29E-07					
1,2,3,6,7,8-HxCDD	3.66E-07	1.00E-04	SD-FCCD-01	19 (26)	2.44E-07	4.79E-07					
1,2,3,6,7,8-HxCDF	1.25E-07	5.16E-05	SD-FCCD-03	17 (26)	2.83E-07	5.19E-07					
1,2,3,7,8,9-HxCDD	2.05E-06	5.18E-05	SD-FCCD-01	15 (26)	4.33E-07	4.42E-06					
1,2,3,7,8,9-HxCDF	9.13E-07	1.72E-05	SD-FCCD-03	12 (26)	2.49E-07	2.37E-06					
1,2,3,7,8-PCDD	1.36E-06	1.34E-05	SD-FCCD-01	10 (26)	2.19E-07	2.43E-06					
1,2,3,7,8-PCDF	9.39E-07	7.28E-06	SD-FCCD-02	11 (26)	2.47E-07	1.07E-05					
2,3,4,6,7,8-HxCDF	1.14E-06	9.93E-05	SD-FCCD-03	16 (26)	0.00000025	5.94E-07					
2,3,4,7,8-PCDF	1.53E-06	1.62E-04	SD-FCCD-03	13 (26)	1.81E-07	2.64E-06					
2,3,7,8-TCDD	1.47E-06	1.92E-05	SD-FCCD-01	7 (26)	8.79E-08	1.25E-06					
2,3,7,8-TCDF	2.47E-07	1.78E-05	SD-FCCD-03	15 (26)	6.1E-08	1.04E-06					
OCDD	8.61E-06	3.46E-02	SD-FCCD-01	26 (26)							
OCDF	6.82E-07	1.42E-03	SD-FCCD-01	26 (26)							
HpCDD, Total	3.50E-06	6.11E-03	SD-FCCD-01	26 (26)							
HpCDF, Total	5.09E-07	1.34E-03	SD-FCCD-01	26 (26)							
HxCDD, Total	3.24E-07	7.53E-04	SD-FCCD-01	22 (23)		4.39E-07					
HxCDF, Total	1.69E-07	1.22E-03	SD-FCCD-01	25 (25)							
PCDD, Total	2.98E-06	1.61E-04	SD-FCCD-03	16 (19)	5.02E-07	6.4E-07					
PCDF, Total	6.13E-07	1.88E-03	SD-FCCD-03	19 (19)							
TCDD, Total	8.85E-07	7.27E-05	SD-FCCD-01	13 (19)	3.84E-07	1.91E-06					
TCDF, Total	2.47E-07	7.13E-04	SD-FCCD-01	20 (21)		4.76E-07					
TEQDF-WHO98 (ND = 1/2 DL)	4.00E-07	1.76E-04	SD-FCCD-01	26 (26)				19	0.00000085	ISQG	CCME 2002
Metals (mg/kg)											
Aluminum	563	8,240	SD-FCCD-03	32 (32)					26000	TEL	Ingersoll et al. 1996
Antimony	0.20	8.00	SD-RR-03	6 (32)	0.64	10.60	18	2	3	LAET	Cubbage et al. 1997
Arsenic	0.49	30.60	SD-FCCD-03	12 (32)	0.46	17.90	10	6	9.79	TEC	MacDonald et al. 2000

Table 7-9. Area B Ecological Sediment Benchmark Screening

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Frequency of Detection (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Screening Benchmark	Frequency Detected Concentration Exceeds Screening Benchmark	Ecological Screening Benchmark		
									Concentration	Type	Source
Barium	7.80	216	SD-CLDH-02	32 (32)							
Beryllium	0.13	1.20	SD-FCCD-05	13 (32)	0.08	1.30					
Cadmium	0.30	12.60	SD-FCCD-03	11 (32)	0.10	1.80	13	8	0.99	TEC	MacDonald et al. 2000
Calcium	2,340	216,000	SD-CLDH-01	32 (32)							
Chromium	1.20	43.40	SD-FCCD-03	30 (32)	3.40	3.70			43.4	TEC	MacDonald et al. 2000
Cobalt	0.50	10.40	SD-FCCD-03	20 (32)	2.40	6.20					
Copper	0.50	523	SD-FCCD-03	31 (32)	6.40	6.40		8	31.6	TEC	MacDonald et al. 2000
Iron	916	21,600	SD-FCCD-03	32 (32)					190000	TEL	Ingersoll et al. 1996
Lead	0.65	493.00	SD-FCCD-03	31 (32)	0.55	0.55		8	35.8	TEC	MacDonald et al. 2000
Magnesium	333	5,770	SD-PBDH-01	32 (32)							
Manganese	23.00	2,520	SD-FCD-01	32 (32)				15	630	TEL	Ingersoll et al. 1996
Mercury	0.06	11.10	SD-FCCD-03	11 (32)	0.06	1.10	13	8	0.18	TEC	MacDonald et al. 2000
Nickel	0.92	26.40	SD-FCCD-03	23 (32)	5.00	8.80		2	22.7	TEC	MacDonald et al. 2000
Potassium	97.20	1,230	SD-FCCD-05	32 (32)							
Selenium	1.00	12.40	SD-FCCD-03	11 (32)	0.56	13.80		11	0.1		Tetra Tech 2004a
Silver	0.13	80.70	SD-FCCD-03	14 (32)	0.16	3.80		8	4.5	LAET	Cubbage et al. 1997
Sodium	89.20	3,370	SD-PBDH-01	32 (32)							
Thallium	0.06	0.35	SD-FCCD-03	5 (32)	0.89	14.90					
Vanadium	1.30	34.30	SD-FCCD-03	32 (32)							
Zinc	2.70	4,090	SD-FCCD-03	32 (32)				9	121	TEC	MacDonald et al. 2000
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg)											
2-Methylnaphthalene	0.039	0.34	SD-FCCD-03	3 (28)	0.024	5.4					
Acenaphthene	0.014	0.16	SD-HWY-03	19 (46)	0.0022	0.17			4.1	LAET	Cubbage et al. 1997
Acenaphthylene	0.0063	0.69	SD-FCCD-03	20 (46)	0.0022	0.24			2.2	LAET	Cubbage et al. 1997
Anthracene	0.016	1	SD-HWY-03	20 (46)	0.0022	0.67	17	13	0.0572	TEC	MacDonald et al. 2000
Benzo(a)anthracene	0.00088	4	SD-HWY-03	33 (46)	0.0022	0.48	10	24	0.108	TEC	MacDonald et al. 2000
Benzo(a)pyrene	0.00085	3.8	SD-HWY-03	29 (46)	0.02	0.47	14	18	0.15	TEC	MacDonald et al. 2000
Benzo(b)fluoranthene	0.00067	5.7	SD-FCCD-03	35 (46)	0.13	0.47					
Benzo(k)fluoranthene	0.001	4.1	SD-HWY-03	29 (46)	0.0022	0.76					
Total Benzofluoranthenes	0.00067	7.7	SD-HWY-03	--	--	--	--	20	0.027	TEL	Ingersoll et al. 1996
Benzo(g,h,i)perylene	0.00062	2.5	SD-FCCD-03	31 (46)	0.16	0.59	15	24	0.016	TEL	Ingersoll et al. 1996
Chrysene	0.0008	5.4	SD-HWY-03	37 (46)	0.018	0.41	6	29	0.166	TEC	MacDonald et al. 2000

Table 7-9. Area B Ecological Sediment Benchmark Screening

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Frequency of Detection (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Screening Benchmark	Frequency Detected Concentration Exceeds Screening Benchmark	Ecological Screening Benchmark		
									Concentration	Type	Source
Dibenz(a,h)anthracene	0.0047	1.4	SD-FCCD-03	21 (46)	0.0022	0.3	17	17	0.033	TEC	MacDonald et al. 2000
Fluoranthene	0.0015	8.5	SD-HWY-03	39 (46)	0.2	0.74	4	26	0.423	TEC	MacDonald et al. 2000
Fluorene	0.0061	0.34	SD-FCCD-03	19 (46)	0.0022	0.44	18	7	0.0774	TEC	MacDonald et al. 2000
Indeno(1,2,3-cd)pyrene	0.00054	2.7	SD-FCCD-03	30 (46)	0.36	1.3	16	24	0.017	TEL	Ingersoll et al. 1996
Naphthalene	0.054	1.9	SD-FCSW-01	4 (28)	0.018	5.4	13	2	0.176	TEC	MacDonald et al. 2000
Phenanthrene	0.00074	2.7	SD-FCCD-03	36 (46)	0.0022	0.2		26	0.204	TEC	MacDonald et al. 2000
Pyrene	0.0016	6.4	SD-HWY-03	39 (46)	0.21	0.77	7	29	0.195	TEC	MacDonald et al. 2000
Total PAH	0.22	39	SD-FCCD-03	5 (5)				3	1.61	TEC	MacDonald et al. 2000
Pesticides (mg/kg)											
4,4`-DDD	0.0015	0.0015	SD-FCD-04	1 (9)	0.002	0.024	5		0.00488	TEC	MacDonald et al. 2000
4,4`-DDE	0.0006	0.1700	SD-FCCD-03	2 (14)	0.002	0.045	9	1	0.00316	TEC	MacDonald et al. 2000
4,4`-DDT	0.0006	0.0830	SD-FCCD-03	3 (14)	0.002	0.024	8	1	0.00416	TEC	MacDonald et al. 2000
Chlordane	0.0004	0.0037	SD-CLDH-01	5 (9)	0.0011	0.012	2	2	0.00324	TEC	MacDonald et al. 2000
Endrin Aldehyde	0.0093	0.0093	SD-FCD-01	1 (9)	0.002	0.024					
Heptachlor Epoxide	0.0003	0.0023	SD-FCD-01	4 (9)	0.0011	0.012	4		0.00247	TEC	MacDonald et al. 2000
Aroclor-1254	0.1700	0.6700	SD-FCCD-03	2 (20)	0.02	0.5	14	2	0.0598	TEC	MacDonald et al. 2000
Aroclor-1260	0.8800	0.8800	SD-FCCD-03	1 (20)	0.02	0.5	15	1	0.0598	TEC	MacDonald et al. 2000
Total PCBs	0.1700	1.6000	SD-FCCD-03	2 (5)	0.109999999	0.14					
Semivolatile Organic Compounds (SVOCs) (mg/kg)											
4-Chloroaniline	0.21	0.87	SD-FCCD-03	2 (28)	0.011	5.4					
Acetophenone	0.3	1.3	SD-PBDH-01	2 (28)	0.1	5.4					
Benzaldehyde	0.3	5.2	SD-FCD-01	4 (28)	0.1	0.81					
Bis(2-ethylhexyl)phthalate	1.1	10	SD-FCCD-01	9 (28)	0.15	5.4	5	9	0.75	LAET	Cubbage et al. 1997
Dibenzofuran	0.18	0.29	SD-FCCD-03	2 (28)	0.029	5.4			32	LAET	Cubbage et al. 1997
Di-n-butyl phthalate	0.03	0.03	SD-CLDH-01	1 (28)	0.031	5.4	23		0.043	LAET	Cubbage et al. 1997
p-Cresol	0.11	0.28	SD-FCCD-03	2 (28)	0.023	5.4					
Phenol	0.036	0.076	SD-FCCD-03	4 (5)	0.028	0.028		2	0.048	LAET	Cubbage et al. 1997
Volatile Organic Compounds (VOCs) (mg/kg)											
Acetone	0.041	4.3	SD-FCCD-03	24 (28)	0.92	1.3					
Bromoform	0.01	0.41	SD-FCSW-03	26 (28)	0.013	0.063					
Carbazole	0.12	0.33	SD-FCCD-03	3 (5)	0.098	0.13					
Carbon disulfide	0.009	1.9	SD-FCSW-03	27 (28)	0.063	0.063					

Table 7-9. Area B Ecological Sediment Benchmark Screening

Chemical (mg/kg) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Frequency of Detection (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Screening Benchmark	Frequency Detected Concentration Exceeds Screening Benchmark	Ecological Screening Benchmark		
									Concentration	Type	Source
Cumene (isopropyl benzene)	0.062	0.062	SD-FCSW-03	1 (28)	0.011	0.31					
Methyl acetate	0.16	0.85	SD-RR-01	5 (28)	0.011	0.33					
Methyl ethyl ketone	0.13	0.63	SD-FCCD-03	8 (28)	0.011	0.31					
Methyl tertiary butyl ether	0.037	0.037	SD-PBDH-01	1 (28)	0.011	0.31					
Conventionals (mg/kg)											
Total Organic Carbon	260	1300	STA2	6 (6)							
Organic Carbon Normalized Sediment Concentrations (ug/kg oc)											
1,1,2-Trichloroethane	6,441	6,441	SD-FCD-04	1 (28)	278	10,500			17,000		EPA 1996
1,2-Dichlorobenzene	223	2,054	SD-FCCD-03	3 (56)	101	163,333	8		34,000		EPA 1996
1,3-Dichlorobenzene	393	393	SD-FCCD-03	1 (56)	102	163,333			170,000		EPA 1996
1,4-Dichlorobenzene	330	4,834	SD-FCCD-03	3 (56)	98	163,333	8		35,000		EPA 1996
Chlorobenzene	28	275	SD-FCCD-03	3 (28)	343	10,678			82,000		EPA 1996
Diethyl phthalate	2,115	2,115	SD-FCCD-03	1 (28)	109	163,333	8		63,000		EPA 1996
Endosulfan II	22	180	SD-FCD-05	2 (9)	184	478			1,400		EPA 1996
Methoxychlor	115	2,700	SD-FCD-05	3 (9)	959	1,897		1	1,900		EPA 1996
Toluene	52	1,897	SD-FCD-02	17 (28)	278	10,678			67,000		EPA 1996
Xylenes, Total	106	1,437	SD-FCSW-03	2 (28)	278	10,678	12		2,500		EPA 1996

(1) Only those analytes detected at least once are presented.
(2) The number in parentheses is the total number of samples; the number not in parentheses is the number of samples with detected concentrations.

Table 7-10. Summary of Qualitative Screening and Identification of COPEC in the Aquatic Habitat of Area B

Analyte	Qualitative Screening Summary	COPEC (Y/N)
Metals		
Antimony	Site concentrations are not statistically different from site-specific background concentrations.	N
Arsenic	Site concentrations are not statistically different from site-specific background concentrations.	N
Cadmium	Several on site samples exceeded the benchmark, some by an order of magnitude, and site concentrations exceeded site-specific and regional background concentrations.	Y
Copper	Several on site samples exceeded the benchmark, some by an order of magnitude, and site concentrations exceeded site-specific and regional background concentrations.	Y
Lead	Several on site samples exceeded the benchmark, some by an order of magnitude, and site concentrations exceeded site-specific and regional background concentrations.	Y
Manganese	Site concentrations are not statistically different from site-specific background concentrations.	N
Nickel	Site concentrations are not statistically different from site-specific background concentrations.	N
Silver	Several on site samples exceeded the benchmark, some by an order of magnitude, and site concentrations exceeded site-specific and regional background concentrations.	Y
Zinc	Several on site samples exceeded the benchmark, some by an order of magnitude, and site concentrations exceeded site-specific and regional background concentrations.	Y
Dioxins		
TEQDF-WHO98 (ND = 1/2 DL)	Several on site samples exceeded the benchmark, some by an order of magnitude, and site concentrations exceeded site-specific background concentrations.	Y
Semi-volatile Organic Compounds		
Bis(2-ethylhexyl)phthalate	A suspected common laboratory contaminant. Exceedances included samples collected in the deep water area of Pike Bay and several site concentrations were below detection limits.	N
Phenol	Low frequency and magnitude of exceedance on site concentrations did not exceed site-specific background concentrations.	N

Table 7-10. Summary of Qualitative Screening and Identification of COPEC in the Aquatic Habitat of Area B

Analyte	Qualitative Screening Summary	COPEC (Y/N)
Polycyclic Aromatic Hydrocarbons		
Anthracene	PAHs were evaluated as a group of chemicals because toxicity is known to be additive for individual PAH compounds. Individual PAHs frequently exceeded screening benchmarks, sometimes up to two orders of magnitude. Only one PAH exceeded the screening benchmark in the site-specific background and the magnitude of exceedance was small.	Y
Benzo(a)anthracene		
Benzo(a)pyrene		
Total Benzofluoranthenes		
Benzo(g,h,i)perylene		
Chrysene		
Dibenz(a,h)anthracene		
Fluoranthene		
Fluorene		
Indeno(1,2,3-cd)pyrene		
Naphthalene		
Phenanthrene		
Pyrene		
Total PAH		
Pesticides/PCBs		
4,4`-DDE 4,4`-DDT	Both DDE and DDT exceeded screening benchmarks in one sample in the City Dump area and one site-specific background sample also had an exceedance of DDE. Although the presence of this chemical may not be related to activities on site, site concentrations did exceed site-specific background concentrations.	Y
Chlordane	Low frequency and magnitude of exceedance on site.	N
Methoxychlor	Low frequency and magnitude of exceedance on site.	N
PCBs	Two site samples exceeded the benchmark by up to an order of magnitude and concentrations were non-detect in the site-specific background samples.	Y

Table 7-11. Comparison of Area B Sediment Metals Concentrations to Background

Analyte	Units	Fox Creek			Channel			Pike Bay and Cass Lake			Site-specific Background				Regional Background			
		Number of Detect	Detected Range		Number of Detect	Detected Range		Number of Detect	Detected Range		Number of Detect	Detected Range			Number of Detect	Detected Range		
			Min	Max		Min	Max		Min	Max		Min	Max	90%ile[1]		Min	Max	90%ile[1]
Antimony	mg/kg	3	0.55	3.90	1	8.00	--	2	0.2	0.3	2	0.53	--	0.481	29	2.04	8.44	6.38
Arsenic	mg/kg	9	5.90	30.60	0	--	--	3	0.49	6.7	6	0.5	23.3	18.2	73	3.21	53	29.2
Barium	mg/kg	16	9.7	160.0	5	105.0	172.0	23	7.8	216.0	9	6.2	303	103.6	86	152	840	658
Cadmium	mg/kg	9	0.30	12.60	0	--	--	2	0.4	0.6	2	0.1	0.4	0.37	17	2.07	3.79	3.43
Cobalt	mg/kg	13	0.5	10.4	1	4.0	4.0	12	0.54	3.08	3	0.68	19.8	16.1	--	--	--	--
Copper	mg/kg	15	0.64	523	6	8.9	19.5	10	0.5	11.6	9	0.42	11.7	7.06	103	5.2	156	88.84
Lead	mg/kg	15	0.65	493	6	25.4	57.1	10	0.89	31.8	9	0.87	12.8	11.52	91	5.45	72	60.2
Manganese	mg/kg	16	23.00	2520	6	417	860	10	27.7	1040	9	44.3	14600	3379	86	181	2530	871
Mercury	mg/kg	9	0.07	11.10	0	--	--	2	0.06	0.07	2	0.016	0.097	0.089	29	0.02	5.11	0.19
Nickel	mg/kg	16	0.92	26.40	1	5.70	--	6	1.1	11.3	8	1.1	16.7	8.02	96	7.1	83.6	56.7
Selenium	mg/kg	10	3.6	12.4	0	--	--	2	1.0	1.0	2	0.7	6.5	5.92	22	0.2	5.89	1.79
Silver	mg/kg	11	0.25	80.70	0	--	--	3	0.13	0.27	1	0.33	--	--	15	2.06	3.7	3.64
Zinc	mg/kg	16	2.70	4090	6	64.8	144	10	2.7	51.7	9	3.5	79.8	39.32	86	14.7	301	195

[1] The 90th percentile values were calculated using detected concentrations only.

Table 7-12. Ecological Surface Water Benchmark Screening

Chemcial (mg/L) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Frequency of Detection (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Screening Benchmark	Frequency Detected Concentration Exceeds Screening Benchmark	Ecological Screening Benchmark		
									Concentration (mg/L)	Type	Source
Metals											
Aluminum	0.054	0.370	SW-FCSW-0102	6 (15)	0.0081	0.091					
Antimony	0.00044	0.00044	SW-PB-0102	1 (15)	8E-05	0.00061					
Antimony, dissolved	0.00028	0.00028	SW-PB-0102	1 (4)	5E-05	7E-05			0.03	Tier II SCV	Suter and Tsao 1996
Arsenic	0.0008	0.0016	SW-FCSW-0102	15 (15)							
Arsenic	0.0008	0.0016	SW-FCCD-0102	15 (15)							
Arsenic	0.0008	0.0016	SW-WL-0102	15 (15)							
Arsenic, dissolved	0.0007	0.0010	SW-PB-0102	3 (4)	0.0008	0.0008			0.15	NAWQC	U.S. EPA 2002e
Barium	0.04	0.06	SW-WL-0102	15 (15)							
Barium, dissolved	0.04	0.04	SW-PB-0102	4 (4)				4	0.004	Tier II SCV	Suter and Tsao 1996
Cadmium	3E-05	2.5E-04	SW-FCCD-0102	4 (15)	0.00017	0.00017					
Cadmium, dissolved	0.0001	0.0001	SW-PB-0102	1 (4)	3E-05	3E-05			0.00025	NAWQC	U.S. EPA 2002e
Calcium	24	57	SW-FCSW-0102	15 (15)							
Calcium	24	57	SW-FCCD-0102	15 (15)							
Calcium, dissolved	27.8	54	SW-FCSW-0102	4 (4)							
Chromium	0.00089	0.00200	SW-FCSW-0102	4 (15)	0.00038	0.00089					
Cobalt	0.00026	0.00084	SW-FCCD-0102	6 (15)	0.00012	0.00016					
Cobalt, dissolved	0.00025	0.00050	SW-FCSW-0102	4 (4)					0.02	Tier II SCV	Suter and Tsao 1996
Copper	0.0047	0.0440	SW-PB-0102	13 (15)	0.00866	0.0144					
Iron	0.07	1.16	SW-FCCD-0102	10 (15)	0.036	0.072					
Iron, dissolved	0.0076	0.0574	SW-FCCD-0102	4 (4)					1	NAWQC	U.S. EPA 2002e
Lead	0.00057	0.00844	SW-FCCD-0102	11 (15)	0.0019	0.0027					
Lead, dissolved	0.00086	0.00086	SW-PB-0102	1 (4)	0.000128	0.000522			0.0025	NAWQC	U.S. EPA 2002e
Magnesium	13.00	17.00	SW-RR-0102	15 (15)							
Magnesium	13.00	17.00	SW-WL-0102	15 (15)							
Magnesium, dissolved	13.20	16.20	SW-PB-0102	4 (4)							
Manganese	0.02	0.31	SW-FCCD-0102	15 (15)							
Manganese, dissolved	0.0159	0.0243	SW-FCCD-0102	3 (4)	0.00099	0.00099			0.12	Tier II SCV	Suter and Tsao 1996
Mercury	0.00054	0.00054	SW-PB-0102	1 (15)	5.67E-05	0.000481					
Nickel	0.0013	0.0200	SW-PB-0102	9 (15)	0.0004	0.0051					
Nickel, dissolved	0.0138	0.0138	SW-PB-0102	1 (4)	0.0003	0.0022			0.052	NAWQC	U.S. EPA 2002e
Potassium	1.29	3.70	SW-FCCD-0102	15 (15)							
Potassium, dissolved	1.30	2.45	SW-FCCD-0102	4 (4)							
Silver	0.00015	0.00300	SW-PB-0102	4 (15)	2E-05	0.00012					
Sodium	3.60	6.60	SW-WL-0102	15 (15)							
Sodium, dissolved	4.06	5.70	SW-PB-0102	4 (4)							
Thallium	6E-06	8.E-06	SW-FCCD-0102	2 (15)	5E-06	9.6E-05					
Vanadium	0.00032	0.00140	SW-FCSW-0102	6 (15)	9E-05	0.00045					
Vanadium, dissolved	0.00025	0.00050	SW-FCCD-0102	3 (4)	0.00018	0.00018			0.02	Tier II SCV	Suter and Tsao 1996
Zinc	0.01	0.04	SW-PB-0102	8 (15)	0.0125	0.047799999					

Table 7-12. Ecological Surface Water Benchmark Screening

Chemcial (mg/L) (1)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration	Frequency of Detection (2)	Minimum Detection Limit	Maximum Detection Limit	Frequency Detection Limit Exceeds Screening Benchmark	Frequency Detected Concentration Exceeds Screening Benchmark	Ecological Screening Benchmark		
									Concentration (mg/L)	Type	Source
Polycyclic Aromatic Compounds (PAHs)											
2-Methylnaphthalene	2.5E-06	9.3E-05	SW-PB-0102	4 (16)	2E-05	0.0054			0.32955	EPA R5 ESL	U.S. EPA 2003
Acenaphthene	5.1E-06	6.3E-06	SW-FCSW-0102	2 (17)	1.3E-06	0.0054			0.0099	EPA R5 ESL	U.S. EPA 2003
Acenaphthylene	1.8E-06	2.1E-06	SW-FCCD-0102	2 (17)	1E-06	0.0054			4.84	EPA R5 ESL	U.S. EPA 2003
Anthracene	1.5E-06	4.9E-06	SW-FCCD-0102	2 (24)	1E-06	0.0054	11		0.00073	Tier II SCV	Suter and Tsao 1996
Benzo(a)anthracene	2.5E-06	8.7E-06	SW-FCCD-0102	2 (17)	1E-06	0.0054	11		0.000027	Tier II SCV	Suter and Tsao 1996
Benzo(a)pyrene	2.8E-06	2.9E-05	SW-FCD-0102	3 (24)	1E-06	0.0054					
Benzo(b)fluoranthene	4.9E-06	1.1E-05	SW-FCCD-0102	2 (17)	1E-06	0.0054			0.00907	EPA R5 ESL	U.S. EPA 2003
Benzo(k)fluoranthene	2.4E-06	4.4E-06	SW-FCCD-0102	2 (17)	1E-06	0.0054	11		0.0000056	EPA R5 ESL	U.S. EPA 2003
Benzo(g,h,i)perylene	5.3E-06	5.3E-06	SW-FCCD-0102	1 (17)	1E-06	0.0054			0.00764	EPA R5 ESL	U.S. EPA 2003
Chrysene	1.8E-06	1.2E-05	SW-FCCD-0102	3 (17)	1E-06	0.0054	11		0.000033	EPA R5 ESL	U.S. EPA 2003
Dibenz(a,h)anthracene	2.1E-06	2.1E-06	SW-FCCD-0102	1 (17)	1.4E-06	0.0054	14	1	0.0000016	EPA R5 ESL	U.S. EPA 2003
Fluoranthene	1.9E-06	4.1E-05	SW-FCCD-0102	5 (17)	2E-06	0.0054			0.0081	EPA R5 ESL	U.S. EPA 2003
Fluorene	4.4E-06	6.4E-06	SW-FCCD-0102	2 (28)	1.4E-06	0.0054	11		0.0039	Tier II SCV	Suter and Tsao 1996
Indeno(1,2,3-cd)pyrene	2.8E-06	5.2E-06	SW-FCCD-0102	2 (17)	1.7E-06	0.0054	11		0.00431	EPA R5 ESL	U.S. EPA 2003
Naphthalene	7.2E-06	1.1E-04	SW-PB-0102	6 (18)	0.003	0.0054			0.01	Tier II SCV	Suter and Tsao 1996
Naphthalene	7.2E-06	1.1E-04	SW-FCSW-0102	6 (18)	0.003	0.0054			0.01	Tier II SCV	Suter and Tsao 1996
Phenanthrene	4E-06	4.4E-05	PBDH-018081	8 (25)	3E-06	0.0054	11		0.0021	EPA R5 ESL	U.S. EPA 2003
Pyrene	1.6E-06	3.4E-05	SW-FCCD-0102	5 (16)	2E-06	0.0054	10		0.0003	EPA R5 ESL	U.S. EPA 2003
Pentachlorophenol	1.3E-05	7.5E-02	CL-S	7 (48)	0.0005	0.05	4	1	0.015	NAWQC	U.S. EPA 2002e
Semivolatile Organic Compounds (SVOCs)											
1-Methylnaphthalene	2.1E-06	3.4E-06	CL-N	2 (2)					0.0021	Tier II SCV	Suter and Tsao 1996
2,3-Benzofuran	6E-06	6.0E-06	CL-N	1 (2)	0.003	0.003					
2,3-Dihydro-1H-indene	2.2E-06	2.2E-06	CL-N	1 (3)	1.4E-06	0.003					
Bis(2-ethylhexyl)phthalate	0.0014	0.0063	SW-RR-0102	7 (11)	0.005	0.0051	4	1	0.003	Tier II SCV	Suter and Tsao 1996
Caprolactam	0.0044	0.0044	SW-PB-0102	1 (11)	0.005	0.0054					
Phenol	0.001	0.001	CL-S	1 (20)	0.003	0.01			0.1	EPA R5 ESL	U.S. EPA 2003
Volatile Organic Compounds (VOCs)											
1,3-Dichloro-1-propene, cis-	0.0001	0.0001	SW-FCSW-0102	2 (11)	0.0005	0.0005			0.0079	EPA R5 ESL	U.S. EPA 2003
1,3-Dichloro-1-propene, cis-	0.0001	0.0001	SW-HWY-0102	2 (11)	0.0005	0.0005			0.0079	EPA R5 ESL	U.S. EPA 2003
Benzene	0.00015	0.00028	SW-FCD-0102	2 (11)	0.0005	0.0005			0.13	Tier II SCV	Suter and Tsao 1996
Carbon disulfide	0.00035	0.0003	SW-FCCD-0102	1 (11)	0.0005	0.0005			0.00092	Tier II SCV	Suter and Tsao 1996
Ethyl benzene	0.00011	0.00018	SW-FCD-0102	3 (11)	0.0005	0.0005			0.0073	Tier II SCV	Suter and Tsao 1996
Methylene chloride	0.00012	0.00014	SW-RR-0102	2 (11)	0.0005	0.0005			2.2	Tier II SCV	Suter and Tsao 1996
Toluene	0.00027	0.00027	SW-FCSW-0102	1 (11)	0.0005	0.00092			0.0098	Tier II SCV	Suter and Tsao 1996
Xylenes, Total	0.00053	0.00110	SW-FCD-0102	3 (11)	0.0005	0.0005			0.01	Tier II SCV	Suter and Tsao 1996
Conventionals											
Hardness, total	143	197	SW-FCCD-0102	4 (4)							

(1) Only those analytes detected at least once are presented.

(2) The number in parentheses is the total number of samples; the number not in parentheses is the number of samples with detected concentrations.

Table 7-13. Summary of Toxic Effects of COPECs in Soil at Area B

Chemical	Soil Toxic Threshold for Plants (ppm)	Soil Toxic Threshold for Soil Invertebrates (ppm)	Dose Threshold to Birds and Mammals (mg/kg/day)
Chromium	1.8	2.0	5
Lead	100	500	11
Zinc	50	470	89.9
Pentachlorophenol	3	30	0.67
PAHs	25	unknown	10.8
Chlorinated dioxins/furans	Not expected to adversely affect plants	Not expected to adversely affect soil invertebrates	0.0000011

Table 7-14. Summary of Toxic Effects of COPECs in Sediments in Area B

Chemical	Toxicity to Aquatic Life	Toxicity to Fish	Toxicity to Benthic Invertebrates	Toxicity to Birds and Mammals
Copper	The most sensitive freshwater species have LC50(96 h) values between 0.23 and 0.91 µg/L and include daphnids (Daphnia spp.), amphipods (Gammarus pseudolimnaeus), snails (Physa spp.), and chinook salmon (Oncorhynchus tshawytscha (Eisler 1998).		Non-polluted sediments are those that contain < 25 mg/kg. Benthic toxicity occurs at concentrations of > 9,000 mg/kg. A consensus-based threshold for invertebrate toxicity is 31.6 mg/kg.	No data are available on the toxicity of copper to avian wildlife. Mammals and birds are 100-1,000 times more resistant to copper than other animals. Day old chickens experienced reduced growth when exposed to 350 mg/kg copper for 25 days. Mink exposed to 3.5 mg/kg body weight (BW)/day for 50 weeks had decreased survival.
Lead	Adverse effects on daphnid reproduction are evident at 1.0 µg/L.	Adverse effects to fish can occur at concentrations above 10 µg/L.	A consensus-based threshold for invertebrate toxicity is 35.8 mg/kg.	Liver concentrations of 23 mg/kg have been measured in bald eagles that died from lead ingestion. Lead is acutely toxic to rats at a concentration of 5 mg/kg BW.
Selenium				
Silver	Concentrations as low as 1.2 µg/L can kill sensitive species; concentrations of 0.5 µg/L can adversely affect growth.		An apparent toxicity threshold for invertebrates is 4.5 mg/kg.	No data are available on the toxicity of copper to avian or mammalian wildlife. Water concentrations of 400 µg/L exposed to rats for 100 days caused kidney damage; a similar response was seen in rats with dietary concentrations of 130 mg/kg BW/day.
Zinc	Concentrations as low as 10 µg/L can kill or result in adverse effects on growth and reproduction to sensitive species.	Acute LC50s are between 32 and 40,920 µg/L.	A consensus-based benchmark for invertebrates is 121 mg/kg.	Mallards fed 3,000 mg/kg Zn in the diet had reduced survival after 30 days. At 1,500 mg/kg in the diet, ferrets died after 21 days.
PAHs	Based on equilibrium partitioning; threshold concentrations of individual PAHs range from 0.3 to 300 µg/L		A consensus-based threshold for invertebrate toxicity is 1,610 µg/kg.	Few studies have reported toxicity thresholds because PAHs are metabolized in birds and mammals.
Dioxins and Furans	Safe levels are estimated to be above 0.01 ng/L.		An apparent toxicity threshold for invertebrates is 0.0088 µg/kg.	Safe levels in birds are estimated to be at 10-12 ng/kg in food. In mammals no effect on rats were observed at a dietary concentration of less than 1.0 ng/kg BW/day.

Table 7-15. Summary of Fate and Transport Characteristics for COPECs in Terrestrial Habitat of Area B

Chemical	Fate and Transport	Bioaccumulation Potential
Chromium	• Mainly present as insoluble oxide • Cr (III) and Cr (VI) are more soluble, but solubility is dependent on clay, Fe_2O_3, and organic matter content	Plants – low Soil invertebrates – moderate
Lead	• Low mobility, but increases with decreasing pH and coarser texture	Plants – low Soil invertebrates – high
Zinc	• Low mobility, but increases with decreasing pH	Plants – low Soil invertebrates - high
Pentachlorophenol	• Low water solubility, but co-solvents may increase mobility • Readily degraded by chemical, microbial, and photochemical processes	Plants – high Soil invertebrates – high
PAHs	• Low molecular weight PAHs more soluble and mobile • Adsorption increase with increasing organic matter • Volatilization and biodegradation are important processes	Plants – moderate Soil invertebrates – unknown
Dioxins	• Low water solubility • Persistent and strongly adsorbed to soil	Plants – low Soil invertebrates - high

Table 7-16. Fate and Transport Characteristics for COPECs in the Aquatic Habitat of Area B

Chemical	Fate and Transport	Bioaccumulation Potential
Cadmium	• Cadmium is insoluble in aquatic environments. • Precipitation and sorption to mineral surfaces and organic materials are dominant processes. • pH, Eh, chemical speciation, and AVS are major factors that control cadmium concentration in the water column.	• Cadmium is not highly mobile in aquatic food webs. • Biomagnification does not occur.
Copper	• Cupric ion (Cu+2) is the form of copper that is most readily accumulated and toxic; however, cupric ions generally account for less than 1 percent of the total copper concentration in water. • The most common forms of copper in freshwater between ph 6.0 and 9.0 are carbonates. • Factors that affect cupric ion partitioning to organic carbon and complexation with other compounds include pH, temperature, hardness, AVS, and concentrations of bicarbonate and organic ligands.	• Copper bioconcentrates in aquatic organisms, but does not bioaccumulate in mammals. • Copper also does not biomagnify in aquatic food chains.
Lead	• Lead compounds in aquatic systems can accumulate in the surface water micro layer. • Most lead entering aquatic systems is precipitated to the sediment in the form of carbonate and hydroxide complexes. • Factors affecting sediment sorption include sediment type, pH, organic carbon, cation exchange capacity, and AVS.	• Lead is accumulated by aquatic organisms equally from food and water intake. • Organolead compounds are the form which is most readily bioaccumulated. • Lead does not biomagnify in food chains.
Selenium	•	•
Silver	• Under oxidizing conditions silver mostly forms complexes with bromides, chlorides, and iodides. • Under reducing conditions free metal and silver sulfide predominate. • Hardness and pH are important factors that control the amount of available soluble silver ion (Ag^{+}), which is the most toxic form.	• Silver is highly mobile in aquatic habitats and uptake is almost entirely of the dissolved form. • 99 percent of the silver ingested is excreted. • Silver does not biomagnify.
Zinc	• Forms of zinc most common in natural waters are complexes with sulfide, oxide, and carbonate that readily precipitate to the sediment. • Factors affecting zinc bioavailability include sediment composition, iron and manganese concentrations, pH, and the presence of ligands.	• Zinc is an essential trace element for all living organisms. • Zinc is not highly mobile in aquatic food webs. • Zinc does not biomagnify.

Table 7-16. Fate and Transport Characteristics for COPECs in the Aquatic Habitat of Area B

Chemical	Fate and Transport	Bioaccumulation Potential
PAHs	• LPAHs are more mobile than HPAHs; LPAHs are more acutely toxic. • Most PAHs in the aquatic environment become sorbed to suspended particles or sediment with sorption dependent on particle size and organic carbon content.	• PAHs may accumulate in benthic organisms and the animals that consume them. • PAHs are rapidly metabolized by fish, birds, and mammals. • Biomagnification is unlikely.
Dioxins	• Dioxins, as a class of over 135 compounds, have high K_{ow} and extremely low water solubility. • Dioxins are generally strongly sorbed to sediment in the aquatic environment with little potential for leaching.	• Dioxins have been shown to biomagnify in bird and mammals species present in aquatic food webs. • Most bioaccumulation occurs through food ingestion.
PCBs	• As a class of over 209 different compounds, PCBs are inert, non-polar, halogenated hydrocarbons. • PCBs are stable and persistent and in the aquatic environment and readily bind to sediment organic carbon.	• PCBs have been shown to biomagnify in bird and mammals species present in aquatic food webs. • Most bioaccumulation occurs through food ingestion.

Table 7-17. Feeding Guilds and Trophic Status of Potential Aquatic and Semi-aquatic Receptors in Area B

Assemblage	Common Name	Scientific Name	Food Items	Feeding Guild	Trophic Level
Benthic Invertebrates[a]	Clams	Corbiculidae, Sphariidae, Unionidae, Magaretiferidae	Phytoplankton, detritus	Filter-feeder	2
	Crayfish	*Oronectes virilis*	Zoobenthos, algae, carrion	Omnivorous scavenger	3
	Cladocerans	Cladocera	Algae, zoobenthos, zooplankton	Herbivore & carnivores	2,3
	Copepods	Calanoid and harpacticoid species	Algae, bacteria, detritus	Herbivore & detritivore	2
	Pericarideans	Amphipods, isopods, mysid shrimp	Algae, zoobenthos, zooplankton	Herbivore & carnivores	2,3
	Oligochaetes	Naidid, tubificid species	Algae, bacteria, detritus	Herbivore & detritovore	2
	Gastropods	Planorbid snails	Bacteria, detritus	Detritivores	2
	Aquatic insects	Plecoptera, Diptera, Ephemeroptera, Coleoptera	Algae, bacteria, detritus	Detritivores	2
	Odonate nymphs; Coleopteran adults	Anisoptera, Zygoptera (Odonata); Dytiscidae (Colleoptera)	Insects, annelids, zooplankton	Predator	3
Fish	Lake Whitefish	*Coregonus clupeaformis*	Zooplankton, zoobenthos	Invertebrates	3
	Rock Bass	*Ambloplites rupestris*	Zoobenthos	Invertebrates	3
	Yellow Bullhead	*Ameiurus natalis*	Detritus, zoobenthos, nekton	Invertebrates	3
	Bluegill	*Lepomis macrochirus*	Zoobenthos, zooplankton	Invertebrates	3
	Tullibee (Cisco)	*Coregonus artedii*	Zooplankton, zoobenthos	Invertebrates	3
	White Sucker	*Catostomus commersoni*	Detritus, zoobenthos, plants	Detritivore, herbivore	2
	Black Bullhead	*Ameiurus melas*	Zoobenthos, plants, nekton	Invertebrates	3
	Brown Bullhead	*Ameiurus nebulosus*	Zoobenthos, plants, nekton	Invertebrates	3
	Yellow Perch	*Perca flavescens*	Zooplankton, zoobenthos	Invertivore	3
	Largemouth Bass	*Micropterus salmoides*	Nekton, zooplankton, zoobenthos	Invertebrates, fish	4
	Walleye	*Stizostedion vitreum (Sander vitreus)*	Nekton	Piscivore	4
	Northern Pike	*Esox lucius*	Nekton	Piscivore	4
Birds -*Raptors*	Bald Eagle	*Haliaeetus leucocephalus*	Opportunistic and primarily carrion feeders especially fish.	Piscivore	4
	Osprey	*Pandion haliaetus*	Piscivorous, occasionally preying on birds, frogs, and crustaceans	Piscivore	4
-*Songbirds*	Bank Swallow	*Riparia riparia*	flying insects	Insectivore	3
	Barn Swallow	*Hirundo rustica*	flying insects	Insectivore	
	Cliff Swallow	*Hirundo pyrrhonota*	flying insects	Insectivore	

	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	flying insects	Insectivore	3
	Purple Martin	*Progne subis*	flying insects	Insectivore	3
	Tree Swallow	*Tachycineta bicolor*	flying insects	Insectivore	3

Table 7-17. Feeding Guilds and Trophic Status of Potential Aquatic and Semi-Aquatic Receptors in Area B

Assemblage	Common Name	Scientific Name	Food Items	Feeding Guild	Trophic Level
-Marshbirds	American Coot	*Fulica americana*	Aquatic vegetation & algae; Occasionally fish, tadpoles, zoobenthos, aquatic and terrestrial insects, birds eggs.	Herbivore	2
	Great Blue Heron	*Ardea herodias*	Fish (98%), crustaceans and amphibians (2%)	Piscivore	4
	Horned Grebe	*Podiceps auritus*	Small fish, plant seeds, aquatic insects, snails and leeches.	Omnivore	3
	Pied-billed Grebe	*Podilymbus podiceps*	Small fish, plant seeds, aquatic insects, snails and leeches.	Omnivore	3
	Red-necked Grebe	*Podiceps grisegena*	Small fish, plant seeds, aquatic insects, snails and leeches.	Omnivore	3
-Shorebirds	Black Tern	*Chlidonias niger*	Insects and freshwater fish are dominantly consumed during breeding	Carnivore	4
	Common Tern	*Sterna hirundo*	Primarily small fish, occasionally crustaceans and insects.	Carnivore	4
	Herring Gull	*Larus argentatus*	Polytrophic including fish, crustacea, mollusks, worms, insects, small mammals and birds, bird eggs and chicks, and garbage.	Carnivore	4
	Ring-billed Gull	*Larus delawarensis*	Small rodents, dead fish, discarded food scraps, insects, and the eggs of other nesting bird species	Carnivore	4
	Spotted Sandpiper	*Actitis macularia*	Primarily adult flying insects, also crustaceans, leeches, mollusks, small fish, and carrion.	Carnivore	4
-Kingfishers	Belted Kingfisher	*Ceryle alcyon*	Fish (46%), amphibians (27%), crustaceans & insects (24%), birds and mammals (1%), other (2%).	Carnivore	4
-Dabbing Ducks	American Widgeon	*Anas americana*	Leaves, fruits, seeds and insects	Herbivore	2
	Green-winged Teal	*Anas crecca*	62% plant seeds and 38% animal matter	Omnivore	2
	Mallard	*Anas platyrhynchos*	Primarily plants, seasonally switching to insects.	Omnivore	3
	Wood Duck	*Aix sponsa*	90% aquatic plants, especially duckweed	Herbivore	2

Table 7-17. Feeding Guilds and Trophic Status of Potential Aquatic and Semi-Aquatic Receptors in Area B

Assemblage	Common Name	Scientific Name	Food Items	Feeding Guild	Trophic Level
-Diving Birds	Common Goldeneye	*Bucephala clangula*	Crustaceans (32%), insects (28%), mollusks (10%)	Benthivore	4
	Common Loon	*Gavia immer*	Eats almost entirely fish	Piscivore	4
	Common Merganser	*Mergus merganser*	Primarily fish, also aquatic invertebrates, amphibians, small mammals and birds.	Carnivore	3
	Hooded Merganser	*Lophodytes cucullatus*	Primarily fish, also aquatic invertebrates, amphibians, small mammals and birds.	Carnivore	3
	Redhead	*Aythya americana*	Spring diet: 77% animals and 23% plants	Omnivore	3
	Ring-necked Duck	*Aythya collaris*	80% seeds, pondweed, and tubers, and 20% insects, mollusks, worms, and crustaceans.	Omnivore	3
Mammals *-Bats*	Bats				
	Big Brown Bat	*Eptesicus fuscus*	Beetles & flying insects.	Insectivore	3
-Carnivores	Mink	*Mustela vison*	Fish, crayfish, frogs, muskrats	Carnivore	3
	Raccoon	*Procyon lotor*	Fruits, nuts, berries, corn, insects, small mammals, bird eggs and nestlings, reptiles eggs, frogs, fishes, aquatic invertebrates, worms, and garbage.	Omnivore	3
	River Otter	*Lutra canadensis*	Aquatic animals, particularly fishes (mostly slow-moving, mid-size species such as suckers), frogs, crayfish, and turtles.	Carnivore	4
-Rodents	Beaver	*Castor canadensis*	Trees, shrubs, aquatic plants.	Herbivore	2
	Muskrat	*Ondatra zibethicus*	Primarily aquatic plants, particularly cattails, cordgrass, and bulrushes. Also eats crustaceans and mollusks	Herbivore	2
Reptiles *-Turtles*	Snapping Turtle	*Chelydra serpentina*	Wide variety of animal matter but also eats aquatic vegetation in the summer.	Carnivore	4
Amphibians *-Frogs*	Northern Leopard Frog	*Rana pipiens*	Algae and plant material	Herbivore	2
	Mink Frog	*Rana septentrionalis*	Algae and plant material	Herbivore	2
-Salamanders	Mud puppy	*Necturus maculosus*	Crayfish, insect larvae, fish, and snails	Carnivore	3

[a] Benthic organisms listed are only common examples of a diverse fauna that may contain additional species.

Reference: Adapted from Benyrus *et al.* (1992) and Nelson *et al.* (2004 - www.ncrs.fs.fed.us/northwoods).

Table 7-18. Ecological Receptors of Concern, Exposure Routes, and Potentially Contaminated Media – Aquatic Habitat of Area B

Species Assemblage	Receptors of Concern	Feeding Guild	Route of Exposure	Exposure Media			
				Sediments	Sediment Porewater	Surface Water[a]	Aquatic Biota
Aquatic - Benthic	Benthic infauna	Polytrophic	Respiration	--	●	●	--
			Ingestion	●	--	--	●
			Dermal Contact	--	●	--	--
	Clams[b]	Herbivore	Respiration	--	☐	●	--
		(Phytoplankton, detritus)	Ingestion	●	--	--	●
			Dermal Contact	--	☐	--	--
	Crayfish[b]	Omnivore/Scavenger	Respiration	--	--	●	
			Ingestion	●	--	--	●
			Dermal Contact	--	--	--	--
	White sucker	Herbivore, detritovore	Respiration	--	--	●	
			Ingestion	●	--	--	●
			Dermal Contact	☐	--	☐	--
Aquatic - Pelageal[b]	Walleye	Piscivore	Respiration	--	--	●	--
			Ingestion	--	--	--	●
			Dermal Contact	--	--	●	--
	Yellow perch	Carnivore	Respiration	--	--	●	--
		(Zoobenthos, zooplankton)	Ingestion	☐	--	--	●
			Dermal Contact	--	--	☐	--
Semi-aquatic birds	Kingfisher	Piscivore	Respiration	--	--	--	--
			Ingestion	--	--	☐	●
			Dermal Contact	--	--	☒	--
	Mallard	Omnivore	Respiration	--	--	--	--
			Ingestion	●	☐	●	●
			Dermal Contact	--	--	☒	--
Semi-aquatic birds (cont.)	American Coot	Herbivore	Respiration	--	--	--	--
			Ingestion	●	☐	●	●
			Dermal Contact	--	--	☒	--

Species Assemblage	Receptors of Concern	Feeding Guild	Route of Exposure	Exposure Media			
				Sediments	Sediment Porewater	Surface Water[a]	Aquatic Biota
Semi-aquatic mammals	Mink	Carnivore	Respiration	--	--	--	--
			Ingestion	●	--	●	●
			Dermal Contact	☒	--	☒	--
	Raccoon	Omnivore	Respiration	--	--	--	--
			Ingestion	●	--	●	●
			Dermal Contact	☒	--	☒	--
	Muskrat	Herbivore	Respiration	--	--	--	--
			Ingestion	●	--	●	●
			Dermal Contact	☒	--	☒	--

[a] Includes indirect exposure via ground water that may be discharged to Fox Creek or Pike Bay.
[b] These receptors will be evaluated for bioaccumulation and as vectors for chemical exposure to higher trophic levels.
Symbols:

- ● = Primary pathway
- ❑ = Secondary pathway
- ☒ = Complete, but too uncertain to evaluate
- -- = Incomplete/inapplicable pathway

Table 7-19. Assessment and Measurement Endpoints for the Terrestrial Habitat of Areas A and B

Assessment Endpoint	Measurement Endpoint
Maintenance of the plant community that lives in soil containing COPECs and that provides forage and breeding habitat for wildlife (Cr, Pb, Zn, PCP)*	Evaluation of chemical concentrations measured in soil and plant tissue relative to levels reported as toxic to plants in the scientific literature and background concentrations
Maintenance of the soil invertebrate community that lives in soil containing COPECs and that provides forage for wildlife (Cr, Pb, Zn, PCP)	Evaluation of chemical concentrations measured in soil and soil invertebrate tissue relative to levels reported as toxic to soil invertebrates in the scientific literature and background concentrations
Survival and reproductive success of populations of herbivorous and insectivorous mammals that ingest COPECs while living and foraging on the site (Cr, Pb, Zn, PCP, PAHs, Dioxins)	Comparison of chemical doses as estimated by exposure modeling for the meadow vole and northern short-tailed shrew to laboratory dose-response relationships to estimate hazard quotients and hazard indices of risk
Survival and reproductive success of populations of herbivorous and insectivorous birds that ingest COPECs while living and foraging on the site (Cr, Pb, Zn, PCP, PAHs, Dioxins)	Comparison of chemical doses as estimated by exposure modeling for the American robin to laboratory dose-response relationships to estimate hazard quotients and hazard indices of risk

* COPECs most likely to adversely affect the assessment endpoint.

Table 7-20. Reference Body Weights and Intake Rates for Common Laboratory Animals

Species	Body Weight (kg)	Food Intake Rate (kg/day)	Water Intake Rate (L/day)
Rat	0.35	0.028	0.046
Mouse	0.03	0.0055	0.0075
Rabbit	3.8	0.135	0.268
Dog	12.7	0.301	0.652
Mink	1.0	0.137	0.099

Source: Sample et al. (1996)

Table 7-21. Assessment Endpoints and Measures of Effects for the Aquatic Habitat for Area B

Assessment Endpoint	Measurement Endpoints	
	Phase 1	Additional Phases
(1) Maintenance of a freshwater benthic community in Area B nearshore littoral environments that can serve as a prey base for local populations of higher trophic level organisms. (Cd, Cu, Pb, Ag, Zn, DDD/DDE/DDT, PAHs)*	(1) Evaluate concentrations of chemicals of concern in sediment relative to levels reported in the scientific literature that relate to adverse effects; evaluate whole sediment toxicity considered significant according to toxicity testing protocols.	(1) Calculation of inorganic background chemical concentrations; speciation of the various forms of metals present on site; Calculation of reference area performance standards for the bioassays; evaluation of benthic invertebrate community structure relative to reference areas; additional bioassays and TIE/TRE procedures.
(2) Survival and reproductive success of fish inhabiting Area B nearshore littoral environments, which can serve as a prey base to higher trophic level organisms. (Cd, Cu, Pb, Ag, Zn, DDD/DDE/DDT, PAHs)	(2) Evaluate concentrations of chemicals of concern in sediment relative to levels reported in the scientific literature that relate to adverse effects; evaluate concentrations of chemicals of concern in water to levels reported in the scientific literature that relate to adverse effects; evaluate the ability of the chemicals of concern to bioaccumulate in selected fish species; evaluate concentrations of chemicals of concern in fish tissue relative to levels reported in the scientific literature.	(2) Calculation of inorganic background chemical concentrations; speciation of the form of metals present on site; evaluation of the toxicity of whole sediment/water bioassays on regionally sensitive and important fish species and life stages; evaluation of the presence and type of neoplastic internal lesions present in fish.
(3) Survival and reproductive success of semi-aquatic birds within the foraging range of Area B nearshore littoral environments. (Cd, Cu, Pb, Ag, Zn, DDD/DDE/DDT, PAHs, PCBs, Dioxins)	(3) Compare chemical doses as estimated by exposure modeling for avian receptors of concern to laboratory dose-response relationships to estimate HQs and HIs of risk.	(3) Evaluation of chemical bioavailability by analyzing for specific types of metals; evaluation of chemical bioavailability by collecting and analyzing tissues of wildlife for contaminant levels, and comparing these levels to background concentrations reported in the literature, and measured on reference areas; evaluation of sediment ingestion rates by fecal sampling local receptor populations.
(4) Survival and reproductive success of semi-aquatic mammals within the foraging range of Area B nearshore littoral environments. (Cd, Cu, Pb, Ag, Zn, DDD/DDE/DDT, PAHs, PCBs, Dioxins)	(4) Compare chemical doses as estimated by exposure modeling for mammalian receptors of concern to laboratory dose-response relationships to estimate HQs and HIs of risk.	(4) Evaluation of chemical bioavailability by analyzing for specific types of metals; evaluation of chemical bioavailability by collecting and analyzing tissues of wildlife for contaminant levels, and comparing these levels to background concentrations reported in the literature, and measured on reference areas; evaluation of sediment ingestion rates by fecal sampling local receptor populations.

- COPECs most likely to adversely affect the assessment endpoint.

Table 7-22. Examples of Conclusions Resulting From Information Provided by the Measures of Effects Associated with the Benthic Community Assessment Endpoint

Results from Sediment Quality Comparisons		Toxicity Bioassay Results	Possible Conclusions
NOAEL Exceedance	LOAEL Exceedance		
Yes	Yes	Significant effects	Strong evidence of COPEC-induced risk to the benthic community. Further action may be warranted.
No	No	No significant effects	Strong evidence of no COPEC-induced risk to the benthic community. No further action is warranted.
Yes	Yes/no	No significant effects	COPECs are present, but do not appear to be bioavailable or present at levels that pose unacceptable risks. Further action likely not warranted.
Yes	No	Significant effects	COPECs may be present at levels that pose significant impacts. Additional evaluation is warranted.

Note: adapted from Burton (1992)

Table 7-23. Framework for Evaluating the Measures of Effects Associated with Assessment Endpoints for Water Column Organisms

Aqueous Concentrations Exceed AWQC Benchmarks	Bioaccumulation Exceeds Background Levels and Tissue Effects Benchmarks	Possible Conclusion
Yes	Yes	Strong evidence of risk to water-column organisms and to the prey base for higher trophic level piscivores. Additional measures of effects likely are warranted.
Yes	No	Evidence of risk to water column organisms. Bioaccumulation may be present but is not a risk to the prey base for higher trophic level piscivores.
No	Yes	No evidence of risk to water-column organism. Chemicals may be bioaccumulated from other sources and may be a risk to the prey base of higher tropic level receptors.
No	No	No evidence of risk to water-column biota or the prey-base to higher trophic level piscivores.

Note: Adapted from Burton (1992). Exposure benchmarks will be defined during the risk assessment as concentrations in tissues that, when exceeded, suggest elevated exposure. Effects benchmarks are defined as concentrations in tissue that suggest adverse effects to the organism.

Table 7-24. Framework for Evaluating the Measures of Effects Associated with Assessment Endpoints for Piscivorous Wildlife

Bioaccumulation or Abiotic Exposure Exceeds Background	Exposure Modeling HQ > 1	Possible Conclusion
Yes	Yes	Strong evidence of COPEC bioaccumulation or abiotic exposure resulting in risk. Additional measures of effects likely are warranted.
Yes	No	Evidence of bioaccumulation or abiotic exposure, but resulting risks are acceptable.
No	Yes	Modeling indicates potential risk associated with background levels of bioaccumulation or abiotic exposure. Additional model calibration may be warranted.
No	No	No evidence of bioaccumulation or abiotic exposure. Resulting risks are acceptable.

Note: Adapted from Burton (1992)