Table 1.2-1
Summary of Contaminants of Concern in Sediment
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	Unit	Surface				Subsurface			
		Frequency of Detection	Min-Max	Mean	Median	Frequency of Detection	Min-Max	Mean	Median
Acenaphthene	µg/kg	1311/1573	0.2 - 430000	1303.6	20	1372/1654	0.2 - 3900000	17783	39
Acenaphthylene	µg/kg	1199/1573	0.2 - 54000	173.6	10	1255/1654	0.2 - 1500000	4020	16
Acrolein	µg/kg	0/40	ND - ND	ND	ND	2/111	0.9 - 1.4	1.1	1.1
Aldrin	µg/kg	254/1081	0.003 - 691	5.0	0.5	127/1151	0.1 - 1340	23.7	0.8
Aluminum	mg/kg	1190/1190	1630 - 47400	23413.9	24100	1037/1037	5730 - 45900	22888	23500
Ammonia	mg/kg	454/459	0.3 - 481	98.2	87.2	215/215	1.4 - 775	205	196
Anthracene	µg/kg	1370/1573	0.4 - 390000	1163.8	28.5	1374/1654	0.2 - 1310000	8923	41.8
Antimony	mg/kg	965/1303	0.02 - 47.7	1.1	0.2	843/1189	0.02 - 55.1	0.9	0.2
Arsenic	mg/kg	1348/1473	0.7 - 132	4.8	3.7	1429/1492	0.5 - 51.4	4.08	3.6
Barium	mg/kg	232/232	58.9 - 5950	200.01	177	129/129	45.3 - 637	170	164
Benzene	µg/kg	43/346	0.08 - 720	20.4	0.2	209/639	0.03 - 270000	4593	0.4
Benzo(a)anthracene	µg/kg	1499/1573	0.5 - 320000	1538.2	83	1466/1654	0.2 - 772000	5825	96
Benzo(a)pyrene	µg/kg	1495/1573	0.9 - 340000	1862.6	98	1453/1654	0.2 - 1010000	7092	110
Benzo(b)fluoranthene	µg/kg	1415/1467	0.9 - 300000	1541.1	100	1445/1654	0.2 - 850000	5658	110
Benzo(b+k)fluoranthene	µg/kg	434/482	3.8 - 108000	2417.3	190	368/433	0.2 - 157000	2813	159
Benzo(g,h,i)perylene	µg/kg	1469/1573	0.5 - 180000	1314.09	76	1447/1653	0.2 - 730000	5014	88
Benzo(k)fluoranthene	µg/kg	1369/1435	0.8 - 100000	844.5	49	1405/1654	0.2 - 540000	3011	66
Benzyl Alcohol	µg/kg	166/1288	2.2 - 244	12.8	9.05	160/1266	2.2 - 3700	38.9	7.8
Beryllium	mg/kg	200/233	0.2 - 1.2	0.6	0.6	81/89	0.3 - 0.8	0.5	0.5
Bis(2-ethylhexyl) phthalate	µg/kg	884/1438	7 - 440000	1060.6	150	603/1530	2.4 - 18000	352	95
Bromochloromethane	µg/kg	0/290	ND - ND	ND	ND	0/599	ND - ND	ND	ND
Bromodichloromethane	µg/kg	0/290	ND - ND	ND	ND	0/599	ND - ND	ND	ND
Butylbenzyl phthalate	µg/kg	445/1429	2.2 - 2800	58.5	18	252/1528	2 - 11800	75.8	11
Cadmium	mg/kg	1332/1460	0.02 - 10.1	0.4	0.3	1377/1469	0.01 - 43.7	0.4	0.3
Carbazole	µg/kg	715/1220	1.4 - 32000	269.3	13	605/1143	0.6 - 520000	4198	17
Carbon disulfide	µg/kg	25/287	0.1 - 4.5	0.6	0.3	132/599	0.1 - 850	7.8	0.3
Chlordane-cis	µg/kg	380/1101	0.01 - 203	2.0	0.3	260/1152	0.05 - 630	5.9	0.6
Chlordanes (total)	µg/kg	723/1103	0.06 - 669	6.2	1.2	615/1152	0.1 - 70367.5	138	2.1
Chlorobenzene	µg/kg	47/299	0.1 - 35000	1833.2	1	85/610	0.1 - 390000	32480	6.1
Chloroethane	µg/kg	1/293	32 - 32	32.0	32	5/599	0.9 - 1600	327	9.2
Chloroform	µg/kg	13/290	0.09 - 98	12.3	0.1	39/610	0.08 - 2300	120	1.7
Chromium	mg/kg	1439/1445	4.1 - 819	35.07	29.4	1469/1469	6.4 - 464	28.6	26.8
Chromium, hexavalent	mg/kg	27/60	0.2 - 2.1	0.7	0.5	5/39	0.2 - 0.3	0.2	0.2
Chrysene	µg/kg	1517/1573	1.4 - 370000	1809	110	1456/1654	0.2 - 980000	6830	130
Cobalt	mg/kg	145/145	11.1 - 55.5	18.3	18.3	37/37	16.2 - 24.6	18.4	18.2
Copper	mg/kg	1457/1461	6.2 - 2830	58.4	38.7	1481/1481	9.4 - 3290	55.8	35.8
Cyanide,Total	mg/kg	33/38	0.1 - 39.4	4.5	0.4	91/125	0.03 - 1410	27.0	0.5
DDD (Total of 2,4' and 4,4'-DDD)	µg/kg	1008/1179	0.07 - 11000	50.02	3.4	1288/1668	0.1 - 1230000	4407	8.1
DDD,2,4'-	µg/kg	677/1047	0.03 - 710	11.7	1.2	918/1485	0.06 - 420000	1299	4.03
DDD,4,4'-	µg/kg	982/1179	0.05 - 11000	43.1	2.2	1250/1668	0.09 - 810000	3586	5.7
DDE (Total of 2,4' and 4,4'-DDE)	µg/kg	968/1176	0.08 - 2530	18.7	2.5	1114/1668	0.06 - 24000	153	4.6
DDE,4,4'-	µg/kg	964/1176	0.05 - 2240	16.0	2.2	1077/1668	0.05 - 24000	125	4.3
DDT (Total of 2,4' and 4,4'-DDT)	µg/kg	888/1178	0.08 - 81000	244.9	2.6	1158/1667	0.09 - 4500000	11068	6.4
DDT,4,4'-	µg/kg	801/1165	0.06 - 81000	258.6	2.2	1059/1649	0.07 - 4500000	11569	5.5
DDx	µg/kg	1072/1179	0.1 - 85000	267	8.3	1384/1668	0.2 - 4800000	13493	17
Dibenzo(a,h)anthracene	µg/kg	1288/1573	0.2 - 25000	234.4	19.2	1260/1654	0.2 - 88000	736	20
Dibenzofuran	µg/kg	1088/1416	0.3 - 31000	114.4	6.2	1069/1417	0.2 - 230000	1493	13
Dibutyl phthalate (Di-n-butyl phthalate)	µg/kg	468/1428	3.5 - 1800	41.9	14	356/1530	3.2 - 3200	33.5	8.8
Dichlorobenzene,1,2-	µg/kg	13/1176	3.2 - 610	68.4	9.1	36/1330	1.4 - 730	61.4	11.0
Dichlorobenzene,1,4-	µg/kg	31/1009	2.7 - 730	68.6	8	81/1386	0.4 - 2000	116	8.9
Dichloroethane,1,2-	µg/kg	3/290	0.1 - 0.4	0.3	0.4	9/610	0.06 - 12	1.8	0.4
Dichloroethene, cis-1,2-	µg/kg	2/121	0.2 - 0.3	0.2	0.2	8/227	16.9 - 1920	348	138
Dichloroethene, trans-1,2-,	µg/kg	1/287	0.5 - 0.5	0.5	0.5	5/599	0.4 - 8.1	3.6	1.3
Dichloroethene,1,1-	µg/kg	0/290	ND - ND	ND	ND	3/610	0.3 - 3.7	2.1	2.3
Dichloropropane,1,2-	µg/kg	0/290	ND - ND	ND	ND	1/599	0.3 - 0.31	0.3	0.3
Dieldrin	µg/kg	238/1121	0.008 - 356	2.6	0.3	72/1183	0.04 - 100	3.7	0.4
Diethyl phthalate	µg/kg	160/1425	1.6 - 370	9.7	3.9	98/1522	1.3 - 1950	106	4.5
Endosulfan,Total	µg/kg	322/1115	0.03 - 270	2.8	0.5	234/1125	0.1 - 4600	36.1	0.8
Endrin	µg/kg	77/882	0.01 - 32	4.0	0.8	127/919	0.1 - 311	15.2	1.9
Endrin ketone	µg/kg	188/1101	0.006 - 90.1	1.9	0.6	119/1102	0.1 - 263	11.1	1.6
Ethylbenzene	µg/kg	32/362	0.1 - 220	8.03	0.3	121/629	0.05 - 140000	6846	18
Fluoranthene	µg/kg	1546/1581	0.8 - 1200000	4089	190	1481/1654	0.2 - 3500000	21939	250
Fluorene	µg/kg	1313/1573	0.3 - 220000	724	17	1342/1654	0.2 - 1500000	9117	33.2
Heptachlor	µg/kg	69/1126	0.003 - 6	0.6	0.2	57/1194	0.1 - 22	1.3	0.5

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Portland Harbor Superfund Site
Portland, Oregon

Contaminant	Unit	Surface				Subsurface			
		Frequency of Detection	Min-Max	Mean	Median	Frequency of Detection	Min-Max	Mean	Median
Heptachlor Epoxide	µg/kg	86/1114	0.002 - 17	1.3	0.3	120/1135	0.1 - 610	8.5	0.8
Hexachlorobenzene	µg/kg	7/50	0.3 - 2.7	1.01	0.7	219/1319	0.07 - 14000	76.7	1.04
Hexachlorocyclohexane, beta-	µg/kg	421/1115	0.001 - 20.3	2.6	1.9	339/1125	0.06 - 1000	8.4	2.3
Hexachlorocyclohexane, delta-	µg/kg	139/1112	0.002 - 5.3	0.6	0.3	44/1106	0.1 - 45.4	3.2	0.6
Hexachlorocyclohexane, gamma-	µg/kg	198/1126	0.003 - 430	4.5	1.2	117/1194	0.05 - 172	4.9	1.2
Hydrocarbons, Diesel Range	mg/kg	739/794	0.05 - 20000	259	83	884/1087	0.04 - 190000	1294	200
Hydrocarbons, Gasoline Range	mg/kg	60/429	1.2 - 140	18.2	7.2	222/817	0.7 - 21000	321	19
Hydrocarbons, Residual Range	mg/kg	621/645	0.3 - 18000	654	410	838/999	0.2 - 110000	1181	553
Indeno(1,2,3-c,d)pyrene	µg/kg	1464/1573	0.9 - 210000	1381	74	1416/1654	0.2 - 610000	4653	87.8
Iron	mg/kg	161/161	19100 - 84900	41855	42300	81/81	18900 - 53900	35936	36300
Isopropylbenzene	µg/kg	42/293	0.07 - 340	10.4	0.6	161/603	0.06 - 19000	560.7	2.4
Lead	mg/kg	1469/1484	1.1 - 13400	49.2	15.8	1528/1536	1.5 - 3330	47.2	20
Magnesium	mg/kg	145/145	3710 - 14500	6709	6930	88/88	2280 - 8510	5463	5810
Manganese	mg/kg	278/278	236 - 2220	674	659	136/136	206 - 2330	566	530.5
MCPP	µg/kg	2/200	193 - 4200	2197	2197	3/171	1.6 - 3000	1013	37.2
Mercury	mg/kg	1331/1452	0.005 - 65.2	0.1	0.07	1316/1395	0.004 - 16.8	0.2	0.09
Methylene chloride	µg/kg	2/290	0.9 - 1.3	1.09	1.09	49/600	0.3 - 7100	239.8	79.3
Methylnaphthalene, 2-	µg/kg	1142/1432	0.4 - 52000	248.4	8.3	1263/1616	0.3 - 3800000	16287	22
Methylphenol, 4-	µg/kg	646/1309	2 - 2500	123.7	20	627/1179	1.6 - 800	60.4	32
Monobutyltin	ug/kg	210/310	0.09 - 740	13.8	1.5	175/352	0.08 - 540	12.9	1.0
MTBE	µg/kg	11/270	0.07 - 0.8	0.3	0.3	87/595	0.07 - 14	0.6	0.2
Naphthalene	µg/kg	1070/1511	0.3 - 73000	424.2	27	1241/1695	0.3 - 20000000	105849	57
Nickel	mg/kg	1418/1435	6.2 - 594	25.8	23.3	1462/1462	6.0 - 716	25.5	23.5
PAHs, Total Carcinogenic	µg/kg	1533/1580	0.4 - 450000	2477	130	1514/1654	0.3 - 1300000	8992	140
PAHS, Total HPAHs	µg/kg	1559/1580	3.9 - 4300000	18533	1000	1555/1654	1.9 - 13000000	82564	1100
PAHs, Total LPAHs	µg/kg	1506/1580	2 - 2900000	7668	207	1533/1654	1.1 - 40000000	152730	340
PAHs,Total	µg/kg	1559/1580	6.3 - 7300000	26006	1200	1582/1654	3.3 - 53000000	229795	1400
PCBs (Total TEQ) - mammalian WHO 2005 TEFs	µg/kg	280/331	0.000008 - 0.2	0.005	0.0006	145/153	0.00004 - 0.3	0.01	0.002
PCBs, total aroclors	µg/kg	725/984	6.2 -6000	161.7	40	744/1328	3.8 - 26000	311	83
PCBs, total congeners	µg/kg	244/244	1.7 - 35000	467	35.5	149/153	0.4 - 37000	705	99.7
PCDD/PCDFs, total	µg/kg	222/222	0.004 - 200	1.9	0.3	294/312	0.0003 - 425.0	9.5	0.3
Pentachlorophenol	µg/kg	92/238	0.3 - 72	8.0	3.8	374/1318	0.3 - 5600	37.6	3.9
Perchlorate	mg/kg	3/11	96.2 - 274	213.07	269	NA	NA	NA	NA
Phenanthrene	µg/kg	1493/1573	0.5 - 1700000	4234	98	1480/1654	0.2 - 8500000	46332	180
Phenol	µg/kg	388/1340	2.2 - 680	18.6	11	307/1321	2.1 - 347	22.4	11
Potassium	mg/kg	145/145	540 - 50000	1671	1280	82/88	321 - 1550	942.6	880.5
Pyrene	µg/kg	1542/1573	0.6 - 1300000	4541	190	1504/1654	0.1 - 4700000	27324	260
Selenium	mg/kg	520/1145	0.03 - 20	2.9	0.2	408/1056	0.02 - 14	1.01	0.1
Silver	mg/kg	1339/1438	0.01 - 14.8	0.3	0.2	1349/1456	0.01 - 4.3	0.3	0.3
Silvex (2,4,5-TP)	µg/kg	1/200	5.4 - 5.4	5.4	5.4	1/182	2.2 - 2.2	2.3	2.3
Sodium	mg/kg	145/145	352 - 49000	1798	1100	88/88	167 - 57800	1427	613
Sulfide	mg/kg	402/462	0.2 - 1830	30.3	6	176/208	0.4 - 796	29.2	8.9
TCDD TEQ - mammalian WHO 2005 TEFs	µg/kg	222/222	0.00003 - 14	0.07	0.002	295/312	0.00001 - 24.4	0.5	0.002
TCDD-2,3,7,8-	µg/kg	46/222	0.00004 - 0.1	0.003	0.0004	94/312	0.00002 - 0.08	0.003	0.0005
Tetrachloroethene	µg/kg	4/337	0.2 - 2.4	1	0.6	36/627	0.2 - 19000	824	1.6
Thallium	mg/kg	182/251	0.03 - 27	7.7	8	61/89	0.04 - 12	2	0.09
Toluene	µg/kg	18/337	0.08 - 3800	385	2.9	134/629	0.03 - 190000	3052	2.5
Tributyltin ion	µg/kg	321/342	0.5 - 47000	480	22	213/417	0.3 - 90000	1469	29
Trichloroethane,1,1,2-	µg/kg	0/290	ND - ND	ND	ND	2/600	0.5 - 1.9	1.2	1.2
Trichloroethene	µg/kg	6/337	0.1 - 2.3	0.7	0.3	116/627	0.1 - 1900000	18997	0.6
Trimethylbenzene,1,2,4-	µg/kg	1/47	142 - 142	142	142	17/96	64.9 - 13100	1944	720
Trimethylbenzene,1,3,5-	µg/kg	0/47	ND - ND	ND	ND	15/96	19.2 - 3860	456	209
Vanadium	mg/kg	145/145	63 - 152	102.2	104	37/37	89.9 - 136	103	103
Vinyl chloride	µg/kg	2/290	0.3 - 0.6	0.5	0.5	18/611	0.1 - 4000	235	1.2
Xylenes, total	µg/kg	1/34	50 - 50	50	50	1/2	330 - 330	330	330
Xylene,o-	µg/kg	41/337	0.1 - 170	5.5	0.5	162/629	0.04 - 80000	2001	2.6
Xylene-m,p-	µg/kg	26/337	0.08 - 87	4.8	0.8	129/629	0.05 - 200000	4949	5.1
Zinc	mg/kg	1490/1490	3.7 - 4220	152.6	106	1521/1521	24 - 9000	147.7	105

Table 1.2-2
Chemicals Potentially Posing Unacceptable Risks for Human Health
Portland Harbor Superfund Site
Portland, Oregon

								Surface Water					In-Water Sediment												Fish Tissue					Shellfish	
Chemical of Concern		Dockside Worker	Low-Frequency Fisher	High-Frequency Fisher	Tribal Fisher	Transients	Ingestion of Human Milk (Dockside Worker)	Recreational Beach User	Transients	Diver in Wet Suit	Diver in Dry Suit	Potential Future Domestic Water Use	In-Water Worker	Low Frequency Fisher	High Frequency Fisher	Tribal Fisher	Diver in Wet Suit	Diver in Dry Suit	Ingestion of Human Milk (In-Water Worker)	Ingestion of Human Milk (Low Frequency Fisher)	Ingestion of Human Milk (High Frequency Fisher)	Ingestion of Human Milk (Tribal Fisher)	Ingestion of Human Milk (Diver in Wet Suit)	Ingestion of Human Milk (Diver in Dry Suit)	Fish Consumption, River Mile Basis	Fish Consumption, Study Area-Wide	Tribal Fish Consumption	Ingestion of Human Milk (Non-tribal Consumption)	Ingestion of Human Milk (Tribal Consumption)	Adult Consumption	Ingestion of Human Milk (Non-tribal Consumption)
Metals																															
Antimony																											+				
Arsenic	Xb		Xb	Xb	O							X			Xab	Xb									O	O	#			O	
Chromium, hexavalent												Xa																			
Leadd																											X				
Mercury																									+	+	+				
PAHs																															
Benzo(a)anthracene	Xab	Xab										O		Xab	Xab	Xab	Xab								Xab					O	
Benzo(a)pyrene	Ob	Oa		Xab	Xb					Xab		#	Xab	Ob	Ob	O	Ob	Xab							O	Xc	X			#	
Benzo(b)fluoranthene	Xab	Xab										O		Xab	Xab	Xab	Xab													O	
Benzo(k)fluoranthene																														Xa	
Dibenzo(a,h)anthracene	Xb	Xab										O		Xab	Xab	Xab	Xab								Xab	Xc	X			O	
Indeno(1,2,3-cd)pyrene	Xab	Xab										O		Xab	Xab	Xab	Xab													X	
Total Carcinogenic PAHs	O	Oa	Xab	Xab	Xb					Xab	Xab	#	Xab	Ob	Ob	#	Ob	Xab							O	X	X			#	
Phthalates																															
Bis(2-ethylhexyl)phthalate																											O				
SVOCs																															
Hexachlorobenzene																										O	O				
Phenols																															
Pentachlorophenol																														Xa	
Polychlorinated Biphenyls																															
Total PCBs														Xab	Xab	Ob	Xab				+ab	+ab	+ab		#	#	#	+	+	#	+
Total PCB TEQ														Xab	Xab	Xb	Xab								O	#	#	+b	+	O	+b
Dioxin/Furan																															
Total Dioxin TEQ													Oab	Oab	Oab	#	Oab	Xab	+ab	+ab	+ab	+ab			#	#	#	+	+	#	+b
Pesticides																															
Aldrin																														Xa	
Dieldrin																									O	O	O			X	
Total Chlordane																										Xc	X				
Total DDD																									Xa	X	O			X	
Total DDE																									X	X	O			X	
Total DDT																									X	X	O			Xa	
Total DDX																															
Herbicides																															
MCPP												+ab																			
Polybrominated Diphenyl Ethers																												+ab			

Notes:
Groundwater seep exposure resulted in no cancer or noncancer exceedances of target risk levels.
Abbreviations:
X Chemical exceeds cancer risk of 10-6 or a hazard quotient of 1 for at least one BHHRA scenario. O Chemical exceeds cancer risk of 10-5 or a hazard quotient of 1 for at least one BHHRA scenario.
Chemical exceeds cancer risk of 10-4 or a hazard quotient of 1 for at least one BHHRA scenario.
+ Chemical exceeds a hazard quotient of 1 for at least one BHHRA scenario, but does not exceed a cancer risk of 10-6. a Status is result of target risk or hazard exceedance for two or fewer exposure points.
b Status is result of target risk or hazard exceedance for RME scenario only.
c Status is result of target risk or hazard exceedance only for subsistence fish consumption. d Status for lead is based on results of predicted blood lead levels.
Shading indicates an exceedance of a hazard quotient of 1 for at least one BHHRA scenario.

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Table 1.2-3

COPCs Posing Potentially Unacceptable Ecological Risks within the Portland Harbor Study Area

Portland Harbor Superfund Site

Portland, Oregon

Assessment Endpoint	Exposure Pathway	COPCs with HQ ≥ 1.0	Additional Details in the BERA
Aquatic plants, amphibians	Surface water	Benzo(a)anthracene, benzo(a)pyrene, BEHP, naphthalene, total DDx, total PCBs,a zinc	Sections 9-1 (amphibians) and 10-1 (aquatic plants)
	TZW	1,2,4-Trimethylbenzene, 1,2-dichlorobenzene, 2-methylnaphthalene, 4,4′-DDT, acenaphthene, anthracene, barium, benzo(a)anthracene, benzo(a)pyrene, cadmium, carbon disulfide, chlorobenzene, chloroethane, chloroform, copper, cyanide, ethylbenzene, fluorene, gasoline fraction (aliphatic) C4 – C6, gasoline fraction (aliphatic) C10 – C12, iron, isopropylbenzene, lead, magnesium, manganese, naphthalene, nickel, perchlorate, phenanthrene, potassium, sodium, toluene, total DDx, zinc	Sections 9-2 (amphibians) and 10-1 (aquatic plants)
Benthic invertebrates, bivalves, decapods	Sediment	2,4′-DDD, 2-methylnaphthalene, 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, 4-methylphenol, acenaphthene, acenaphthylene, ammonia,b anthracene, Aroclor 1254c, arsenicc, benzo(a)anthracene, benzo(a)pyrene,c benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzyl alcohol, cadmium, carbazole, chlordane (cis and trans),c chromium, chrysene, cis-chlordane, copper, dibenzo(a,h)anthracene, dibenzofuran, dibutyl phthalate, dieldrin, diesel-range petroleum hydrocarbons, endrin, endrin ketone, fluoranthene, fluorene, gasoline-range hydrocarbons,d heptachlor epoxide,c indeno(1,2,3-cd)pyrene, lead, lindane (γ-HCH),c mercury, naphthalene,c nickel,c phenanthrene, phenol, pyrene, residual-range hydrocarbons,e silver, sulfide,b sum DDD, sum DDE, sum DDT, total chlordane,c total DDx, total endosulfan, total HPAH, total LPAH, total PAH, total PCBs, TBT, zinc,c β-HCH, δ-HCH	Sections 6-2 and 6-3
	Surface water	4,4′-DDT,a benzo(a)anthracene, benzo(a)pyrene, BEHP, ethylbenzene, naphthalene, total DDx, total PCBs,a trichloroethene, zinc	Section 6-5
	TZW	1,1-Dichloroethene, 1,2,4-trimethylbenzene, 1,2-dichlorobenzene, 1,3,5-trimethylbenzene, 1,4- dichlorobenzene, 2-methylnaphthalene, 4,4′-DDT, acenaphthene, anthracene, barium, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, beryllium, cadmium, carbon disulfide, chlorobenzene, chloroethane, chloroform, chrysene, cis-1,2- dichloroethene, cobalt, copper, cyanide, dibenzo(a,h)anthracene, dibenzofuran, ethylbenzene, fluoranthene, fluorene, gasoline fraction (aliphatic) C4 – C6, gasoline fraction (aliphatic) C6 – C8, gasoline fraction (aliphatic) C10 – C12, gasoline fraction (aromatic) C8 – C10, indeno(1,2,3-cd)pyrene, iron, isopropylbenzene, lead, m,p-xylene, magnesium, manganese, naphthalene, nickel, o-xylene, perchlorate, phenanthrene, potassium, pyrene, sodium, toluene, total DDx, total xylenes, trichloroethene, vanadium, zinc	Section 6-6
	Tissue	4,4′-DDD, arsenic, BEHP, copper, total DDx, total PCBs, TBT, zinc	Section 6-4

Table 1.2-3
COPCs Posing Potentially Unacceptable Ecological Risks within the Portland Harbor Study Area
Portland Harbor Superfund Site
Portland, Oregon

Assessment Endpoint	Exposure Pathway	COPCs with HQ ≥ 1.0	Additional Details in the BERA
Fish	Surface water	4,4′-DDT,a benzo(a)anthracene, benzo(a)pyrene, BEHP, ethylbenzene, naphthalene, total DDx, total PCBs,a trichloroethene, zinc	Section 7-3
	Fish tissue	1,1-Dichloroethene, 1,2,4-trimethylbenzene, 1,2-dichlorobenzene, 1,3,5-trimethylbenzene, 1,4-dichlorobenzene, methylnaphthalene, 4,4′-DDT, acenaphthene, anthracene, barium, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, beryllium, cadmium, carbon disulfide, chlorobenzene, chloroethane, chloroform, chrysene, cis-1,2-dichloroethene, cobalt, copper, cyanide, dibenzo(a,h)anthracene, dibenzofuran, ethylbenzene, fluoranthene, fluorene, gasoline fraction (aliphatic) C4 – C6, gasoline fraction (aliphatic) C6 – C8, gasoline fraction (aliphatic) C10 – C12, gasoline fraction (aromatic) C8 – C10, indeno(1,2,3-cd)pyrene, iron, isopropylbenzene, lead, m,p-xylene, magnesium, manganese, naphthalene, nickel, o-xylene, perchlorate, phenanthrene, potassium, pyrene, sodium, toluene, total DDx, total xylenes, trichloroethene, vanadium, zinc	Section 7-4
		Antimony, BEHP, copper, lead, total DDx, total	Section 7-1
Birds	Diet	PCBs Cadmium, copper, mercury, TBT	Section 7-2
		Aldrin, benzo(a)pyrene, copper, dibutyl phthalate, lead, sum DDE, total DDx, total dioxin/furan TEQ, total PCBs, total PCB TEQ, total TEQ	Section 8-1
	Bird egg tissue	otal dioxin/furan TEQ, total PCBs, total PCB TEQ, total TEQ	Section 8-2
Mammals	Diet	Aluminum, lead, total dioxin/furan TEQ, total PCBs, total PCB TEQ, total TEQ	Section 8-1

a Identified as a COPC (HQ ≥ 1,0) when the AWQC TRV was adopted; not identified as a COPC (HQ < 1.0) when the alternative TRV was adopted. These chemicals are not included in the total counts of COPCs with potentially unacceptable ecological risk unless they were identified as a COPC for another LOE.
b Ammonia and sulfide in bulk sediment exceeded SLs but are not included in the total counts of COPCs with potentially unacceptable ecological risk.
c Identified as a COPC based on concentrations that exceeded the sediment PEC and/or PEL [see Section 6.3]; chemical was not identified as a COPC based on the FPM or LRM predicted toxicity LOE. These chemicals are not included in the total counts of COPCs with potentially unacceptable ecological risk unless they were
identified as a COPC for another LOE (e.g., arsenic is identified as a COPC with potentially unacceptable risk for benthic invertebrates based on the tissue LOE and
is therefore included in the total count of COPCs).
d Identified as a COPC based on concentrations that exceeded the TPH SQG (i.e., the chemical was not identified as a COPC for any other benthic sediment evaluation).
e Identified as a COPC based on concentrations that exceeded the TPH SQG; chemical was not included in the COPC counts if identified as a COPC based only on the TPH SQG exceedance.

AWQC – ambient water quality criteria	HPAH – high-molecular-weight polycyclic aromatic hydrocarbon	SL – screening level
BEHP – bis(2-ethylhexyl) phthalate	HQ – hazard quotient	SQG – sediment quality guideline
COPC – chemical of potential concern	LOE – line of evidence	TBT – tributyltin
DDD – dichlorodiphenyldichloroethane	LPAH – low-molecular-weight polycyclic aromatic hydrocarbon	TEQ – toxic equivalent total DDx – sum of all six DDT isomers (2,4′-DDD, 4,4′-DDD, 2,4′-DDE, 4,4′- DDE, 2,4′-DDT and 4,4′-DDT)
DDE – dichlorodiphenyldichloroethylene	LRM – logistic regression model	TPH – total petroleum hydrocarbons
DDT – dichlorodiphenyltrichloroethane	PCB – polychlorinated biphenyl	TRV – toxicity reference value
FPM – floating percentile model	PEC – probable effects concentration	TZW – transition zone water
HCH – hexachlorocyclohexane	PEL – probable effects level	

Table 1.2-4

Chemicals Identified as Most Likely to be Contaminants of Ecological Significance

Portland Harbor Superfund Site

Portland, Oregon

Contaminants of Primary Ecological Significance	
PCBs	Dioxins and furans
PAHs	DDT and its metabolites
Additional Contaminants of Ecological Significance	
Total chlordanes	Lead
Copper	Zinc
Lindane (γ-HCH)	Tributyltin
Perchlorate	Mercury
Cadmium	BEHP
Dieldrin	Cyanide
Ethylbenzene	C10 – C12 TPH
Manganese	Vanadium

Table 1.2-5
Locations and Media with Highest PCBs Concentrations
Portland Harbor Superfund Site
Portland, Oregon

Location	Sediment	Sediment Traps	Surface Water	Biota
RM 2E	X		X	X
International Slip (RM 4E)	X	NA	X	X
Willamette Cove (RM 7E)	X	X	X	X
Swan Island Lagoon (RM 8E)	X	X	X	X
RM 11E	X	X	X	X
RM 9W	X	X	X	X

Table 1.2-6

Locations and Media with Highest Dioxin/Furan Concentrations

Portland Harbor Superfund Site

Portland, Oregon

Location	Sediment	Sediment Traps	Surface Water	Pore Water	Biota
International Slip (RM 4E)	X	X	X	NA	X
Willamette Cove (RM 7E)	X		X	NA	X
Swan Island Lagoon (RM 8E)	X	X	X	NA	X
RM 7W	X	X	X	X	X
RM 9W	X	X	X	NA	X

Table 1.2-7

Locations and media with highest DDx concentrations

Portland Harbor Superfund Site

Portland, Oregon

Location	Sediment	Sediment Traps	Surface Water	Pore Water	Biota
RM 11E	X	X		NA	
RM7W	X	X	X	X	X
RM9W	X	X	X	NA	X

Table 1.2-8
Locations and Media with Highest PAH
Portland Harbor Superfund Site
Portland, Oregon

Location	Sediment	Sediment Traps	Surface Water	Pore Water	Biota
International Slip (RM 4E)	X	X		NA	X
Swan Island Lagoon (RM 8E)	X	X	X	NA	NA
RM 3W-6W	X			X	X
RM 6W	X	X	X	X	X
RM 9W	X		X	NA	X

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Table 2.1-1
Chemical-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Medium	Regulation/Citation	Criterion/Standard	Comments
Protection of surface water	Clean Water Act, 33 USC 1313 and 1314 (Sections 303 and 304). Most recent 304(a) list of recommended water quality criteria, as updated up to issuance of the ROD	Under CWA Section 304(a), EPA develops recommended water quality criteria for water quality programs established by states. Two kinds of water quality criteria are developed: one for protection of human health, and one for protection of aquatic life. CWA §303 requires States to develop water quality standards based on Federal water quality criteria to protect existing and attainable use or uses (e.g., recreation, public water supply) of the receiving waters.	The most recent 304(a) recommended water quality criteria are relevant and appropriate for cleanup standards for surface water and contaminated groundwater discharging to surface water if more stringent than promulgated state criteria. Relevant and Appropriate as criterion to apply to limit short-term impacts from dredging and capping if more stringent than promulgated state criteria. Relevant and Appropriate as criterion to apply to point source discharges that may occur in implementing the remedy, if applicable.
Protection of potential drinking water sources	Safe Drinking Water Act, 42 USC 300f, 40 CFR Part 141, Subpart O, App. A. 40 CFR Part 143	Establishes Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) to protect human health from contaminants in drinking water.	Relevant and Appropriate as cleanup standards for groundwater and surface water at Portland Harbor, which are potential drinking water sources.
Protection of potential drinking water sources	EPA Regional Screening Level (RSL) for Groundwater. Office of Superfund Remediation and Technology Innovation, Assessment and Remediation Division. November 2015.	Establishes acceptable risk levels for human health at 1x10-6 for individual carcinogens or hazard quotient (HQ) of 1 for individual contaminants in drinking water. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data.	To be considered for establishing PRGS for contaminants of concern where MCLGs and MCLs are not established.
Measure of protectiveness of human health and the environment in all media	Oregon Environmental Cleanup Law ORS 465.315(b)(A). Oregon Hazardous Substance Remedial Action Rules OAR 340- 122-0040(2)(a) and (c), 0115(2-4).	Sets standards for degree of cleanup required for hazardous substances. Establishes acceptable risk levels for human health at $1x10^{-6}$ for individual carcinogens, $1x10^{-5}$ for multiple carcinogens, and Hazard Index of 1 for noncarcinogens.	Applicable standards for the final selected remedy to achieve these human health carcinogen and noncarcinogen risk levels by implementation of dredging, capping, enhanced natural recovery, monitored natural recovery, on or off-site disposal, implementation of institutional controls and other response actions set forth in the ROD.
Protection of surface water	Water Pollution Control Act ORS 468B.048. State-wide Numeric water quality criteria set forth in OAR Part 340, Division 41, including, Toxic Substances criterion at OAR Part 340-41-0033 (Tables 30 and 40), and Designated Uses for the Willamette Basin and Numeric Water Quality Criteria specified for the Willamette Basin at OAR 340-041-340 and 340-041-0345	DEQ is authorized to administer and enforce CWA program in Oregon. The state has promulgated numeric water criteria, both criteria that applies state-wide and specific Willamette Basin criteria promulgated to protect Willamette Basin designated beneficial uses.	Oregon's numeric toxics water quality standards (Tables 30 and 40) are applicable requirements as cleanup standards for surface water to the extent they are more stringent than Clean Water Act 304(a) recommended criterion. All state promulgated numeric water quality criteria are applicable standards of control on discharges to state waters during the implementation of remedial actions, such as setting limits on short-term impacts from dredging and capping, and limits on point source discharges that may occur in implementing the remedy. Oregon's numeric criteria are relevant and appropriate as cleanup standards for groundwater discharging to surface water.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions that discharge dredged or fill material into navigable waters	Clean Water Act, Section 404 and Section 404(b)(1) Guidelines, 33 USC 1344, 40 CFR Part 230 (Guidelines for Specification of Disposal Sites for Dredged or Fill Material)	CWA §404 regulates the discharge of dredged or fill material into waters of the U.S, including return flows from such activity. This program is implemented through regulations set forth in the 404(b)(1) guidelines, 40 CFR Part 230. The guidelines specify: the restrictions on discharge (40 CFR 230.10); the factual determinations that need to be made on short-term and long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment (40 CFR 230.11) in light of Subparts C through F of the guidelines; and the findings of compliance on the restrictions (40 CFR 230.12). Subpart J of the guidelines provide the standards and criteria for the use of all types of compensatory mitigation when the response action will result in unavoidable impacts to the aquatic environment.	Applicable criteria and guidelines for selecting in-water disposal sites and to evaluating impacts from dredging, capping, enhanced monitored natural recovery, and in-situ treatment of sediments that will occur in implementing the remedy. Through the analysis of impacts required by Section 404, controls on dredging and capping, including return flows, and the design and construction of an on-site CDF will be developed to minimize or avoid the impacts. Also through 404 analysis, compensatory mitigation for unavoidable loss of aquatic habitat will be developed during remedial design and constructed during remedial implementation.
Actions that discharge pollutants to waters of U.S.	Clean Water Act, Section 402, 33 USC 1342	Regulates discharges of pollutants from point sources to waters of the U.S., and requires compliance with the standards, limitations and regulations promulgated per Sections 301, 304, 306, 307, 308 of the CWA. CWA §301(b) requires all direct dischargers to meet technology-based requirements. These requirements include, for conventional pollutants, application of the best conventional pollutant control technology (BCT), and for toxic and nonconventional pollutants, the best available technology economically achievable (BAT). Where effluent guidelines for a specific type of discharge do not exist, BCT/BAT technology-based treatment requirements are determined on a case-by-case basis using best professional judgment (BPJ). Once the BPJ determination is made, the numerical effluent discharge limits are derived by applying the levels of performance of a treatment technology to the wastewater discharge.	Relevant and Appropriate to remedial activities that result in a point source discharge of pollutants to the river if more stringent than state promulgated point source requirements.
Actions that discharge pollutants to waters of U.S.	Clean Water Act, 33 USC 1341, (Section 401), 40 CFR Section, 121.2(a)(3), (4) and (5) Also see OAR 340-048-0015 "When Certification Required" pursuant to Oregon state law.	Any federally authorized activity which may result in any discharge into navigable waters requires reasonable assurances that the activity will be conducted in a manner which will not violate applicable water quality standards by the imposition of any effluent limitations, other limitations, and monitoring requirements necessary to assure the discharge will comply with applicable provisions of sections 1311, 1312, 1313, 1316, and 1317 of the Clean Water Act. Oregon administrative rule OAR 340-048-0015, Provides that federally-approved activities that may result in a discharge to waters of the State requires evaluation whether an activity may proceed and meet water quality standards with conditions, which if met, will ensure that water quality standards are met.	Relevant and Appropriate requirement, if more stringent than state implementation regulations, that in-water response actions that result in a discharge of pollutants comply with water quality standards through the placement of water quality-based conditions and other requirements on the discharge deemed necessary. The applicable state regulations require reasonable assurance that any discharge to state waters will comply with state water quality standards. Implementation of the remedial action (e.g., dredging, capping, and construction of confined disposal facility) will result in a discharge to waters of the State, thus, conditions and other requirements deemed necessary will be placed on the discharge.
Actions resulting in discharges to waters of the State of Oregon, including removal and fill activities	ORS 468B.025 - State water quality standards established by rule: OAR 340-041-0002 through 0059, and Willamette Basin Designated Uses and Basin-specific water quality standards at OAR 340-041-340 and OAR 340-041-345.	ORS 468B.025 prohibits pollution of any waters of the state and prohibits the discharge of any wastes into state waters if the discharge reduces the quality of the water below state water quality standards.	All state-wide and Willamette Basin-specific water quality standards, including numeric, narrative, and designated uses, are applicable requirements for any discharges to surface water from point sources and activities that may result in discharges to waters of the state, such as dredge and fill, capping, de-watering sediments, construction and operation of an on-site CDF. All state-wide and Willamette Basin-specific water quality standards are relevant and appropriate to measuring effectiveness of controls on contaminated groundwater discharging to the Willamette River.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions resulting in discharges from removal and fill activities	ORS 196.825(5) -Statutory requirement to mitigate for expected adverse effects of removal and fill activities. Applicable substantive mitigation rules are: OAR 141-085-510, 141-085-680, 141-085 0685, 141-085-0690, 141-085-0710, 141-085-715.	State substantive requirements for mitigation for the reasonably expected adverse effects of removal or fill in a project development in waters of the state, including in designated Essential Indigenous Anadromous Salmonid Habitat.	Applicable compensatory mitigation standards and requirements for impacts from dredge and fill activities, capping, and riverbank remediation. The Site includes Essential Indigenous Anadromous Salmonid Habitat and the listed state regulations contain specific habitat mitigation standards not found in CWA Section 404 regulations for reasonably expected adverse effects of the dredging, capping, construction and operation of the CDF.
Actions in federal navigation channels	River and Harbors Act of 1899, Section 10, 33 USC Section 403. 33 CFR Section 322(e), 33 CFR Section 323.3 and Section 323.4(b)-(c) and 329	The creation of any obstruction not affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States is prohibited; and it shall not be lawful to build or commence the building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structures in any port, roadstead, haven, harbor, canal, navigable river, or other water of the United States, outside established harbor lines. 33 CFR 322(e) addresses placing of aids to navigation in navigable waters is under the purview of Section 10, and must meet requirements of the U.S. Coast Guard (33 CFR 330.5(a)(1)). 33 CFR Section 323.4(b) and (c) provide if any discharge of dredged or fill material contains any toxic pollutant listed under section 307 of the CWA such discharge shall require compliance with Section 404 of the CWA. Placement of pilings, or discharge of dredged material that where the flow or circulation of waters of the United States may be impaired or the reach of such waters reduced must comply with Section 10. 33 CFR 329.4 defines the terms "navigable water of the United States" for purposes of the USACE regulations, including those addressing the discharge of dredged or fill material.	Applicable requirement for how remedial actions are taken or constructed in the navigation channel. Applicable to the use of aids to navigation as institutional controls for maintaining the integrity of the selected remedy or placement of pilings or discharge of dredged material that may impair the flow or circulation of waters or reach of such waters.
Actions generating pesticide residue	Hazardous Waste and Hazardous Materials II. Identification and Listing of Hazardous Waste OAR 340-101-0033(6) and (7); OAR 340-100-0010(j); and OAR 340-109-0010(3) and (4)	Identifies and defines pesticide residue as a hazardous waste under state law, but which is not subject to land disposal restrictions.	Relevant and appropriate to identifying dredged materials that would meet the definition of pesticide residue that cannot be disposed of in the CDF in accordance with the disposal criteria. Applicable to characterizing dredged material as hazardous waste for off-site disposal.
Action disposing of dredged material in on-site CDF	OAR 340-095-0010(3), OAR 340-095-0030(5), and OAR 340-095-0070(2).	Substantive State of Oregon solid waste disposal requirements related to the location, design, and closure of a non-municipal land disposal site.	Relevant and appropriate regulations for the on-site CDF. Although a CDF is not a land disposal site, the listed solid waste regulatory requirements for the location (floodplains), design (surface drainage control), and closure (final cover, restoration, and surface water management) of a non-municipal land disposal site have been found to be relevant and appropriate to the CDF.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions handling PCB remediation wastes and PCB containing material	Toxic Substances Control Act, 15 USC §2601 et seq., 40 CFR Part 761, Subpart D.	Subpart D regulates storage and disposal of PCB wastes and establishes requirements for handling, storage, and disposal of PCB-containing materials, including PCB remediation wastes, and sets performance standards for disposal technologies for materials/wastes with concentrations in excess of 50 milligrams per kilogram (mg/kg). Establishes decontamination standards for PCB contaminated debris. Oregon PCB regulations regarding the storage for disposal of PCB and PCB Items also require the owners or operators of any facility using containers described in CFR 761.65(c)(7)(i) prepare and implement a Spill Prevention Control and Countermeasure (SPCC) plan as described in 40 CFR Part 112. In complying with 40 CFR Part 112, the owner or operator shall read "oil(s)" as "PCB(s)" whenever it appears. Because the remedy requires removal of sediment to specific depths and the maximum PCB concentrations detected in areas of the river to be dredged do not exceed 50 mg/kg, no substantive requirements triggered. If additional testing during remedial design identifies sediments at concentrations of 50 mg/kg PCBS, TSCA regulations may be applicable for managing dredged material for off-site disposal and listed here: 40 CFR 761.1(b)(5), 40 CFR 761.3, 40 CFR 761.50(a) and (b)3, 40 CFR 761.61(a)(5) and (b), 40 CFR 761.65(c)(9)(i)-(iii), and 40 CFR 761(c).	TSCA decontamination and disposal requirements are applicable to the disposal of contaminated material, debris, or surface water with PCB contamination if dredged sediment is found to contain 50 mg/kg in concentration.
Risk-based limits protective of human health for air emissions associated with soil or sediment removal	Clean Air Act, 40 CFR Parts 50 and 52	Places restrictions on air emissions from stationary and mobile sources that creates threats to human health as defined in the regulations and which may be generated from equipment used to construct the remedy.	These regulations are Relevant and Appropriate to evaluating how emissions may be minimized or reduced during construction of the remedy.
Actions generating air emissions	Oregon Air Pollution Control ORS 468A et. seq., General Emissions Standards OAR 340-226	DEQ is authorized to administer and enforce Clean Air program in Oregon. Rules provide general emission standards for fugitive emissions of air contaminants and require highest and best practicable treatment or control of such emissions.	Applicable to remedial actions taking place in on-site uplands. Could apply to earth-moving equipment, dust from vehicle traffic, and mobile-source exhaust, among other things.
Actions that involve handling of dredged sediment or riverbank soils containing asbestos	National Emission Standards for Asbestos, 40 CFR 61.150(a)(1)(i) - (v)	40 CFR 61.150(a) requires that there be no visible emissions to the outside air during collection, processing, packaging, or transporting of any asbestos-containing waste material. Subsections (a)(1)(i) and (ii) require that asbestos-containing waste material be adequately kept wet and provide how to keep such wet so as not to discharge any visible emissions to the outside air. Subsection (a)(1)(iii) requires that after wetting, seal all asbestos-containing waste material in leak-tight containers while wet; or, for materials that will not fit into containers without additional breaking, put materials into leak-tight wrapping. Subsections (a)(1)(iv) and (v) require: Label the containers or wrapped materials specified in paragraph (a)(1)(iii) of this section using warning labels specified by Occupational Safety and Health Standards of the Department of Labor, Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.1001(j)(4) or 1926.1101(k)(8). The labels shall be printed in letters of sufficient size and contrast so as to be readily visible and legible. For asbestos-containing waste material to be transported off the facility site, label containers or wrapped materials with the name of the waste generator and the location at which the waste was generated.	Relevant and appropriate as standards for handling dredged sediment or riverbank soils containing asbestos that is going to on-site or off-site disposal facilities

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions that involve off-site disposal of dredged sediment or riverbank soils containing asbestos	National Emission Standards for Asbestos, 40 CFR 61.150(b)(1) and (2) and (c)	40 CFR 61.150(b)(1) and (2) require: All asbestos-containing waste material shall be deposited as soon as is practical by the waste generator at a waste disposal site operated in accordance with the provisions of § 61.154, or an EPA-approved site that converts RACM and asbestos-containing waste material into nonasbestos (asbestos-free) material according to the provisions of § 61.155. Subsection (c) requires: Mark vehicles used to transport asbestos-containing waste material during the loading and unloading of waste so that the signs are visible. The markings must conform to the requirements of §§ 61.149(d)(1) (i), (ii), and (iii).	Relevant and appropriate to offsite transportation, treatment and disposal of asbestos-containing waste material segregated from contaminated environmental media such as sediment and soil that is generated during dredging or excavation of sediment and riverbank soils.
Actions on the riverbanks that expose and manage on-site soils containing asbestos	National Emission Standards for Asbestos, 40 CFR 61.151(a)(2) and (3), 40 CFR 61.151(b)(1)(i) through (iii) and 40 CFR 61.151(b)(2)	40 CFR 61.151(a)(2) requires: Cover the asbestos-containing waste material with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, and grow and maintain a cover of vegetation on the area adequate to prevent exposure of the asbestos-containing waste material. In desert areas where vegetation would be difficult to maintain, at least 8 additional centimeters (3 inches) of well-graded, nonasbestos crushed rock may be placed on top of the final cover instead of vegetation and maintained to prevent emissions. 40 CFR 61.151(b)(3) requires: Cover the asbestos-containing waste material with at least 60 centimeters (2 feet) of compacted nonasbestos-containing material, and maintain it to prevent exposure of the asbestos-containing waste. 40 CFR 61.151(b)(1)(i) through (iii) requires: (1) Display warning signs at all entrances and at intervals of 100 m (328 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited. The warning signs must: (i) Be posted in such a manner and location that a person can easily read the legend; and (ii) Conform to the requirements for 51 cm × 36 cm (20" × 14") upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and (iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph. Spacing between any two lines must be at least equal to the height of the upper of the two lines. 40 CFR 61.151(b)(2) requires: Fence the perimeter of the site in a manner adequate to deter access by the general public.	Relevant and appropriate to exposed asbestos-containing waste material and soils managed in situ on riverbanks during remediation.
Actions generating air emissions	Fugitive Emission Requirements OAR 340-208	Prohibits any handling, transporting, or storage of materials, or use of a road, or any equipment to be operated, without taking reasonable precautions to prevent particulate matter from becoming airborne. These rules for "special control areas" or other areas where fugitive emissions may cause nuisance and control measures are practicable.	Applicable to remedial actions taking place in on-site uplands. Could apply to earth-moving equipment, dust from vehicle traffic, and mobile-source exhaust, among other things.
Actions that may alter waterbodies and that may affect fish and wildlife	Fish and Wildlife Coordination Act. 16 USC 662 and 663, 50 CFR 6.302(g)	Requires federal agencies to consider effects on fish and wildlife from projects that may alter a body of water and mitigate or compensate for project-related losses, which includes discharges of pollutants to water bodies.	Applicable to determining impacts and appropriate mitigation, if necessary, for effects on fish and wildlife from filling activities or discharges from point sources.
Actions that may affect ESA listed and State protected fish and wildlife species	ODFW Fish Management Plans for the Willamette River. OAR 635, div 500	Provides basis for in-water work (dredging and filling) windows in the Willamette River.	To be considered for placing restrictions on when dredging and filling can occur in the Willamette River due to presence of ESA listed and state protected species at the site.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions that may affect marine mammals	Marine Mammal Protection Act. 16 USC §1361 et seq. 50 CFR 216	Imposes restrictions on the taking, possession, transportation, selling, offering for sale, and importing of marine mammals.	Applicable to response actions that could harm marine mammals in the Willamette River and may require best management practices be used for observing and avoiding contact with such species during construction of the remedy.
Actions that may affect migratory birds	Migratory Bird Treaty Act. 16 USC §703 50 CFR §10.12	Makes it unlawful to take any migratory bird. "Take" is defined as pursuing, hunting, wounding, killing, capturing, trapping and collecting.	Applicable to response actions that could harm migratory birds using the Willamette River and may require use of best management practices for observing and avoiding contact with such species during construction of the remedy.
On-site actions that involve generating, handling and disposal of hazardous waste	OAR 340-100-0001(3) and OAR 340-100-0002(1)	Oregon has adopted and incorporates by reference the federal RCRA hazardous waste management program. Oregon adopted the federal Hazardous Waste Identification Rule that provides for an exclusion for dredged materials subject to the requirements of a permit under the Clean Water Act or the Marine Protection, Research, and Sanctuaries Act from RCRA Subtitle C.	Oregon's hazardous waste and materials regulations are applicable to the generation, storage, handling, treatment and disposal of hazardous waste on-site and slated for off-site disposal. Oregon's hazardous waste identification rule exempts handling and on-site disposal of dredged materials subject to the requirements of a permit under the Clean Water Act or Marine Protection, Research, and Sanctuaries Act.
Actions generating solid wastes or hazardous wastes for disposal in CDF or for off-site disposal	Solid waste defined in 40 CFR 261.2. Determining if solid waste is hazardous per 40 CFR § 262.11(a-c) and OAR 340-102-0011 - Hazardous Waste Determination	Must determine if solid waste (residue as defined in OAR 340-100-0010) is a hazardous waste using the following method: • Should first determine if waste is excluded from regulation under 40 CFR261.4; and • Must then determine if waste is listed as a hazardous waste under subpart D 40 CFR part 261 or whether the waste is (characteristic waste) identified in subpart C of 40 CFR part 261 by either: (1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR §260.21; or (2) Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used. Additionally, Oregon has promulgated its own hazardous waste determination regulation: "(1) The provisions of this rule replace the requirements of 40 C.F.R. Sec. 262.11.	Hazardous waste characterization and determination is applicable to for off-site disposal. Hazardous waste identification critieria is being applied as relevant and appropriate to dredged materials to be disposed of in the CDF per the disposal criteria established for the CDF.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions generating solid wastes or hazardous wastes for disposal in CDF or for off-site disposal	Solid waste defined in 40 CFR 261.2. Determining if solid waste is hazardous per 40 CFR § 262.11(a-c) and OAR 340-102-0011 - Hazardous Waste Determination	(2) A person who generates a residue as defined in OAR 340-100-0010 must determine if that residue is a hazardous waste using the following method: (a) Persons should first determine if the waste is excluded from regulation under 40 C.F.R. Sec. 261.4 or OAR 340-101-0004; (b) Persons must then determine if the waste is listed as a hazardous waste in Subpart D of 40 C.F.R. Part 261; (c) Persons must then determine if the waste is listed under the following listings:	
		NOTE: Even if the waste is listed, the person still has an opportunity under OAR 340-100-0022 to demonstrate to the Commission that the waste from their particular facility or operation is not a hazardous waste. (d) Regardless of whether a hazardous waste is listed through application of subsections (2)(b) or (2)(c) of this rule, persons must also determine whether the waste is hazardous under Subpart C of 40 C.F.R. Part 261 by either: (A) Testing the waste according to the methods set forth in Subpart C of 40 C.F.R. Part 261, or according to an equivalent method the Department approves under OAR 340-100-0021, or NOTE: In most instances, the Department will not consider approving a test method until the EPA approves it. (B) Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used."	
Actions generating dredged material hazardous waste	40 CFR § 261.4(g)	Dredged material that is subject to the requirements of Section 404 of the CWA is not a hazardous waste for purposes of regulation under RCRA.	The exemption is applicable to the dredging, in-situ treatment, handling, storage or other on-site activities of dredged materials that are being managed in accordance with Section 404 analysis and approvals.
Actions generating RCRA hazardous waste that will be disposed of in a permitted off-site disposal facility	40 CFR § 264.13(a)(1)	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	This requirement is applicable to characterizing dredged materials for off-site disposal.
Actions generating RCRA hazardous waste	40 CFR § 268.7(a)(1)	Must determine if the hazardous waste has to be treated before land disposed. This is done by determining if the waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste. This determination can be made concurrently with the hazardous waste determination required in 40 CFR 262.11. Must comply with the special requirements of 40 CFR § 268.9 in addition to any applicable requirements in 40 CFR § 268.7.	This requirement is applicable to characterizing and treating dredged materials slated for off-site disposal.
Actions generating RCRA hazardous waste	40 CFR § 268.9(a)	Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 et seq. This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter. Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste.	This requirement is applicable to characterizing and treating dredged materials slated for off-site disposal.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions generating industrial wastewater	40 CFR § 261.4(a)(2)	Industrial wastewater discharges that are point source discharges subject to regulation under section 402 of the CWA, as amended, are not solid wastes for the purpose of hazardous waste management. [Comment: This exclusion applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment.]	This requirement is applicable to wastewater generated by the remedy that will be discharged from a point source in accordance with Section 402 of the CWA.
Actions requiring temporary storage of hazardous waste	OAR 340-102-0034 40 CFR § 262.34(a); 40 CFR §262.34(a)(1)(i); 40 CFR § 262.34(a)(2) and (3) 40 CFR § 262.34(c)(1)	A generator may accumulate hazardous waste at the facility provided that (accumulation of RCRA hazardous waste on site as defined in 40 CFR §260.10): • waste is placed in containers that comply with 40 CFR 265.171–173; and • the date upon which accumulation begins is clearly marked and visible for inspection on each container; • container is marked with the words “hazardous waste”; or • container may be marked with other words that identify the contents if accumulation of 55 gal. or less of RCRA hazardous waste or one quart of acutely hazardous waste listed in §261.33(e) at or near any point of generation Oregon hazardous waste regulations further require: (1) In addition to the requirements of 40 CFR 262.34, a generator may accumulate hazardous waste on-site for 90 days or less without a permit provided that, if storing in excess of 100 containers, the waste is placed in a storage unit that meets the Accumulation requirements of 40 CFR 264.175 and (2) A generator shall comply with provisions found in 40 CFR, Part 262 and each applicable requirement of 40 CFR 262.34(a), (b), (c), (d), (e), and (f).	This requirement is applicable to temporary storage of hazardous waste at an on-site transloading facility.
Actions resulting in the storage of solid waste	OAR 340-093-0210 and 0220	State of Oregon solid waste general provisions regarding storage and collection of solid waste and transportation related requirements for trucks servicing a solid waste collection facility.	Applicable requirements to operation of an on-site transloading facility for dredged materials slated for off-site disposal.
Actions resulting in the storage of solid waste	OAR 340-095-0010, 0020, 0030, 0050(1) & (2), 0070(2)	State of Oregon solid waste regulations for solid waste land disposal sites other than municipal solid waste landfills. Specifically, regulations related to the location siting, operating criteria, design criteria, groundwater monitoring and closure requirements for a non-municipal solid waste landfill.	Applicable requirements to the siting, design, operation and closure of an on-site transloading facility for dredged material slated for off-site disposal.
Actions transporting hazardous materials	49 CFR 171.1(b)	Any person who, under contract with a department or agency of the federal government, transports “in commerce,” or causes to be transported or shipped, a hazardous material shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171 - 180 related to marking, labeling, placarding, packaging, emergency response, etc.	Applicable to transportation of hazardous materials.

Table 2.1-2
Action-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Action	Regulation/Citation	Criterion/Standard	Comments
Actions that involve storage and treatment of hazardous waste at the transloading facility	40 CFR Part 264, Subparts B, C, F, G, I, J, K, L, M, AA, BB, CC, and DD	These regulations provide standards for location, design, operation, and closure of units in which treatment of hazardous waste may occur at the transloading facility. These regulations also provide requirements for use and management of containers, tank systems, surface impoundments, waste piles, and land treatment units one or more of which may be used for the storage and treatment of hazardous waste at the transloading facility. Subparts AA, BB, and CC provide air emission standards for process vents, equipment leaks, and tanks, surface impoundments and containers may be used at the transloading facility.	The listed requirements of Part 264 are applicable to the siting, design, operation, and closure of any containers, tank systems, surface impoundments, waste piles or land treatment areas used for the storage (over 90 days) and/or treatment of hazardous waste on-site prior to disposal off-site. The specific storage system and treatment methods that may be employed at the on-site transloading facility will be determined during remedial design.

Table 2.1-3
Location-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Location	Regulation/Citation	Criterion/Standard	Comments
Presence of archaeologically or historically sensitive area	Native American Graves Protection and Reparation Act, 25 USC 3001-3013, 43 CFR 10	Requires Federal agencies and museums which have possession of or control over Native American cultural items (including human remains, associated and unassociated funerary items, sacred objects and objects of cultural patrimony) to compile an inventory of such items. Prescribes when such Federal agencies and museums must return Native American cultural items. "Museums" are defined as any institution or State or local government agency that receives Federal funds and has possession of, or control over, Native American cultural items.	If Native American cultural items are present on property belonging to the Oregon Division of State Lands (DSL) that is a part of the response action area, this requirement is applicable. If Native American cultural items are collected by an entity which is either a federal agency or museum, then the requirements of the law are applicable.
Presence of archaeologically or historically sensitive area	Indian Graves and Protected Objects ORS 97.740-760	Prohibits willful removal of cairn, burial, human remains, funerary object, sacred object or object of cultural patrimony. Provides for re-interment of human remains or funerary objects under the supervision of the appropriate Indian tribe. Proposed excavation by a professional archaeologist of a native Indian cairn or burial requires written notification to the State Historic Preservation Officer and prior written consent of the appropriate Indian tribe. Prohibits persons from excavating, injuring, destroying or damaging archaeological sites or objects on public or private lands unless authorized.	Relevant and appropriate if archaeological material is encountered.
Presence of archaeologically or historically sensitive area	Archaeological Objects and Sites ORS 358.905- 955 ORS 390.235	Imposes conditions for excavation or removal of archaeological or historical materials.	Relevant and appropriate if archaeological material encountered.
Presence of archaeologically or historically sensitive area	National Historic Preservation Act. 16 USC 470 et seq. 36 CFR Part 800	Requires the identification of historic properties potentially affected by the agency undertaking, and assessment of the effects on the historic property and seek ways to avoid, minimize or mitigate such effects. Historic property is any district, site, building, structure, or object included in or eligible for the National Register of Historic Places, including artifacts, records, and material remains related to such a property.	Applicable if historic properties are potentially affected by remedial activities.
Presence of archaeologically or historically sensitive area	Archaeological and Historic Preservation Act. 16 USC 469a-1	Provides for the preservation of historical and archaeological data that may be irreparably lost as a result of a federally-approved project and mandates only preservation of the data.	Applicable if historical and archaeological data may be irreparably lost by implementation of the remedial activities.
Presence of floodplain as designated on FEMA Flood Insurance map	44 CFR 60.3(d)(2) and (3)	Prohibits encroachments that would result in any increase in flood levels during occurrence of base flood discharge.	FEMA flood rise requirements are considered relevant and appropriate requirements for remedial actions.
Presence of floodplain as designated on map	Federal Emergency Management Act regulations at 44 CFR 9 (which sets forth the policy, procedure and responsibilities to implement and enforce Executive Orders 11988 (Management of Floodplain) **To Be Considered**, as amended by E.O. 13690 and 11990 (Protection of Wetlands) **To Be Considered**	44 CFR 9 (Requirements for Flood Plain Management Regulations Areas) Requires measures to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains. The Executive Orders 11988 as amended by 13690 direct federal agencies to evaluate the potential effects of action that may be taken in a floodplain and to avoid, to the extent possible, long-term and short-term adverse effects associated with the occupancy and modification of floodplains, and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Executive Order 11990 directs that activities conducted by federal agencies avoid, to the extent possible, long-term and short-term adverse effects associated with the modification or destruction of wetlands and to avoid direct or indirect support of new construction in wetlands when there are practical alternatives.	The substantive identified FEMA regulations are relevant and appropriate for assessing impacts, if any, to the floodplain and flood storage from the response action and developing compensatory mitigation that is beneficial to floodplain values. Substantive portions of the Executive Order are To-Be-Considered.
Presence of wetlands	Executive Order for Wetlands Protection. Executive Order 11990 (1977) **To Be Considered**	Requires measures to avoid adversely impacting wetlands whenever possible, minimize wetland destruction, and preserve the value of wetlands.	To be considered guidelines in assessing impacts to wetlands, if any, from the response action and for developing appropriate compensatory mitigation for the project.

Table 2.1-3
Location-Specific ARARs for Remedial Action
Portland Harbor Superfund Site
Portland, Oregon

Location	Regulation/Citation	Criterion/Standard	Comments
Presence of state-listed threatened or endangered wildlife species	Protection and Conservation Programs ORS. 496.171 to 496.182. Survival Guidelines OAR 635-100-0135	Survival Guidelines are rules for state agency actions affecting species listed under Oregon's Threatened or Endangered Wildlife Species law.	Substantive requirements of Survival Guidelines are relevant and appropriate to remedial activities affecting state-listed species.
Presence of essential fish habitat	Magnuson-Stevens Fishery Conservation and Management Act. 50 CFR Part.600.920	Requires federal agencies consult with NMFS on actions that may adversely affect Essential Fish Habitat (EFH), defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."	Applicable because the National Marine Fisheries Service has designated the Lower Willamette River as EFH. EPA evaluated effects to EFH from the proposed remedial action in a biological assessment.
Presence of federally endangered or threatened species	Endangered Species Act. 16 USC 1536 (a)(2), Listing of endangered or threatened species per 50 CFR 17.11 and 17.12 or designation of critical habitat of such species listed in 50 CFR 17.95	Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species or result in the adverse modification of species' critical habitat. Agencies are to avoid jeopardy or take appropriate mitigation measures to avoid jeopardy.	Applicable to remedial actions that may impact endangered or threatened species or critical habitat that are present at the site. Listed species are found at the Site, and critical habitat for listed salmonids has been designated within the site. Coordination will occur with the National Marine Fisheries Service and US Fish and Wildlife Service regarding actions to be taken, their impacts on listed species, and measures that will be taken to reduce, minimize, or avoid such impacts so as not to jeopardize the continued existence or adversely modify critical habitat. If take cannot be avoided, take permission from the Services will be obtained. EPA evaluated effects to listed and threatened species and critical habitat from the proposed remedial action in a biological assessment.

Table 2.1-4
Numeric Criteria Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

		Surface Water								Surface Water and Groundwater
	Statute/Regulation:	**Clean Water Act, 33 U.S.C. 1313 and1314, Section 304(a) List**				**Oregon Water Pollution Control Act ORS 468B.048**				**Safe Drinking Water Act 42 U.S.C. 300f, 40 CFR Part 141, 143**
		Aquatic Life		**Human Health**		**Aquatic Life**		**Human Health**		**Human Health**
	Receptor:	**CMC (acute)**	**CCC (chronic)**	**Current (water + organism)**	**Current (organism only)**	**CMC (acute)**	**CCC (chronic)**	**Current (water + organism)**	**Current (organism only)**	**MCL**
	Consumption Rate:			**22 g/day**	**22 g/day**			**175 g/day**	**175 g/day**	
Contaminant	**CAS #**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Acenaphthene	83-32-9	NA	NA	70	90	NA	NA	95	99	NA
Acenaphthylene	208-96-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	309-00-2	3.0[1]	NA	0.00000077[7]	0.00000077[7]	3[1]	NA	0.000005	0.000005	NA
Anthracene	120-12-7	NA	NA	300	400	NA	NA	NA	NA	NA
Arsenic	7440-38-2	340[2]	150[2]	0.018[7,8]	0.14[7,8]	340[7]	150[2]	2.1[8,12]	2.1[8,13]	10
Benzene	71-43-2	NA	NA	2.1[7]	58[7]	NA	NA	0.44	1.4	5
Benzo(a)anthracene	56-55-3	NA	NA	0.0012[7]	0.0013[7]	NA	NA	0.001	0.002	NA
Benzo(a)pyrene	50-32-8	NA	NA	0.00012[7]	0.00013[7]	NA	NA	0.001	0.002	0.2
Benzo(b)fluoranthene	205-99-2	NA	NA	0.0012[7]	0.0013[7]	NA	NA	0.001	0.002	NA
Benzo(g,h,i)perylene	191-24-2	NA	NA	NA	NA	NA	NA	0.001	0.002	NA
Benzo(k)fluoranthene	207-08-9	NA	NA	0.012[7]	0.013[7]	NA	NA	0.001	0.002	NA
Bis(2-ethylhexyl) phthalate (BEHP)	117-81-7	NA	NA	0.32[7]	0.37[7]	NA	NA	0.2	0.2	6
Cadmium	7440-43-9	0.52[2,3,14]	0.094[2,3,14]	2	NA	0.8[3,11]	0.9[2,3,11]	NA	NA	5
Chlordanes	57-74-9	2.4[1]	0.0043	0.00031[7]	0.00032[7]	2.4[1]	0.004	0.0001	0.0001	2
Chlorobenzene	108-90-7	NA	NA	100	800	NA	NA	74	160	100
Chromium	7440-47-3	NA	NA	100	NA	NA	NA	NA	NA	100
Chromium (III)	16065-83-1	183[2,3,14]	24[2,3,14]	NA	NA	183[2,3,11]	24[2,3,11]	NA	NA	NA
Chromium (VI)	18540-29-9	16[2]	11[2]	NA	NA	16[2]	11[2]	NA	NA	NA
Chrysene	218-01-9	NA	NA	0.12[7]	0.13[7]	NA	NA	0.001	0.002	NA
Copper	7440-50-8	5[2,3,14]	4[2,3,14]	1,300	NA	5[3,11]	4[3,11]	1,300	NA	1,300
Cyanide	57-12-5	22[4]	5.2[4]	4	400	22[4]	5.2[4]	130	130	200
DDx		1.1[1,6]	0.001[1,6]	NA	NA	1.1[1,6]	0.001[1,6]	NA	NA	NA
DDD (2,4´- and 4,4-DDD)	72-54-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4'-DDD	53-19-0	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDD	72-54-8	NA	NA	0.00012[7]	0.00012[7]	NA	NA	0.00003	0.00003	NA
DDE (2,4- and 4,4-DDE)	72-55-9	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	72-55-9	NA	NA	0.000018[7]	0.000018[7]	NA	NA	0.00002	0.00002	NA
DDT (2,4´- and 4,4´-DDT)	50-29-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	50-29-3	NA	NA	0.000030[7]	0.000030[7]	NA	NA	0.00002	0.00002	NA
Dibenz(a,h)anthracene	53-70-3	NA	NA	0.00012[7]	0.00013[7]	NA	NA	0.0013	0.0018	NA
1,1-Dichloroethene (1,1-DCE)	75-35-4	NA	NA	300	20,000	NA	NA	230	710	7

Table 2.1-4
Numeric Criteria Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

		Surface Water								Surface Water and Groundwater
	Statute/Regulation:	Clean Water Act, 33 U.S.C. 1313 and1314, Section 304(a) List				Oregon Water Pollution Control Act ORS 468B.048				Safe Drinking Water Act 42 U.S.C. 300f, 40 CFR Part 141, 143
		Aquatic Life		Human Health		Aquatic Life		Human Health		Human Health
	Receptor:	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	MCL
	Consumption Rate:			22 g/day	22 g/day			175 g/day	175 g/day	
Contaminant	**CAS #**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
cis-1,2-Dichloroethene (cis-1,2-DCE)	107-06-2	NA	NA	9.9[7]	650[7]	NA	NA	NA	NA	70
Dieldrin	60-57-1	0.2	0.06	0.0000012[7]	0.0000012[7]	0.2	0.06	0.000005	0.000005	NA
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	NA	NA	NA	NA	NA	NA	NA	NA	70
Ethylbenzene	100-41-4	NA	NA	68	130	NA	NA	160	210	700
Fluoranthene	206-44-0	NA	NA	20	20	NA	NA	14	14	NA
Fluorene	7782-41-4	NA	NA	50	70	NA	NA	390	530	NA
Hexachlorobenzene	118-74-1	NA	NA	0.000079[7]	0.000079[7]	NA	NA	0.00003	0.00003	1
gamma-Hexachlorocyclohexane (γ-BHC, or Lindane)	58-89-9	0.095	NA	4.2	4.4	1.0	0.08	0.17	0.18	0.2
1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)	70648-26-9	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-c,d)pyrene	193-39-5	NA	NA	0.0012[7]	0.0013[7]	NA	NA	0.001	0.002	NA
Lead	7439-92-1	14[2,3,14]	0.54[2,3,14]	NA	NA	14[2,3,11]	0.54[2,3,11]	NA	NA	15
Manganese	7439-96-5	NA	NA	NA[9]	100	NA	NA	NA	NA	NA
Methylchlorophenoxypropionic acid (MCPP)	7085-19-0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	1.4[2]	0.77[2]	NA	NA	2.4	0.012	NA	NA	2
2-Methylnaphthalene	91-57-6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	118-96-7	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)	40321-76-4	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF)	57117-31-4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	87-86-5	11[5]	8[5]	0.03[7]	0.04[7]	11[5]	8[5]	0.2	0.3	1.0
Perchlorate	14797-73-0	NA	NA	NA	NA	NA	NA	NA	NA	15
Phenanthrene	85-01-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polybrominated diphenyl ethers (PBDE)	67774-32-7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (PCBs)	1336-36-3	NA	0.014	0.000064[7]	0.000064[7]	2	0.014	0.000006	0.000006	0.5
Polycyclic Aromatic Hydrocarbons (PAHs)	130498-29-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	129-00-0	NA	NA	20	30	NA	NA	290	400	NA
2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	51207-31-9	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1746-01-6	NA	NA	0.000000005[7]	0.0000000051[7]	NA	NA	0.0000000005	0.0000000005	0.00003
Tetrachloroethene (PCE)	127-18-4	NA	NA	10[7]	29[7]	NA	NA	0.24	0.33	5
Toluene	108-88-3	NA	NA	57	520	NA	NA	720	1,500	1,000
Total Petroleum Hydrocarbons (TPH) C10-C12 Aliphatic		NA	NA	NA	NA	NA	NA	NA	NA	NA
Tributyltin (TBT)	688-73-3	0.5	0.07	NA	NA	0.46	0.063	NA	NA	NA
Trichloroethene (TCE)	79-01-6	NA	NA	0.6[7]	7[7]	NA	NA	1.4	3.0	5

Table 2.1-4
Numeric Criteria Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

		Surface Water								Surface Water and Groundwater
	Statute/Regulation:	Clean Water Act, 33 U.S.C. 1313 and1314, Section 304(a) List				Oregon Water Pollution Control Act ORS 468B.048				Safe Drinking Water Act 42 U.S.C. 300f, 40 CFR Part 141, 143
		Aquatic Life		Human Health		Aquatic Life		Human Health		Human Health
	Receptor:	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	MCL
	Consumption Rate:			22 g/day	22 g/day			175 g/day	175 g/day	
Contaminant	**CAS #**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP)	93-72-1	NA	NA	100	400	NA	NA	NA	NA	50
Vanadium	7440-62-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	75-01-04	NA	NA	0.022[7]	1.6[7]	NA	NA	0.02	0.2	2
Xylenes	1330-20-7	NA	NA	NA	NA	NA	NA	NA	NA	10,000
Zinc	7440-66-6	36[2,3,14]	36[2,3,14]	7,400	26,000	36[2,3,11]	35[2,3,11]	2,100	2,600	NA

Notes:
1 - If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
2 - Expressed in terms of dissolved metal in the water column.
3 - Expressed as a function of hardness (mg/L) in the water column. The value given corresponds to a hardness of 25 mg/kg.
4 - Expressed as free cyanide.
5 - Expressed as a function of pH. Value corresponds to a pH of 7.2.
6 - This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).
7 - This criterion is based on carcinogenicity at a 10^{-6} risk.
8 - This criterion for arsenic refers to the inorganic form only.
9 - The National AWQC criterion for manganese is not based on toxic effects, but rather is intended to minimize objectionable qualities such as laundry stains and objectionable tastes in beverages. Thus, it is not an ARAR.
10 - EPA is not updating criteria for this chemical pollutant at this time; thus, the current criterion apply.
11 - Criteria are calculated using the following table:

Chemical	mA	bA	mC	bC
Cadmium	1.128	-3.828	0.7409	-4.719
Chromium (III)	0.819	3.7256	0.819	0.6848
Copper	0.9422	-1.464	0.8545	-1.465
Lead	1.273	-1.460	1.273	-4.705
Pentachlorophenol				
Zinc	0.8473	0.884	0.8473	0.884

12 - This criterion is based on carcinogenicity of 10^{-4} risk.
13 - This criterion is based on carcinogenicity of 10^{-5} risk.
14 - Criteria are calculated using the following table:

Chemical	mA	bA	mC	bC
Cadmium	1.0166	-3.924	0.7409	-4.719
Chromium (III)	0.819	3.7256	0.819	0.6848
Copper	0.9422	-1.700	0.8545	-1.702
Lead	1.273	-1.46	1.273	-4.705
Zinc	0.8473	0.884	0.8473	0.884

Table 2.2-1a
Summary of Portland Harbor PRGs by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	HUMAN HEALTH									
	RAO 1			RAO 2			RAO 3		RAO 4	
	Ingestion/Direct Contact			Fish/Shellfish Consumption			Protected Water Uses		Migration of Contaminated Groundwater	
Contaminant	**Units**	**Beach**	**Sediment**	**Units**	**Tissue**	**Sediment**	**Units**	**Surface Water**	**Units**	**Groundwater**
Aldrin				µg/kg	0.06	2	µg/L	0.0000008		
Arsenic	mg/kg	3	3	mg/kg	0.001		µg/L	0.02	µg/L	0.02
Benzene									µg/L	0.4
BEHP				µg/kg	72		µg/L	0.2		
Cadmium										
Chlordanes				µg/kg	3	1.5	µg/L	0.00008		
Chlorobenzene									µg/L	74
Chromium							µg/L	100	µg/L	100
Copper									µg/L	1,300
Cyanide									µg/L	4
DDx				µg/kg	3	6.1				
DDD							µg/L	0.00003	µg/L	0.00003
DDE							µg/L	0.00002	µg/L	0.00002
DDT							µg/L	0.00002	µg/L	0.00002
1,1-DCE									µg/L	7
cis-1,2-DCE									µg/L	9.9
Dieldrin				µg/kg	0.06	0.07				
2,4-D									µg/L	70
Ethylbenzene									µg/L	68
Hexachlorobenzene				µg/kg	0.6		µg/L	0.00003		
Lindane										
Lead										
Manganese									µg/L	430
MCPP							µg/L	16		
Mercury				mg/kg	0.03					
Pentachlorophenol				µg/kg	130		µg/L	0.03	µg/L	0.03
Perchlorate									µg/L	15
PBDEs				µg/kg	26					
PCBs	µg/kg		370	µg/kg	0.3	9	µg/L	0.000006		
PAHs										
cPAHs (BaP eq)	µg/kg	12	106	µg/kg	7.1	3,950	µg/L	0.0001	µg/L	0.0001
Acenaphthene										
Acenaphthylene										
Anthracene										
Benzo(a)anthracene							µg/L	0.001	µg/L	0.001
Benzo(a)pyrene							µg/L	0.0001	µg/L	0.0001
Benzo(b)fluoranthene							µg/L	0.001	µg/L	0.001
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene							µg/L	0.001	µg/L	0.001
Chrysene							µg/L	0.001	µg/L	0.001
Dibenz(a,h)anthracene							µg/L	0.0001	µg/L	0.0001
Fluoranthene										
Fluorene										
Indeno(1,2,3-c,d)pyrene							µg/L	0.001	µg/L	0.001
2-Methylnaphthalene										
Naphthalene										
Phenanthrene										
Pyrene										

Table 2.2-1b
Summary of Portland Harbor PRGs by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	HUMAN HEALTH									
	RAO 1			RAO 2			RAO 3		RAO 4	
	Ingestion/Direct Contact			Fish/Shellfish Consumption			Protected Water Uses		Migration of Contaminated Groundwater	
Contaminant	**Units**	**Beach**	**Sediment**	**Units**	**Tissue**	**Sediment**	**Units**	**Surface Water**	**Units**	**Groundwater**
Dioxins/Furans (2,3,7,8-TCDD eq)	µg/kg		0.01				µg/L	0.0000000005		
1,2,3,4,7,8-HxCDF				µg/kg	0.00006	0.0004				
1,2,3,7,8-PeCDD				µg/kg	0.000006	0.0002				
2,3,4,7,8-PeCDF				µg/kg	0.00002	0.0003				
2,3,7,8-TCDF				µg/kg	0.00006	0.0004				
2,3,7,8-TCDD				µg/kg	0.000006	0.0002				
PCE									µg/L	0.2
Toluene									µg/L	57
TPH-Diesel										
TBT										
TCE									µg/L	0.6
2,4,5-TP									µg/L	50
Vanadium										
Vinyl Chloride									µg/L	0.02
Xylenes									µg/L	10,000
Zinc										

Notes:
NA - Not available
1 - Tissue values are for methyl mercury.
2 - The PRG is less than the achievable detection limit; thus, the PRG is evaluated at the established detection limit from the background data set.
3 - This value is for the dissolved fraction.
4 - Criterion is applied as hexavalent chromium.

Table 2.2-1c
Summary of Portland Harbor PRGs by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	ECOLOGICAL								HUMAN HEALTH and ECOLOGICAL	
	RAO 5		RAO 6		RAO 7		RAO 8		RAO 9	
	Direct Contact/Ingestion		Biota (Predator) Ingestion		Direct Contact/Ingestion		Direct Contact/Ingestion Migration of Contaminated Groundwater		Migration of Contaminants	
Contaminant	**Units**	**Sediment**	**Units**	**Sediment**	**Units**	**Surface Water**	**Units**	**Pore Water**	**Units**	**River Bank Soil/Sediment**
Aldrin									µg/kg	2
Arsenic							µg/L	150	mg/kg	3
Benzene							µg/L	130		
BEHP			µg/kg	135	µg/L	3			µg/kg	135
Cadmium	mg/kg	0.5					µg/L	0.091	mg/kg	0.5
Chlordanes	µg/kg	1.4							µg/kg	1.4
Chlorobenzene							µg/L	64		
Chromium							µg/L	11[3,4]		
Copper	mg/kg	359			µg/L	3	µg/L	2.74[3]	mg/kg	359
Cyanide							µg/L	5.2		
DDx	µg/kg	578	µg/kg	760	µg/L	0.01	µg/L	0.001	µg/kg	6.1
DDD	µg/kg	114								114
DDE	µg/kg	359	µg/kg	226						226
DDT	µg/kg	246					µg/L	0.001		246
1,1-DCE							µg/L	25		
cis-1,2-DCE							µg/L	590		
Dieldrin	µg/kg	22							µg/kg	0.07
2,4-D										
Ethylbenzene					µg/L	7	µg/L	7.3		
Hexachlorobenzene									µg/kg	0.3
Lindane	µg/kg	5							µg/kg	5
Lead	mg/kg	196					µg/L	0.5	mg/kg	196
Manganese							µg/L	1,433		
MCPP										
Mercury	mg/kg	0.09							mg/kg	0.09
Pentachlorophenol										
Perchlorate							µg/L	9,300		
PBDEs										
PCBs	µg/kg	500	µg/kg	36	µg/L	0.2	µg/L	0.01	µg/kg	9
PAHs	µg/kg	23,000							µg/kg	23,000
cPAHs (BaP eq)									µg/kg	12
Acenaphthene							µg/L	23		
Acenaphthylene										
Anthracene							µg/L	0.7		
Benzo(a)anthracene					µg/L	0.03	µg/L	0.03		
Benzo(a)pyrene					µg/L	0.01	µg/L	0.01		
Benzo(b)fluoranthene							µg/L	0.7		
Benzo(g,h,i)perylene							µg/L	0.4		
Benzo(k)fluoranthene							µg/L	0.6		
Chrysene							µg/L	2		
Dibenz(a,h)anthracene							µg/L	0.3		
Fluoranthene							µg/L	6.2		
Fluorene							µg/L	3.9		
Indeno(1,2,3-c,d)pyrene							µg/L	0.3		
2-Methylnaphthalene							µg/L	2.1		
Naphthalene					µg/L	12	µg/L	12		
Phenanthrene							µg/L	6.3		
Pyrene							µg/L	10		

Table 2.2-1d
Summary of Portland Harbor PRGs by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	ECOLOGICAL								HUMAN HEALTH and ECOLOGICAL	
	RAO 5		RAO 6		RAO 7		RAO 8		RAO 9	
	Direct Contact/Ingestion		Biota (Predator) Ingestion		Direct Contact/Ingestion		Direct Contact/Ingestion Migration of Contaminated Groundwater		Migration of Contaminants	
Contaminant	**Units**	**Sediment**	**Units**	**Sediment**	**Units**	**Surface Water**	**Units**	**Pore Water**	**Units**	**River Bank Soil/Sediment**
Dioxins/Furans (2,3,7,8-TCDD eq)										
1,2,3,4,7,8-HxCDF			µg/kg	0.03					µg/kg	0.0004
1,2,3,7,8-PeCDD			µg/kg	0.001					µg/kg	0.0002
2,3,4,7,8-PeCDF			µg/kg	0.004					µg/kg	0.0003
2,3,7,8-TCDF			µg/kg	0.004					µg/kg	0.0004
2,3,7,8-TCDD			µg/kg	0.0008					µg/kg	0.0002
PCE										
Toluene							µg/L	9.8		
TPH-Diesel	mg/kg	91					µg/L	2.6		
TBT	µg/kg	3,080			µg/L	0.06			µg/kg	3,080
TCE							µg/L	47		
2,4,5-TP										
Vanadium							µg/L	20		
Vinyl Chloride							µg/L			
Xylenes							µg/L	13		
Zinc	mg/kg	459			µg/L	36.5[3]	µg/L	36.5	mg/kg	459

Notes:
NA - Not available
1 - Tissue values are for methyl mercury.
2 - The PRG is less than the achievable detection limit; thus, the PRG is evaluated at the established detection limit from the background data set.
3 - This value is for the dissolved fraction.
4 - Criterion is applied as hexavalent chromium.

Table 2.2-2
Summary of COC Selection Process
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	CAS RN	BERA	BHHRA	ARAR	Identified as a COC	Rationale for Including/Eliminating
Acenaphthene	83-32-9	X			Y	Evaluate as PAH
Acenaphthylene	208-96-8	X			Y	Evaluate as PAH
Aldrin	309-00-2	X	X	X	Y	Human health: shellfish
Aluminum	7429-90-5	X			N	Not ecologically significant
Ammonia	7664-41-7	X			N	Ammonia only has an HQ=3 based on FPM, which does not reliably predict sediment toxicity for individual contaminants.
Anthracene	120-12-7	X		X	Y	Evaluate as PAH
Antimony	7440-36-0	X	X		N	Infrequent and/or anomalous detections in fish
Aroclor 1254	11097-69-1	X			N	Evaluate as PCBs
Arsenic	7440-38-2	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Known groundwater plumes at site.
Barium	7440-39-3	X			N	Not ecologically significant
Benzene	71-43-2	X		X	Y	Known groundwater plume at site.
Benzo(a)anthracene	56-55-3	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as cPAH and PAH
Benzo(a)pyrene	50-32-8	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as cPAH and PAH
Benzo(b)fluoranthene	205-99-2	X	X	x	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as cPAH and PAH
Benzo(g,h,i)perylene	191-24-2	X		X	Y	Evaluate as PAH
Benzo(k)fluoranthene	207-08-9	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as cPAH and PAH
Benzyl alcohol	100-51-6	X			N	Not ecologically significant
Beryllium	7440-41-7	X			N	Not ecologically significant
Bis(2-ethylhexyl) phthalate (BEHP)	117-81-7	X	X	X	Y	Human health: fish Ecologically significant contaminant
Cadmium	7440-43-9	X		X	Y	Ecologically significant contaminant
Carbazole	86-74-8	X			N	Not ecologically significant
Carbon disulfide	75-15-0	X			N	Not ecologically significant
Chlordane	57-74-9	X	X	X	Y	Human health: fish Ecologically significant contaminant
cis-Chlordane	5103-71-9	X			N	Evaluate as chlordane

Table 2.2-2
Summary of COC Selection Process
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	CAS RN	BERA	BHHRA	ARAR	Identified as a COC	Rationale for Including/Eliminating
Chlorobenzene	108-90-7	X		X	Y	Known groundwater plume extending to river and mobilizing DDx Potential NAPL
Chloroethane	75-00-3	X			N	Not ecologically significant
Chloroform	67-66-3	X			N	Not ecologically significant
Chromium	7440-47-3	X	X	X	Y	Human health: surface water Known groundwater plumes at site.
Chrysene	218-01-9	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as cPAH and PAH
Cobalt	7440-48-4	X			N	Not ecologically significant
Copper	7440-50-8	X		X	Y	Ecologically significant contaminant Known groundwater plumes at site
Cyanide	57-12-5	X		X	Y	Ecologically significant contaminant Known groundwater plumes at site
1,2-Dichlorobenzene	95-50-1	X			N	Not ecologically significant
1,4-Dichlorobenzene	106-46-7	X			N	Not ecologically significant
DDD (2,4´- and 4,4-DDD)	72-54-8	X	X	X	Y	Human health: fish/shellfish Ecologically significant contaminant Evaluate also as DDx
2,4'-DDD	53-19-0	X			Y	Evaluate as DDD and DDx
4,4'-DDD	72-54-8	X			Y	Evaluate as DDD and DDx
DDE (2,4- and 4,4-DDE)	72-55-9	X	X	X	Y	Human Health: fish/shellfish Ecologically significant contaminant Evaluate also as DDx
4,4'-DDE	72-55-9	X			Y	Evaluate as sum DDE and DDx
DDT (2,4´- and 4,4´-DDT)	50-29-3	X	X	X	Y	Human health: fish/shellfish Ecologically significant contaminant Evaluate also as DDx
4,4'-DDT	50-29-3	X			Y	Evaluate as DDT and DDx
Dibenz(a,h)anthracene	53-70-3	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as cPAH and PAH
Dibenzofuran	132-64-9	X			N	Not ecologically significant
1,1-Dichloroethene (1,1-DCE)	75-35-4	X		X	Y	PCE/TCE plumes identified at site. DCE is a breakdown product of PCE/TCE.

Table 2.2-2
Summary of COC Selection Process
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	CAS RN	BERA	BHHRA	ARAR	Identified as a COC	Rationale for Including/Eliminating
cis-1,2-Dichloroethene (cis-1,2-DCE)	107-06-2	X		X	Y	PCE/TCE plumes identified at site. DCE is a breakdown product of PCE/TCE.
Dieldrin	60-57-1	X	X	X	Y	Human health: fish/shellfish Ecologically significant contaminant
Di-n-butyl phthalate	84-74-2	X			N	Not ecologically significant
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7			X	Y	Known groundwater plume
Endosulfan	115-29-7	X			N	Not ecologically significant
Endrin	72-20-8	X			N	Not ecologically significant
Endrin ketone	53494-70-5	X			N	Not ecologically significant
Ethylbenzene	100-41-4	X		X	Y	Ecologically significant contaminant Known groundwater plumes at site
Fluoranthene	206-44-0	X		X	Y	Evaluate as PAH
Fluorene	7782-41-4	X		X	Y	Evaluate as PAH
Heptachlor epoxide	1024-57-3	X			N	Not ecologically significant
Hexachlorobenzene	118-74-1		X	X	Y	Human health: fish
beta-Hexachlorocyclohexane (β-BHC)	319-85-7	X			N	beta-Hexachlorocyclohexane only has an HQ=1.9 based on FPM, which does not reliably predict sediment toxicity for individual contaminants.
delta-Hexachlorocyclohexane (δ-BHC)	608-73-1	X			N	Not ecologically significant
gamma-Hexachlorocyclohexane (γ-BHC, or Lindane)	58-89-9	X		X	Y	Ecologically significant contaminant
1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)	70648-26-9			X	Y	Dioxin/Furan congener contributing most to 2,3,7,8-TCDD risk
Indeno(1,2,3-c,d)pyrene	193-39-5	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Evaluate as PAH
Iron	7439-89-6	X			N	Not a hazardous substance
Isopropylbenzene	98-82-8	X			N	Not a hazardous substance
Lead	7439-92-1	X	X	X	Y	Human health: Infrequent and/or anomalous detections in fish Ecologically significant contaminant. Eliminated for dietary pathway due to infrequent and/or anomalous detections in fish.
Magnesium	7439-95-4	X			N	Not ecologically significant
Manganese	7439-96-5	X		X	Y	Ecologically significant contaminant Known groundwater plumes at site
Methylchlorophenoxypropionic acid (MCPP)	7085-19-0		X	X	Y	Human health: surface water

Table 2.2-2
Summary of COC Selection Process
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	CAS RN	BERA	BHHRA	ARAR	Identified as a COC	Rationale for Including/Eliminating
Mercury	7439-97-6	X	X	X	Y	Human health: fish tissue Ecologically significant contaminant
2-Methylnaphthalene	91-57-6	X			Y	Evaluate as PAH
4-Methylphenol (p-Cresol)	106-44-5	X			N	Not ecologically significant
Monobutyltin		X			N	Not a hazardous substance
Naphthalene	118-96-7	X		X	Y	Evaluate as PAH
Nickel	7440-02-0	X			N	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)	40321-76-4			X	Y	Dioxin/Furan congener contributing most to 2,3,7,8-TCDD risk
2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF)	57117-31-4			X	Y	Dioxin/Furan congener contributing most to 2,3,7,8-TCDD risk
Pentachlorophenol	87-86-5		X	X	Y	Human health: shellfish Known groundwater plumes
Perchlorate	14797-73-0	X			Y	Ecologically significant contaminant
Phenanthrene	85-01-8	X			Y	Evaluate as PAH
Phenol	108-95-2	X			N	Not ecologically significant
Polybrominated diphenyl ethers (PBDE)	67774-32-7		X		Y	Human health: fish
Polychlorinated Biphenyls (PCBs)	1336-36-3	X	X	X	Y	Human health: sediment, fish/shellfish Ecologically significant contaminant.
Polycyclic Aromatic Hydrocarbons (PAHs)	130498-29-2	X	X	X	Y	Human health: beach, sediment, water, fish/shellfish Ecologically significant contaminant
Potassium	7440-09-7	X			N	Not ecologically significant
Pyrene	129-00-0	X			Y	Evaluate as PAH
Silver	7440-22-4	X			N	Not ecologically significant
Sodium	7440-23-5	X			N	Not ecologically significant
Sulfide	18496-25-8	X			N	Not ecologically significant
2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	51207-31-9			X	Y	Dioxin/Furan congener contributing most to 2,3,7,8-TCDD risk
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1746-01-6	X	X	X	Y	Human health: sediment, fish/shellfish Ecologically significant contaminant
Tetrachloroethene (PCE)	127-18-4			X	Y	PCE plumes identified at site
Toluene	108-88-3	X		X	Y	Known groundwater plume at site

Table 2.2-2
Summary of COC Selection Process
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	CAS RN	BERA	BHHRA	ARAR	Identified as a COC	Rationale for Including/Eliminating
Total Petroleum Hydrocarbons (TPH) C10-C12 Aliphatic		X			Y	Not a hazardous substance; co-mingled with other hazardous substances Ecologically significant contaminant Known TPH plumes at site
Total Petroleum Hydrocarbons (TPH) C4 - C6 Aliphatic		X			N	Not a hazardous substance; co-mingled with other hazardous substances
Total Petroleum Hydrocarbons (TPH) C6 - C8 Aliphatic		X			N	Not a hazardous substance; co-mingled with other hazardous substances
Total Petroleum Hydrocarbons (TPH) C8 - C10 Aromatic		X			N	Not a hazardous substance; co-mingled with other hazardous substances
Total Petroleum Hydrocarbons (TPH), diesel range		X			N	Not a hazardous substance; co-mingled with other hazardous substances
Total Petroleum Hydrocarbons (TPH), gasoline-range		X			N	Not a hazardous substance; co-mingled with other hazardous substances
Total Petroleum Hydrocarbons (TPH), residual-range		X			N	Not a hazardous substance; co-mingled with other hazardous substances
Tributyltin (TBT)	688-73-3	X		X	Y	Ecologically significant contaminant
Trichloroethene (TCE)	79-01-6	X		X	Y	Known groundwater plume extending to river. Potential for others.
1,2,4-Trimethylbenzene	95-63-6	X			N	Not ecologically significant
1,3,5-Trimethylbenzene	108-67-8	X			N	Not ecologically significant
2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP)	93-72-1			X	Y	Known groundwater plume
Vanadium	7440-62-2	X		X	Y	Ecologically significant contaminant
Vinyl Chloride	75-01-04			X	Y	PCE/TCE plumes identified at site. Vinyl chloride is a breakdown product of PCE/TCE.
m-Xylene	108-38-3	X			N	Not ecologically significant
o-Xylene	95-47-6	X			N	Not ecologically significant
p-Xylene	106-42-3	X			N	Not ecologically significant
Xylenes	1330-20-7	X		X	Y	Known groundwater plume at site
Zinc	7440-66-6	X		X	Y	Ecologically significant contaminant Known groundwater plumes at site

Table 2.2-3a
Basis for Portland Harbor COC Selection by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	HUMAN HEALTH					
	RAO 1		RAO 2		RAO 3	RAO 4
	Human Health Ingestion/Direct Contact		Human Health Fish/Shellfish Consumption		Human Health Protected Water Uses	Human Health Migration of Contaminated Groundwater
Contaminant	**Beach**	**Sediment**	**Tissue**	**Sediment**	**Surface Water**	**Groundwater**
Aldrin			R	R	A	
Arsenic	R	R	R	R	A	A
Benzene						A
BEHP			R	R	A	
Cadmium						
Chlordane			R	R	A	
Chlorobenzene						A
Chromium					A	A
Copper						A
Cyanide						A
DDx			R	R		
DDD (2,4- and 4,4-DDD)					R	R
4,4'-DDD					A	A
DDE (2,4- and 4,4-DDE)						A
4,4'-DDE					A	A
DDT (2,4- and 4,4-DDT)					R	R
4,4'-DDT					A	A
1,1-DCE						A
cis-1,2-DCE						A
Dieldrin			R	R		
2,4-D acid						A
Ethylbenzene						A
Hexachlorobenzene			R	R	A	
Lindane						
Lead						
Manganese						R
MCPP					R	
Mercury			R	R		
Pentachlorophenol			R	R	A	A
Perchlorate						A
PBDE			R	R		
PCBs		R	R	R	A	

Table 2.2-3b
Basis for Portland Harbor COC Selection by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	HUMAN HEALTH					
	RAO 1		RAO 2		RAO 3	RAO 4
	Human Health Ingestion/Direct Contact		Human Health Fish/Shellfish Consumption		Human Health Protected Water Uses	Human Health Migration of Contaminated Groundwater
Contaminant	**Beach**	**Sediment**	**Tissue**	**Sediment**	**Surface Water**	**Groundwater**
PAHs	R	R	R	R	A	A
Acenaphthene						
Acenaphthylene						
Anthracene						
Benzo(a)anthracene						
Benzo(a)pyrene						
Benzo(b)fluoranthene						
Benzo(g,h,i)perylene						
Benzo(k)fluoranthene						
Chrysene						
Dibenz(a,h)anthracene						
Fluoranthene						
Fluorene						
Indeno(1,2,3-c,d)pyrene						
2-Methylnaphthalene						
Naphthalene						
Phenanthrene						
Pyrene						
2,3,7,8-TCDD Eq		R			A	
1,2,3,4,7,8-HxCDF			R	R		
1,2,3,7,8-PeCDD			R	R		
2,3,4,7,8-PeCDF			R	R		
2,3,7,8-TCDD			R	R		
2,3,7,8-TCDF			R	R		
PCE						A
Toluene						A
TPH diesel (C10-C12 Aliphatic)						
TBT						
TCE						A
2,4,5-TP acid						A
Vanadium						
Vinyl Chloride						A
Xylenes						A
Zinc						

Notes:
R - Conclusion from Baseline Risk Assessment
A - ARAR

Table 2.2-3c
Basis for Portland Harbor COC Selection by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	ECOLOGICAL				
	RAO 5	RAO 6	RAO 7	RAO 8	RAO 9
	Ecological Direct Contact/Ingestion	Ecological Biota (Predator) Ingestion	Ecological Direct Contact/Ingestion	Ecological Direct Contact/Ingestion	Human Health and Ecological Migration of Contaminants
Contaminant	**Sediment**	**Sediment**	**Surface Water**	**Pore Water**	**River Bank Soil/Sediment**
Aldrin					R
Arsenic				A	R
Benzene				R	
BEHP		R	R		R
Cadmium	R	R		R	R
Chlordane	R				R
Chlorobenzene				R	
Chromium				A	
Copper	R	R	R	R	R
Cyanide				R	
DDx	R	R	R	R	R
DDD (2,4- and 4,4-DDD)	R				R
4,4'-DDD					
DDE (2,4- and 4,4-DDE)	R	R			R
4,4'-DDE					
DDT (2,4- and 4,4-DDT)	R				R
4,4'-DDT				R	
1,1-DCE				R	
cis-1,2-DCE				R	
Dieldrin	R				R
2,4-D acid					
Ethylbenzene			R	R	
Hexachlorobenzene					R
Lindane	R				R
Lead	R			R	R
Manganese				R	
MCPP					
Mercury	R	R			R
Pentachlorophenol					
Perchlorate				R	
PBDE					
PCBs	R	R	R	R	R

Table 2.2-3d
Basis for Portland Harbor COC Selection by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	ECOLOGICAL				
	RAO 5	RAO 6	RAO 7	RAO 8	RAO 9
	Ecological Direct Contact/Ingestion	Ecological Biota (Predator) Ingestion	Ecological Direct Contact/Ingestion	Ecological Direct Contact/Ingestion	Human Health and Ecological Migration of Contaminants
Contaminant	**Sediment**	**Sediment**	**Surface Water**	**Pore Water**	**River Bank Soil/Sediment**
PAHs	R			R	R
Acenaphthene				R	
Acenaphthylene					
Anthracene				R	
Benzo(a)anthracene			R	R	
Benzo(a)pyrene			R	R	
Benzo(b)fluoranthene				R	
Benzo(g,h,i)perylene				R	
Benzo(k)fluoranthene				R	
Chrysene				R	
Dibenz(a,h)anthracene				R	
Fluoranthene				R	
Fluorene				R	
Indeno(1,2,3-c,d)pyrene				R	
2-Methylnaphthalene				R	
Naphthalene			R	R	
Phenanthrene				R	
Pyrene				R	
2,3,7,8-TCDD Eq		R			R
1,2,3,4,7,8-HxCDF		R			R
1,2,3,7,8-PeCDD		R			R
2,3,4,7,8-PeCDF		R			R
2,3,7,8-TCDD		R			R
2,3,7,8-TCDF		R			R
PCE					
Toluene				R	
TPH diesel (C10-C12 Aliphatic)	R			R	
TBT	R	R	R		R
TCE				R	
2,4,5-TP acid					
Vanadium				R	
Vinyl Chloride				R	
Xylenes				R	
Zinc	R		R	R	R

Notes:
R - Conclusion from Baseline Risk Assessment
A - ARAR

Table 2.2-4
RAO 1 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 1 Reduce cancer and noncancer risks to people from incidental ingestion of and dermal contact with COCs in sediments and beaches to exposure levels that are acceptable for fishing, occupational, recreational, and ceremonial uses.											
	Beach Sediment						Sediment					
	Units	Risk-based PRG (10^{-6})	Risk-based PRG (HQ=1)	ARAR or TBC	Background	PRG	Units	Risk-based PRG (10^{-6})	Risk-based PRG (HQ=1)	ARAR or TBC	Background	PRG
Arsenic	mg/kg	0.4	37	NA	3	3	mg/kg	1	435	NA	3	3
PCBs	µg/kg						µg/kg	370	14,760	NA	9	370
cPAHs (BaP Eq)	µg/kg	12	NA	NA	12	12	µg/kg	106	NA	NA	12	106
Dioxins/Furans (2,3,7,8-TCDD eq)	µg/kg						µg/kg	0.01	1.0	NA	NA	0.01

Notes:
NA - Not applicable

Table 2.2-5
RAO 2 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 2 Reduce cancer and noncancer risks to acceptable exposure levels (direct and indirect) for human consumption of COCs in fish and shellfish.										
	Tissue (fillet)					Sediment					
	Units	PRGs (10^{-6})	Risk-based PRGs (HQ=1)	ARAR	Target Level	Units	Risk-based PRG (10^{-6})	Risk-based PRG (HQ=1)	ARAR	Background	PRG
Aldrin	µg/kg	0.06	8	NA	0.06	µg/kg	2	260	NA		2
Arsenic	mg/kg	0.001	0.08	NA	0.001	mg/kg			NA	3	
BEHP	µg/kg	72	5,246	NA	72	µg/kg			NA	62	
Chlordanes	µg/kg	3	131	NA	3	µg/kg	1.5	181	NA	0.5	1.5
DDx	µg/kg	3	94	NA	3	µg/kg	6.1	307	NA	3.1	6.1
Dieldrin	µg/kg	0.06	13	NA	0.06	µg/kg	0.07	40	NA		0.07
Hexachlorobenzene	µg/kg	0.6	210	NA	0.6	µg/kg			NA	0.3	
Mercury	mg/kg	--	26[1]	0.03[1]	0.03[1]	mg/kg			NA	0.03	
Pentachlorophenol	µg/kg	130	--	NA	130	µg/kg			NA		
PBDEs	µg/kg	--	26	NA	26	µg/kg			NA		
PCBs	µg/kg	0.5	0.3	NA	0.3	µg/kg	0	0	NA	9	9
cPAHs (BaP Eq)	µg/kg	7.1[2]	--	NA	7.1	µg/kg	3,950	--	NA	12	3,950
1,2,3,4,7,8-HxCDF	µg/kg	0.00008	0.00006	NA	0.00006	µg/kg	0.0003	0.0002	NA	0.0004	0.0004
1,2,3,7,8-PeCDD	µg/kg	0.000008	0.000006	NA	0.000006	µg/kg	0	0	NA	0.0002	0.0002
2,3,4,7,8-PeCDF	µg/kg	0.00003	0.00002	NA	0.00002	µg/kg	0.0002	0.0001	NA	0.0003	0.0003
2,3,7,8-TCDD	µg/kg	0.000008	0.000006	NA	0.000006	µg/kg	0	0	NA	0.0002	0.0002
2,3,7,8-TCDF	µg/kg	0.00008	0.00006	NA	0.00006	µg/kg	0.0006	0.0004	NA	0.0003	0.0004

Notes:
- NA - Not available
- ND - Not determined or detected
- 1 - Tissue values are for methyl mercury.
- 2 - Tissue concentration is for shellfish assuming a consumption rate of 3.3 g/day

Table 2.2-6
RAO 3 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

	RAO 3 Reduce cancer and noncancer risks to people from direct contact (ingestion, inhalation, and dermal contact) with COCs in surface water to exposure levels that are acceptable for fishing, occupational, recreational, and potential drinking water supply.				
	Surface Water				
Contaminant	**Units**	**Risk (RSL 10^{-6})**	**MCL**	**ARAR or TBC**	**PRG**
Aldrin	µg/L	0.005	NA	0.0000008	0.0000008
Arsenic	µg/L	0.05	10	0.02	0.02
BEHP	µg/L	5.6	6	0.2	0.2
Chlordanes	µg/L	0.2	2	0.00008	0.00008
Chromium	µg/L	NA	100	100	100
DDD	µg/L	0.03	NA	0.00003	0.00003
DDE	µg/L	0.2	NA	0.00002	0.00002
DDT	µg/L	0.2	NA	0.00002	0.00002
Hexachlorobenzene	µg/L	0.5	1	0.00003	0.00003
MCPP	µg/L	16	NA	NA	16
Pentachlorophenol	µg/L	0.04	1	0.03	0.03
PCBs	µg/L	0.04	0.5	0.000006	0.000006
cPAHs (BaP Eq)	µg/L	0.003	0.2	0.0001	0.0001
Benzo(a)anthracene	µg/L	0.03	NA	0.001	0.001
Benzo(a)pyrene	µg/L	0.003	0.2	0.0001	0.0001
Benzo(b)fluoranthene	µg/L	0.03	NA	0.001	0.001
Benzo(k)fluoranthene	µg/L	0.3	NA	0.001	0.001
Chrysene	µg/L	3.4	NA	0.001	0.001
Dibenz(a,h)anthracene	µg/L	0.003	NA	0.0001	0.0001
Indeno(1,2,3-c,d)pyrene	µg/L	0.03	NA	0.001	0.001
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/L	0.0000006	0.00003	0.0000000005	0.0000000005

Notes:
NA - Not available

Table 2.2-7
RAO 4 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 4 Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for human exposure.				
	Groundwater				
	Units	Risk (RSL 10^{-6})	MCL	ARAR or TBC	PRG
Arsenic	µg/L	0.05	10	0.02	0.02
Benzene	µg/L	0.5	5	0.4	0.4
Chlorobenzene	µg/L	78	100	74	74
Chromium	µg/L	NA	100	100	100
Copper	µg/L	800	1,300	1,300	1300
Cyanide	µg/L	1.5	200	4	4
DDD	µg/L	0.03	NA	0.00003	0.00003
DDE	µg/L	0.2	NA	0.00002	0.00002
DDT	µg/L	0.2	NA	0.00002	0.00002
1,1-DCE	µg/L	280	7	230	7
cis-1,2-DCE	µg/L	36	70	9.9	9.9
2,4-D	µg/L	170	70	NA	70
Ethylbenzene	µg/L	1.5	700	68	68
Manganese	µg/L	430	NA	NA	430
Pentachlorophenol	µg/L	0.04	1.0	0.03	0.03
Perchlorate	µg/L	14	15	NA	15
cPAHs (BaP Eq)	µg/L	0.003	0.2	0.0001	0.0001
Benzo(a)anthracene	µg/L	0.03	NA	0.001	0.001
Benzo(a)pyrene	µg/L	0.00	0.2	0.0001	0.0001
Benzo(b)fluoranthene	µg/L	0.03	NA	0.001	0.001
Benzo(k)fluoranthene	µg/L	0.3	NA	0.001	0.001
Chrysene	µg/L	3.4	NA	0.001	0.001
Dibenz(a,h)anthracene	µg/L	0.003	NA	0.0001	0.0001
Indeno(1,2,3-c,d)pyrene	µg/L	0.03	NA	0.001	0.001
PCE	µg/L	11	5	0.2	0.2
Toluene	µg/L	1,100	1,000	57	57
TCE	µg/L	0.5	5	0.6	0.6
2,4,5-TP	µg/L	110	50	100	50
Vinyl chloride	µg/L	0.02	2.0	0.02	0.02
Xylenes	µg/L	190	10,000	NA	10000

Notes:
NA - Not available

Table 2.2-8
RAO 5 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 5 Reduce risk to benthic organisms from ingestion of and direct contact with COCs in sediment to acceptable exposure levels.				
	Sediment				
	Units	Risk-based PRG (HQ=1)	ARAR or TBC	Background	PRG
Cadmium	mg/kg	0.5	NA	0.1	0.5
Chlordanes	µg/kg	1.4	NA	0.5	1.4
Copper	mg/kg	359	NA	26	359
DDD	µg/kg	114	NA	1.2	114
DDE	µg/kg	359	NA	1.7	359
DDT	µg/kg	246	NA	NA	246
DDx	µg/kg	578	NA	3.1	578
Dieldrin	µg/kg	22	NA	NA	22
Lindane	µg/kg	5	NA	NA	5
Lead	mg/kg	196	NA	7.7	196
Mercury	mg/kg	0.09	NA	0.03	0.09
PCBs	µg/kg	500	NA	9	500
PAHs	µg/kg	23,000	NA	113	23,000
TBT	µg/kg	3,080	NA	NA	3,080
TPH-Diesel	mg/kg	91	NA	NA	91
Zinc	mg/kg	459	NA	77	459

Notes:
NA - Not available

Table 2.2-9
RAO 6 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 6 Reduce risks to ecological receptors that consume COCs in prey to acceptable exposure levels.				
	Sediment				
	Units	Risk-based PRG (HQ=1)	ARAR or TBC	Background	PRG
BEHP	µg/kg	135	NA	62	135
Cadmium	mg/kg		NA	0.1	
Copper	mg/kg		NA	26	
DDE	µg/kg	226	NA	1.7	226
DDx	µg/kg	760	NA	3.1	760
Mercury	mg/kg		NA	0.03	
PCBs	µg/kg	36	NA	9	36
1,2,3,4,7,8-HxCDF	µg/kg	0.03	NA	0.0004	0.03
1,2,3,7,8-PeCDD	µg/kg	0.001	NA	0.0002	0.001
2,3,4,7,8-PeCDF	µg/kg	0.004	NA	0.0003	0.004
2,3,7,8-TCDD	µg/kg	0.0008	NA	0.0002	0.0008
2,3,7,8-TCDF	µg/kg	0.004	NA	0.0003	0.004
Tributyltin	mg/kg		NA		

Notes:
NA - Not available

Table 2.2-10
RAO 7 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 7 Reduce risks to ecological receptors from ingestion of and direct contact with COCs in surface water to acceptable exposure levels.			
	Surface Water			
	Units	Risk TRV from BERA	ARAR or TBC	PRG
BEHP	µg/L	3	NA	3
Copper	µg/L	2.7	4	2.7
DDx	µg/L	0.01	0.001	0.011[1]
Ethylbenzene	µg/L	7.3	NA	7.3
PCBs	µg/L	0.2	0.01	0.19[1]
PAHs				
Benzo(a)anthracene	µg/L	0.03	NA	0.03
Benzo(a)pyrene	µg/L	0.01	NA	0.01
Naphthalene	µg/L	12	NA	12
TBT	µg/L	NA	0.06	0.06
Zinc	µg/L	36.5	35	36.5[2,3]

Notes:
NA - Not available
1 - ARAR is more conservative but TRV was selected because of the receptor assumptions in the value.
2 - This value is for the dissolved fraction.

Table 2.2-11
RAO 8 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 8 Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for ecological exposure.			
	Pore Water			
	Units	TRV from BERA	ARAR or TBC	PRG
Arsenic	µg/L		150	150
Benzene	µg/L	130	NA	130
Cadmium	µg/L	0.09[1]	0.09	0.09[1]
Chlorobenzene	µg/L	64	NA	64
Chromium	µg/L		11[1,2]	11[1,2]
Copper	µg/L	2.74[1]	4	2.74[1]
Cyanide	µg/L	5.2	5.2	5.2
DDx	µg/L	0.01	0.001	0.001
DDT	µg/L	0.001	NA	0.001
1,1-DCE	µg/L	25	NA	25
cis-1,2-DCE	µg/L	590	NA	590
Ethylbenzene	µg/L	7.3	NA	7.3
Lead	µg/L	0.5	0.5	0.5
Manganese	µg/L	120	1,433[4]	1,433[4]
Perchlorate	µg/L	9,300	NA	9,300
PCBs	µg/L	0.01	0.01	0.01
PAHs	µg/L		NA	
Acenaphthene	µg/L	23	NA	23
Acenaphthylene	µg/L		NA	
Anthracene	µg/L	0.7	NA	0.7
Benzo(a)anthracene	µg/L	0.03	NA	0.03
Benzo(a)pyrene	µg/L	0.01	NA	0.01

Table 2.2-11
RAO 8 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 8 Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for ecological exposure.			
	Pore Water			
	Units	TRV from BERA	ARAR or TBC	PRG
Benzo(b)fluoranthene	µg/L	0.7	NA	0.7
Benzo(g,h,i)perylene	µg/L	0.4	NA	0.4
Benzo(k)fluoranthene	µg/L	0.6	NA	0.6
Chrysene	µg/L	2.0	NA	2
Dibenz(a,h)anthracene	µg/L	0.3	NA	0.3
Fluoranthene	µg/L	6.2	NA	6.2
Fluorene	µg/L	3.9	NA	3.9
Indeno(1,2,3-c,d)pyrene	µg/L	0.3	NA	0.3
2-Methylnaphthalene	µg/L	2.1	NA	2.1
Naphthalene	µg/L	12	NA	12
Phenanthrene	µg/L	6.3	NA	6.3
Pyrene	µg/L	10	NA	10
Toluene	µg/L	9.8	NA	9.8
TPH-Diesel	µg/L	2.6	NA	2.6
TCE	µg/L	47	NA	47
Vanadium	µg/L	20	NA	20
Vinyl chloride	µg/L		NA	
Xylenes	µg/L	13	NA	13
Zinc	µg/L	36.5	NA	36.5

Notes:
NA - Not available
1 - Criterion is expressed in terms of “dissolved” concentrations in the water column.
2 - Criterion is applied as hexavalent chromium.
3 - This criterion is expressed as µg free cyanide (CN)/L.
4 - This criterion is based on evaluation in Attachment 1 to Appendix B.

Table 2.2-12
RAO 9 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 9 Reduce migration of COCs in riverbanks to sediment and surface water such that levels are acceptable in sediment and surface water for human health and ecological exposures.							
	Sediment							
	Units	RAO 1 Beach PRG	RAO 1 Sediment PRG	RAO 2 Sediment PRG	RAO 5 Sediment PRG	RAO 6 Sediment PRG	Background	PRG
Aldrin	µg/kg			2				2
Arsenic	mg/kg	3	3				3	3
BEHP	µg/kg					135	62	135
Cadmium	mg/kg				0.5		0.1	0.5
Chlordanes	µg/kg			1.5	1.4		0.5	1.4
Copper	mg/kg				359		26	359
DDD	µg/kg				114		1.2	114
DDE	µg/kg				359	226	1.7	226
DDT	µg/kg				246			246
DDx	µg/kg			6.1	578	760	3.1	6.1
Dieldrin	µg/kg			0.07	22			0.07
Hexachlorobenzene	µg/kg						0.3	0.3
Lindane	µg/kg				5			5
Lead	mg/kg				196		7.7	196
Mercury	mg/kg				0.09		0.03	0.09
PCBs	µg/kg		370	9	500	36	9	9
PAHs	µg/kg				23,000		113	23,000
cPAHs (BaP Eq)	µg/kg	12	106	3,950			12	12
1,2,3,4,7,8-HxCDF	µg/kg			0.0004		0.03	0.0004	0.0004
1,2,3,7,8-PeCDD	µg/kg			0.0002		0.001	0.0002	0.0002
2,3,4,7,8-PeCDF	µg/kg			0.0003		0.004	0.0003	0.0003
2,3,7,8-TCDD	µg/kg		0.01	0.0002		0.0008	0.0002	0.0002
2,3,7,8-TCDF	µg/kg			0.0004		0.004	0.0003	0.0004
TBT	µg/kg				3080			3,080
Zinc	mg/kg				459		77	459

Notes:
NA - Not applicable

Table 2.4-1
Initial Screening of Remedial Technologies and Process Options
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Description	Screening Comments
No Action	None	Not Applicable	Under no action, no active remediation of any kind is implemented. The no action response serves as a baseline against which the performance of other remedial alternatives may be compared. The NCP requires that no action be considered as a potential remedial action in a feasibility study. Under the no action alternative in the Study Area, contaminated river sediments would be left in place, without treatment or containment.	Required for consideration by NCP.
Institutional Controls	Governmental Controls	Commercial Fishing Bans	Commercial fishing bans are government controls that ban commercial fishing for specific species or sizes of fish or shellfish and are established by state departments of health or other governmental entities.	Retained site-wide.
		Waterway Use Restrictions or Regulated Navigation Areas	Provides notice to navigation to prevent damage to caps, in-situ treatment, EMNR, etc.	Retained site-wide.
	Proprietary Controls	Land Use/Access Restrictions	Restrictions, such as deed restrictions, easements, and covenants, placed in property related documents or physical barriers such as fences.	Retained site-wide.
		Structure Maintenance Agreements	Requirements to conduct maintenance of in-water structures where caps or buried contamination are co-located in river.	Retained site-wide.
	Enforcement and Permit Tools	Permit Processes or Provisions of Administrative Orders or Consent Decrees	Legal tools, such as administrative orders, permits, and Consent Decrees (CDs), that limit certain site activities or require the performance of specific activities (e.g., to monitor and report on an IC's effectiveness). They may be issued unilaterally or negotiated.	Retained site-wide.
	Informational devices	Isolation Barriers	Construction fencing, geofabric, or other devise to prevent human interference with isolated contamination.	Retained site-wide.
		Fish Consumption Advisories	Fish consumption advisories provide information to the public from state departments of health or other governmental entities on acceptable fish consumption rates and fish preparation techniques.	Retained site-wide.
Monitored Natural Recovery	Physical Transport	Desorption, dispersion, diffusion, dilution, volatilation, resuspension, and transport.	Natural ongoing processes that reduce toxicity through transformation or reduce bioavailability through increased sorption, destruction, or reduction of bioavailability or toxicity of contaminants in sediment.	Retained site-wide.
	Chemical and Biological Degradation	Dechlorination (aerobic and anaerobic), biodegradation	Natural ongoing processes that dechlorinate or degrade chemical toxicity through biological processes.	Retained site-wide.
	Physical Burial Process	Sedimentation	Reduce exposure through natural burial or mixing-in-place.	Retained site-wide.
Enhanced Natural Recovery	Enhanced Burial/Dilution	Thin Layer Cap	Enhancement of MNR (e.g., burial) through placement of a thin layer of material (e.g., 6" of sand).	Retained site-wide.
Containment in Place	Capping	Engineered Cap	Physical isolation of contaminants with sand cover.	Retained site-wide.
				Retained site-wide.
		Armored Cap	Physical isolation of contaminants with sand cover and other structural elements (such as armor) as necessary to keep the cap stable.	Retained site-wide.
		Clay Cap	Physical isolation of contaminants with clay aggregate materials (e.g., AquaBlok™) consisting of a gravel/rock core covered by a layer of clay mixed with polymers that expand in water, decreasing the material's permeability.	Retained site-wide.
		Composite Cap (e.g., HDPE, Geotextile)	Physical and/or chemical isolation of contaminants by layering heavy-duty composite protection mat designed for placement over sediments to guard against damage by erosion, scouring, heavy equipment, or other forces.	Retained site-wide.
		Reactive Cap	Placement of active capping layers, such as activated carbon or organoclay, to reduce contaminant flux through capping materials. Same technology as described above for other cap process options, depending on environmental conditions.	Retained site-wide. Limited to areas where contaminated groundwater plumes or leachable contaminants are present.
In-Situ Treatment	Biological Treatment	Slurry Bioremediation	Addition of nutrients and other amendments to enhance bioremediation.	Screened out site-wide since it is not considered feasible to implement in-situ biological treatment to contaminants that are either not biodegradable (particularly heavy metals) or are very persistent in the environment (e.g., PCDD/F, PCB, pesticides).
		Phytoremediation	Use of plants to remediate contaminated sediments.	
		Aerobic Biodegradation	Bioremediation uses microorganisms to degrade organic contaminants in soil, sludge, and solids in-situ. The microorganisms break down contaminants by using them as a food source or cometabolizing them with a food source. Aerobic processes require an oxygen source, and the end products typically are carbon dioxide and water.	
		Anaerobic Biodegradation	Bioremediation uses microorganisms to degrade organic contaminants in soil, sludge, and solids either excavated or in-situ. The microorganisms break down contaminants by using them as a food source or cometabolizing them with a food source. Anaerobic processes are conducted in the absence of oxygen, and the end products can include methane, hydrogen gas, sulfide, elemental	
		Imbiber Beads	Spherical plastic particles that absorb a very broad cross section of the organic chemical spectrum.	
	Chemical	Chemical Slurry Oxidation	Application of chemical oxidants to remediate contaminated sediments. Chemical oxidation typically involves reduction/oxidation (redox) reactions that chemically convert hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, or inert.	Screened out site-wide. There are no known sediment applications of in-situ chemical treatment involving the injection and subsequent removal of chemical reagents to demonstrate effectiveness and implementability of forming less toxic byproducts on a large scale.
	Physical - Immobilization	Solidification/Stabilization	In-situ immobilization methods typically involve amending sediments in place with reagents, such as cement, quicklime, grout, or pozzolanic materials, that immobilize and/or bind contaminants to the sediment in a solid matrix or chemically stable form or provide a low permeability barrier to groundwater flow. These agents are mixed through the zone of contamination using conventional excavation equipment or a specially designed injection apparatus.	Retained site-wide. Limited to areas where access and slope stability issues exist (e.g., contaminated banks behind or beneath major structures with limited access).
		Sequestration	Sequestration is an innovative in-situ technology that involves the use of remedial agents like activated carbon, organoclays, apatite, and zeolites to reduce the toxicity, bioavailability, and mobility of sediment contaminants. These agents are mixed into the sediment surface layer typically by mechanical means. Materials such as SediMite^{TM} and AquaGate are a low impact system for delivery of remedial agents to the sediment surface. It is an agglomerate comprised of a treatment agent like activated carbon, a weighting agent, and an inert binder. The weighting agent enables the SediMiteTM granular material to sink to the surface and release the activated carbon which is then mixed by bioturbation.	Retained site-wide in areas subject to ENR.
		Ground Freezing	The ground freezing process converts in-situ pore water to ice through the circulation of a chilled liquid via a system of small-diameter pipes placed in drilled holes. The ice acts to fuse the soil or rock particles together, creating a frozen mass of improved compressive strength and impermeability. Brine is the typical cooling agent, although liquid nitrogen can be used in emergency situations or where the freeze is only required to be maintained for a few days.	Screened out site-wide.
Sediment/Soil Removal	Excavation	Dry Excavation	Use of excavators, buckets, etc. deployed from land-based equipment. Can be "in the wet" or "in the dry" in combination with sheet piles, coffer dams, or other measures to remove water.	Retained site-wide for consideration in nearshore areas.
	Dredging	Mechanical Dredging	Use of clamshell, closed, hydraulic, or other buckets to remove contaminated sediment from a barge or other vessels.	Retained site-wide.
		Hydraulic Dredging	Use of hydraulic dredges (e.g., cutterhead, horizontal auger, plain suction, pneumatic, or specialty dredges) with various cutter and suction heads to remove contaminated sediments from the environment in a slurry phase.	Retained site-wide.
		Small Scale Dredge Equipment	Diver assisted or hand held hydraulic dredging, Mud Cat, and similar small scale removal methods.	Retained site-wide for consideration around structures.

Table 2.4-1
Initial Screening of Remedial Technologies and Process Options
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Description	Screening Comments
Disposal	Commercial Landfill	Hillsboro	A disposal site where solid waste is buried between layers of dirt and other materials in such a way as to reduce contamination of the surrounding land. Modern landfills are often lined with layers of absorbent material and sheets of plastic to keep pollutants from leaking into the soil and water.	Retained site-wide.
		Northern Wasco County		Retained site-wide.
		Roosevelt Regional		Retained site-wide.
		Columbia Ridge (Subtitle D)		Retained site-wide.
		Chem Waste (Subtitle C)		Retained for consideration of state listed waste or RCRA exempted waste.
	Onsite Upland Landfill	No likely candidate property.	A disposal site where solid waste is buried between layers of dirt and other materials in such a way as to reduce contamination of the surrounding land. Modern landfills are often lined with layers of absorbent material and sheets of plastic to keep pollutants from leaking into the soil and water.	Screened out site-wide due to lack of location and floodplain issues.
	Confined Aquatic Disposal (CAD)	Willamette River (RM 4/5)	Dredged material deposited in depressions or excavated pits or placed behind subaqueous lateral berms (at a nearshore location) followed by subaqueous covering or capping. If an engineered cap is used in conjunction with CAD at the disposal site, the potential need for armor in erosive areas must be evaluated, and cap maintenance would be required to ensure long-term chemical isolation of the disposed material. The final grade of a capped CAD cell would be similar to the adjacent subaqueous surface elevation.	Screened out due to interference with Federal Navigation use. See Table 2.4-3
		Willamette River (RM 9)		Screened out due to interference with Federal Navigation use. See Table 2.4-3
		Swan Island Lagoon (RM 8)		Screened out due to current and reasonably likely future uses and requires permanent institutional controls (e.g., deed restrictions, dredging moratorium) that may affect future development and uses of Swan Island Lagoon See Table 2.4-3
		Columbia River (RM 102.5)		Retained site-wide.
		Ross Island (RM 15)		Retained site-wide.
	Confined Disposal Facility (CDF)	Terminal 4 Slip 1	A CDF may be constructed as an in-water site (i.e., a containment island). An in-water CDF can be constructed with dikes or other containment structures to contain the contaminated dredged material, isolating it from the surrounding environment. The in-water CDF ultimately converts open water to dry land. A CDF may also be constructed as a nearshore site (i.e., in water with one or more sides adjacent to land). The Nearshore CDF converts open water to dry land. In some cases, a Nearshore CDF can be integrated with site reuse plans to both reduce environmental risk and simultaneously foster redevelopment in urban areas and brownfields sites (USEPA 2005).	Retained site-wide. Excludes RCRA contaminated waste.
		Swan Island Lagoon		Retained site-wide. Excludes RCRA contaminated waste.
		Arkema		Retained for Arkema. Excludes RCRA contaminated waste.
Ex-Situ Treatment	Physical	Particle Separation	Contaminated fractions of solids are concentrated through gravity, magnetic, or sieving separation processes.	Retained site-wide.
		Solidification/Stabilization	The mobility of contaminants in sediments is reduced through addition of reagents such as Portland cement.	Retained site-wide.
		Sorbent Clay Solidification/Stabilization	The mobility of contaminants in sediments is reduced through addition of sorbent clays such as bentonite.	Retained site-wide.
	Biological	Land Farming/Composting	Sediment is mixed with amendments and placed on a treatment area that typically includes leachate collection. The soil and amendments are mixed using conventional tilling equipment or other means to provide aeration. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation. Other organic amendments, such as wood chips, potato waste, or alfalfa, are added to composting systems.	Retained for areas with only petroleum hydrocarbons.
		Biopiles	Large scale land treatment of petroleum hydrocarbons to reduce contaminant concentrations through biodegradation in biocells, bioheaps, biomounds, and compost piles. This is an aerated static pile composting process in which compost is formed into piles and aerated with blowers or vacuum pumps. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation.	Retained for areas with only petroleum hydrocarbons.
		Fungal Biodegradation	Large scale land treatment to reduce organic contaminant concentrations by using fungal lignin-degrading or wood-rotting enzyme systems (example: white rot fungus).	Retained site-wide.
		Slurry-phase Treatment	An aqueous slurry is created by combining sediment with water and other additives. The slurry is mixed to keep solids suspended and microorganisms in contact with the contaminants. Upon completion of the process, the slurry is dewatered and the treated sediment is removed for disposal (example: sequential anaerobic/aerobic slurry-phase bioreactors).	Retained site-wide.
		Enhanced Biodegradation	Acceleration of the natural bioremediation processes by adding oxygen, reducing agents, nutrients, and degrading microrganisms to the sediment to improve the rate of natural biodegradation. Use of heat to break carbon-halogen bonds and to volatilize light organic compounds (example: D-Plus [Sinre/DRAT]).	Retained site-wide.
	Chemical	Acid Extraction	Use of acids to extract contaminants from dredged sediments. Suitable for sediments contaminated with metals but not applicable to PCBs or SVOCs. No data on TBT.	Eliminated.
		Solvent Extraction	Use of solvents to extract contaminants from dredged sediments.	Retained site-wide for consideration for sediments containing total PCBs greater than 50 parts per million (ppm).
	Physical/Chemical	Sediment Washing	A physio-chemical process that uses impact forces in conjunction with chemicals to desorb contaminants from solid sediment particles of all sizes. During this process, contaminants are extracted and concentrated into the sludge associated with water treatment. Depending on the reagents used, in some instances, contaminants may be oxidized.	Eliminated.
		Chemical Oxidation/Reduction	Reducing/oxidizing agents are used to chemically convert toxic contaminants in excavated waste materials to less toxic compounds that are more stable, less mobile, and/or inert. Commonly used reducing/oxidizing agents are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. Target contaminant group for chemical redox is inorganics. Less effective for nonhalogenated VOCs, SVOCs, fuel hydrocarbons, and pesticides. Not cost-effective for high contaminant concentrations because of large amounts of oxidizing agent required.	Eliminated.
		Dehalogenation	Removal of halogens (e.g., chlorine) through chemical dehalogenation reactions. In the dehalogenation process, sediment are screened, processed with a crusher and pug mill, and mixed with sodium bicarbonate (base catalyzed decomposition) or potassium polyethylene glycol. The mixture is heated to above 630°F in a rotary reactor to decompose and volatilize contaminants. Process produces biphenyls, olefins, and sodium chloride. PCB and dioxin-specific technology. Generates secondary waste streams of air, water, and sludge. Similar to thermal desorption but more expensive. Solids content above 80% is preferred. Technology is not applicable to metals.	Eliminated.
		Radiolytic Dechlorination	Radiolytic (electron beam) and photolytic (ultraviole) dechlorination of PCBs. Sediment is placed in alkaline isopropanol solution and gamma irradiated. Products of this dechlorination process are biphenyl, acetone, and inorganic chloride. Process must be carried out under inert atmosphere. Only bench-scale testing has been performed. Difficult and expensive to create inert atmosphere for full-scale project.	Eliminated.

Table 2.4-1
Initial Screening of Remedial Technologies and Process Options
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Description	Screening Comments
Ex-Situ Treatment	Thermal	Incineration	Temperatures greater than 1,400°F are used to volatilize and combust organic contaminants. Commercial incinerator designs are rotary kilns equipped with an afterburner, a quench, and an air pollution control system.	Retained for RCRA-listed waste prior to land disposal of treated residuals.
		Pyrolysis	Chemical decomposition induced in organic materials by heat in the absence of oxygen. Pyrolysis typically occurs under pressure and at operating temperatures above 430ºC (800ºF). High moisture content increases treatment cost. Generates air and coke waste streams. Target contaminant groups are SVOCs and pesticides. It is not effective in either destroying or physically separating inorganics from the contaminated medium.	Eliminated.
		High Temperature Thermal Desorption	Heating of contaminated sediment to drive off and capture contaminants. Involves the application of heat (320 to 560ºC or 600 to 1,000ºF) to excavated wastes to volatilize organic contaminants and water. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system such as a thermal oxidation or recovery unit.	Retained for consideration for sediments containing total PCBs greater than 50 ppm.
		Low Temperature Thermal Desorption	Involves the application of heat (90 to 320ºC or 200 to 600ºF) to excavated wastes to volatilize organic contaminants and water. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system such as a thermal oxidation or recovery unit.	Retained site-wide.
		High Pressure Oxidation	This process includes two related technologies: wet air oxidation and supercritical water oxidation. Both technologies use the combination of high temperature and pressure to break down organic compounds. Predominantly for aqueous-phase contaminants. Wet air oxidation is a commercially proven technology for municipal wastewater sludges and destruction of PCBs is poor. Supercritical water oxidation has demonstrated success for PCB destruction.	Eliminated.
		Vitrification	Vitrification is a process in which higher temperatures (2,500 to 3,000°F) are used to destroy organic chemicals by melting the contaminated dredged material to form a glass aggregate product. The glass aggregates can be used for beneficial use products such as hot mix asphalt, construction fill, cement substitutes, and ceramic floor tiles. Vitrification has been demonstrated to be very effective in destroying organic contaminants such as PCDD/F, PCBs, and PAHs in dredged material.	Retained site-wide.

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
No Action	None	Not Applicable	The no action response is not effective in reducing the baseline unacceptable human health and ecological risks in the Study Area (see Chapters 8 and 9 in the RI report). Does not meet RAOs.	Technically implementable site-wide.	None	Yes	Yes
Institutional Controls	Governmental Controls	Commercial Fishing Bans	Limited to contaminants that accumulate in fish or shellfish. Mainly for commercial fisheries; not very effective for recreational fisheries. Ineffective for limiting ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low	Yes. As a component of alternatives that also include active measures.	No
		Waterway Use Restrictions or Regulated Navigation Areas	Enforcement of restrictions in a large waterway is difficult, especially for recreational boaters. Typically used in conjunction with active remedial technologies such as capping, dredging and capping, EMNR, and in-situ treatment to enhance long-term effectiveness.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public. Dredging and navigation restrictions would be limited due to extensive navigational use of waterway.	Low		Yes
	Proprietary Controls	Land Use/Access Restrictions	Better for controlling human exposures than ecological exposures. Not effective for ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low		Yes
		Structure Maintenance Agreements	Enhances effectiveness of capping-based remedies by requiring maintenance of co-located structures.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low		No
	Informational Devices	Isolation Barriers	Enforcement of restrictions in a large waterway is difficult. Typically used in conjunction with active remedial technologies such as capping, EMNR, and in-situ treatment to enhance long-term effectiveness in riverbank areas.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low		No
		Fish Consumption Advisories	Limited to contaminants that accumulate in fish or shellfish. Mainly for commercial fisheries, not very effective for recreational fisheries. Better for controlling human exposures than ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low		Yes
Monitored Natural Recovery	Physical Transport	Desorption, dispersion, diffusion, dilution, volatilization, resuspension, and transport	Physical transport generally increases exposure to contaminants and may result in unacceptable risks to downstream areas or other receiving water bodies.	MNR works best where the source of pollution has been removed. Need to identify if these processes are occurring to a degree likely to result in reduced risk to receptors.	Low	Yes. As a component of alternatives that also include active measures.	No
	Chemical and Biological Degradation	Dechlorination (aerobic and anaerobic), biodegradation	Limited to SVOCs and PAHs. Does not result in complete degradation of PCBs and dioxins/furans in an acceptable time frame. PCB and dioxin/furan dechlorination is not directly related to toxicity reduction. Not applicable to metals.	MNR works best where the source of pollution has been removed. Need to determine if degradation processes are occurring to a degree likely to result in reduced risk to receptors.	Low		No
	Physical Burial Process	Sedimentation	Works best in depositional areas. Not effective in areas with wave, current, or propwash generated erosion or subject to routine dredge maintenance. Requires demonstration of long-term deposition and burial.	MNR works best where the source of pollution has been removed. Need to identify if depositional processes are occurring sufficiently to reduce risk to receptors.	Low		Yes
Enhanced Natural Recovery	Enhanced Burial/Dilution	Thin Layer Cover	Applicable at areas where MNR processes are demonstrated but faster recovery is required or as a residual management tool after completion of removal action.	ENR works best where the source of pollution has been removed.	Low	Yes	Yes

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
Containment in Place	Capping	Engineered Cap	Effective for low-solubility and highly sorbed contaminants (e.g., PCBs) where principal transport mechanism is resuspension/deposition. Not effective in potential scour areas from river currents or propeller wash. Not effective in controlling groundwater plumes. Long-term monitoring and maintenance would be required to ensure that a cap remained effective despite these factors. The organic carbon content of the primary capping material may provide some sorptive capacity in an engineered cap, allowing the cap to both physically and chemically sequester contaminants and increase its effectiveness.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. Easily applied in-situ; however, scouring must be considered. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation.	Low	Yes	Yes
		Armored Cap	Armored caps are effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect the toxicity or the volume of contaminants. Applicable at areas where increased velocities from river flow or potential scouring due to propeller wash might be expected. Not effective in controlling groundwater plumes.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation.	Low-Moderate	Yes, for areas with high erosive forces.	Yes. For areas in main navigation channel.
		Clay Cap	Such materials can be used for maintaining slope stability. They are effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect toxicity or volume of contaminants. Effective for scour and biointrusion protection and maintaining slope stability. Since the use of subaqueous clay caps over large areas has not been well documented, the effectiveness is unknown.	A primary concern with the use of clay caps is their long-term performance (with respect to maintaining integrity) in areas of significant groundwater upwelling or diversion. However, clay aggregate material and geosynthetic clay liners (GCLs) may be technically implementable and administratively feasible as an armor layer to protect an underlying engineered cap from erosive forces while also reducing friction in erosive areas (compared to friction anticipated to be generated using stone armor).	Moderate	Yes as potential armoring and slope stabilization material.	No
		Composite Cap (e.g., HDPE, Geotextile)	Porous geotextile cap layers do not achieve sediment isolation, but are effective in reducing the potential for mixing and displacement of the underlying sediment with the cap material. Geotextiles allow the sediments to consolidate and gain strength under the load of additional cap material. Effective in reducing cap thickness, providing additional floor-support, providing bioturbation barrier, or areas where methane generation may be an issue. They are effective in reducing the mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect toxicity or volume of contaminants.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation. Implementability over large areas may be challenging.	Low-Moderate	Yes, for areas that do not otherwise have the strength to support a cap.	No
		Reactive Cap	Reactive caps are effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect toxicity or volume of contaminants. They are specific to chemical being managed; demonstrated effectiveness for PAHs, PCBs, dioxins and furans, and chlorinated pesticides. Bench scale effectiveness for metals. May not be effective where multiple types of contaminants (e.g., metals and organics) are co-located. Reactive caps eventually lose their sorptive or chemically reactive treatment capabilities. Site monitoring would be required to determine whether the active layer should be replaced and the cap reconstructed to remain protective.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation.	Low-Moderate	Yes	Yes. For areas with groundwater plumes

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
In-Situ Treatment	Physical	Solidification/Stabilization	Effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect the toxicity or the volume of contaminants.		Low-Moderate	Yes. Limited to areas where access and slope stability issues exist (e.g., contaminated banks behind major structures with limited access).	Yes. For limited access areas.
		Sequestration	Limited to organic compounds and some metals. Requires site-specific studies to determine extent of use and effectiveness.	Has been demonstrated to work best with lower levels of contaminants. Easily applied in-situ; may require armoring in scour areas.	Low-Moderate	Yes	Yes. For lower contaminant concentrations.
Sediment/Soil Removal	Dredging	Mechanical Dredging	Effective in removing stiffer or denser sediments but requires greater effort to reduce resuspension rates and residual production. Residuals will require management strategies to achieve cleanup goals. More effective at handling debris. Environmental buckets suitable for softer materials with low debris; clamshell buckets suitable for harder, dense sediments.	Equipment is available. Dredge depths are limited by the ladder and cable lengths. Application in shallow water depths limited by draft of supporting barge or ship. Requires barge to place material during operations. May require contaminant barrier during dredging activities.	Moderate	Yes	Yes
		Hydraulic Dredging	Effective in removing soft or loose sediments with high water content. Capable of lower resuspension rates at the point of dredging as well as lower in-water residual production than mechanical dredging. Residuals will require management strategies to achieve cleanup goals.	The presence of large amounts of debris can adversely affect hydraulic dredging operations and may require pre-debris sweeps. Dredge depths are limited by the ladder and cable lengths. Application in shallow water depths limited by draft of supporting barge or ship. Requires close proximity (3 to 5 miles) to land-based dewatering facility, barge dewatering facility, or CDF due to pumping limitations. Slurry separation and disposal rates can be slower than dredging rates and may limit the rate of dredging. May require contaminant barrier during dredging activities. Although in some cases diver-assisted hydraulic dredging or video-monitored dredging can be used, turbidity, safety, and other technological constraints typically result in dredging being performed without visual assistance. Barge transport of hydraulically dredged material is inefficient.	Moderate	Yes	No
		Specialized and Small Scale Dredge Equipment	Can be conducted close to infrastructure and within tightly restricted areas. Less residuals due to higher precision from dredging operations. May be the most effective approach for precise cleanup of a hard face, since the divers can feel the surface and adjust the excavation accordingly. Vic Vac can be useful for removing residuals from hard surface.	Production rates are much less than other removal equipment mainly due to smaller size of removal equipment a diver can handle. Seldom require contaminant release controls. Barge transport of hydraulically dredged material is inefficient. Ability of divers to maintain a desired position will be hampered by currents. Presence of logs and large debris may present dangerous conditions for diver-assisted dredging. Although divers can remove sediment from around large debris or rocks, this type of operation would be inefficient. Removal is limited to thin cuts.	High	Yes. Limited to areas with infrastructure and within tightly restricted areas.	No
	Excavation	Dry Excavation	Effective where water depths limit conventional dredging equipment.	Requires installation of sheet pile walls or cofferdam unless performed in exposed areas during low river stages. Limited application to areas that can be reached from shore or by specialty equipment designed to work on soft unconsolidated sediments. Equipment is locally commercially available.	Low-Moderate	Yes	Yes

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
Disposal	Commercial Landfill	Hillsboro	Most effective for materials with the lowest potential to leach constituents. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Requires overland transportation. Requires elimination of free liquids for both transport and disposal. May be less favored by agencies and the public, at least for some materials, because of proximity to metropolitan Portland.	Low	Yes	No
		Northern Wasco County	Adequate capacity. May be limited as to quantity of material that can be accepted. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Requires overland transportation.	Low-Moderate	Yes	No
		Roosevelt Regional	Adequate capacity. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Accepts wet waste. Rail transportation available if a transloading facility can be sited in Portland near the river. Differences between Hazardous Waste Regulations in Oregon and Dangerous Waste Regulations in Washington need to be considered. Farther from the Site than Hillsboro or Wasco County but transportation would be mostly by barge or rail.	Moderate	Yes	Yes
		Columbia Ridge (Subtitle D)	Adequate capacity. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Accepts wet waste. Rail transportation available if a transloading facility can be sited in Portland near the river.	Moderate	Yes	No
		Chem Waste (Subtitle C)	Redundant containment and leachate collection systems and location in an area that receives little precipitation and is removed from shallowest groundwater all contribute to long-term effectiveness.	Accepts RCRA waste. Rail transport available if a transloading facility can be sited in Portland near the river.	High	Yes	Yes
	Confined Aquatic Disposal (CAD)	Columbia River (RM 102.5)	Demonstrated effectiveness in aquatic environment. Effective containment of metals, organics, and PCBs. Can be designed to include habitat enhancement for salmonids. CADs must be engineered to withstand bioturbation, advective flux, and release of buried COPCs, propeller and/or high-flow scour, and earthquakes. Requires long-term monitoring, institutional controls, and financial commitment.	High potential for increased releases during disposal. CAD cells may be implemented with solid phase controls, such as silt curtains or berms, in order to address concerns with potential sediment transport outside the CAD area during filling events. Need for seasonal capping reduces available capacity. Potential for additional actions if CAD fails. Requires concurrence with land owner.	Moderate	No See Table 2.4-3	
		Ross Island	Demonstrated effectiveness in aquatic environment. Effective containment of metals, organics, and PCBs. Can be designed to include habitat enhancement for salmonids. CADs must be engineered to withstand bioturbation, advective flux, and release of buried COPCs, propeller and/or high-flow scour, and earthquakes. Requires long-term monitoring, institutional controls, and financial commitment.	High potential for increased releases during disposal. CAD cells may be implemented with solid phase controls, such as silt curtains or berms, in order to address concerns with potential sediment transport outside the CAD area during filling events. Need for seasonal capping reduces available capacity. Potential for additional actions if CAD fails. Requires concurrence with land owner.	Moderate	No See Table 2.4-3	

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
Disposal	Confined Disposal Facility (CDF)	Terminal 4 Slip 1	Effective if constructed and maintained properly.	60% design complete. Large capacity. Requires long-term monitoring and maintenance. Requires flood rise analysis and mitigation. RCRA regulations exclude dredged material that is subject to the requirements of Section 404 of the Clean Water Act, which would govern disposal of sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. Waterway impacts such as disruption of circulation patterns, impact on flooding, need for low permeability subgrade formation, and avoidance of buried utilities need to be minimized. In addition, because of the permanent loss of aquatic habitat, extensive mitigation would be required.	High	Yes	Yes
		Swan Island Lagoon	Effective if constructed and maintained properly.	Large capacity. Requires long-term monitoring and maintenance. Requires flood rise analysis and mitigation. No proponent. RCRA regulations exclude dredged material that is subject to the requirements of Section 404 of the Clean Water Act, which would govern disposal of sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. Waterway impacts such as disruption of circulation patterns, impact on flooding, need for low permeability subgrade formation, and avoidance of buried utilities need to be minimized. In addition, because of the permanent loss of aquatic habitat, extensive mitigation would be required.	High-Very High	No See Table 2.4-3	
		Arkema	May not be effective due to high levels of contamination offshore of Arkema and presence of uneven bedrock surface.	Limited capacity. Requires long-term monitoring and maintenance. Construction adjacent to active river channel may result in unacceptable flood rise. RCRA regulations exclude dredged material that is subject to the requirements of Section 404 of the Clean Water Act, which would govern disposal of sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. Waterway impacts such as disruption of circulation patterns, impact on flooding, need for low permeability subgrade formation, and avoidance of buried utilities. In addition, because of the permanent loss of aquatic habitat, extensive mitigation would be required.	Very High	No See Table 2.4-3	

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
Ex-Situ Treatment	Physical	Particle Separation	Effective in reducing volume of highly contaminated material with high sand content. Increases effectiveness of dewatering dredged material. Not effective with sediments containing high concentration material with high organic content.	Readily implementable - mobile units available for quick setup and takedown time. Can be combined with soil washing to improve separation. Clean separated sand may be available for potential beneficial use (would require identification of reuse). Separation technologies available and have been used in several programs of similar size and scope. Bench scale testing to characterize the different size or density fractions is typically needed to assess feasibility.	Low	Yes	No
		Cement Solidification/ Stabilization	Bench-scale studies have added immobilizing reagents ranging from Portland cement to lime cement, kiln dust, pozzolan, and proprietary reagents. Lime has been successfully added to dredged material at other projects.	BMPs are necessary to ensure air quality impacts are minimized. Dewatering prior to cement stabilization/solidification is dependent on logistics. Mechanically dredged sediments will be saturated, but since the volumes of water produced by mechanical dredging are much more limited, blending with stabilizing agents can be done in barges on wet materials. Where hydration of the blending agent is required, some water would actually be desirable. A similar operation could be performed on hydraulically dredged sediments after they have become sufficiently dewatered (passively) to permit handling or after they were mechanically dewatered.	Low-Moderate	Yes	Yes
		Sorbent Clay Solidification/ Stabilization	Allows adsorption of organic contaminants on to clay. Not good for volatile or flammable organics, due to vapor emission and fire concerns. Factors that influence the performance of S/S include: (1) interfering agents that prevent proper set or curing, including organics (oils, grease, phenols, chlorinated solvents) and inorganics (sulfate, phosphate); (2) gas emissions - since generally exothermic reactions, heat is generated and some volatilization of toxics can occur; and (3) final strength - decreased by organics.	BMPs are necessary to ensure air quality impacts are minimized. Lime amendment for pH control to allow for adsorption of organic contaminants.	Moderate	Yes	No
	Biological	Land Farming/Composting	Limited to TPH and PAHs. Not effective for metals, PCBs, dioxin or, TBT. PAHs and some SVOCs are amenable to aerobic degradation.	Large staging areas are required within close proximity to the project. BMPs may be necessary to ensure air quality impacts are minimized. If air quality impacts are expected, a contained biological process option may be more appropriate. BMPs are also necessary to control contaminant migration from runoff. Bench-scale testing would be required during design. Requires dewatering of dredged material.	Low-Moderate	No	
		Biopiles	Limited to VOCs, SVOCs, PAHs and TPH. Not effective for metals, PCBs, TBT, or dioxins. The presence of site COCs such as PCBs, organochlorine pesticides, and metals may prevent these technologies from achieving the desired cleanup levels.	Large treatment areas are required. Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Bench-scale testing would be required during design. Requires dewatering of dredged material.	Low-Moderate	No	
		Fungal Biodegradation	Not effective for metals, PCBs, dioxins, or TBT. High concentrations of contaminants may inhibit growth.	The technology has been tested only at bench scale. No known full-scale applications.	Low-Moderate	No	
		Slurry-phase Treatment	Not effective for metals, PCBs, dioxin, or TBT. PAHs and some SVOCs are amenable to aerobic degradation.	Large volume of tankage required. No known full-scale applications.	Low-Moderate	No	
		Enhanced Biodegradation	Not effective for metals, PCBs, dioxin or TBT. PAHs and some SVOCs are amenable to aerobic degradation.		Moderate	No	

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
Ex-Situ Treatment	Chemical	Solvent Extraction	Successfully pilot-demonstrated at New Bedford Harbor, which is contaminated with PCBs. Where metals and organics are both present in the sediment, which is typical, chemical extraction targeting organics would likely need to be coupled with other operations addressing removal/stabilization of metals. This demonstration has limited applicability to the Portland Harbor project as the goal of the pilot program was to reduce PCB concentrations to below 50 mg/kg to reduce the waste code from Subtitle C to Subtitle D; therefore, there are limited data available to determine the effectiveness of the pilot in treating to lower concentrations.	Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design.	High	No	
	Thermal	Incineration	High temperatures result in generally complete decomposition of PCBs and other organic chemicals. Effective across wide range of sediment characteristics. Not effective for metals.	Requires air pollution control device. Mobile treatment may be used, if available, and may be more cost effective than offsite thermal treatment if the treatment volumes are high enough. Nearest existing, permitted facility is greater than 500 miles from project. High energy consumption. Potential for dioxin generation is a concern. Public concern may make implementability challenging.	Very High	No	
		High Temperature Thermal Desorption	Target contaminants are SVOCs, PAHs, PCBs, TBT, and pesticides. Metals are not destroyed. Especially effective with high levels of PCBs (>50 ppm).	Requires air pollution control device. Technology readily available as mobile units that would need to be set up at a fixed location in close proximity to the contaminated sediments. High energy consumption; however, costs may be offset through the sale/use of generated power. Pre-permitting consultation and acceptance of BU products is crucial to economic viability of PO.	High	No	
		Low Temperature Thermal Desorption	Effective for SVOCs and PAHs. May have limited effectiveness for PCBs. Metals not destroyed. Effectiveness demonstrated at other sediment remediation sites. Fine-grained sediment and high moisture content will increase retention times. Widely-available commercial technology for both on-site and off-site applications. Acid scrubber will be added to treat off-gas.	Requires air pollution control device. Fine-grained sediment and high moisture content will increase retention times. Vaporized organic contaminants that are captured and condensed need to be destroyed by another technology. The resulting water stream from the condensation process may require further treatment. Widely available commercial technology for both on-site and off-site applications.	Low	Yes	Yes
		Vitrification	Thermally treats PCBs, SVOCs, TBT, and stabilizes metals. Successful bench-scale application to treating contaminated sediments in Lower Fox River and in Passaic River.	Not commercially available or applied on similar site and scale.	Moderate-High	No	

Table 2.4-3
CAD/CDF Disposal Option Summary
Portland Harbor Superfund Site
Portland, Oregon

Process Option Screening Criteria	Process Option Screening Subcriteria	In-water CAD	Nearshore CDFs		
		Swan Island Lagoon	Swan Island Lagoon	Terminal 4	Arkema
Process Option Concept Summary	NA	Conceptual design provided in 2012 draft Feasibility Study (FS). CAD is a 54-acre disposal site within Swan Island Lagoon. A berm will be constructed to contain the contaminated material. A 6-foot-thick cover was assumed to be required for effective isolation of the contaminated sediment. The estimated capacity is 280,000 cubic yards (cy) before consolidation. Wastes not designated for upland disposal could be placed in this CAD.	Conceptual design provided in 2012 draft FS. CDF is a 54-acre disposal site within Swan Island Lagoon. A berm will be constructed to contain the contaminated material. Imported fill material, including suitable dredged sediment and/or soil, would be placed as cover material above the water table in the CDF to bring the facility up to its design elevation. The estimated capacity is 1.4 million cy before consolidation. Wastes not designated for upland disposal could be placed in this CDF.	Detailed 60% design available. CDF consists of a 14-acre disposal site within Terminal 4, Slip 1. A berm will be constructed to contain the contaminated material. The CDF will be covered with fill and aggregate. The estimated capacity is 670,000 cy before consolidation. Wastes not designated for upland disposal could be placed in this CDF.	Conceptual design provided in draft Engineering Evaluation/ Cost Analysis (EE/CA). The CDF would be constructed of a sheetpile wall tied into the upland groundwater control slurry wall. An engineered impermeable cap would be placed over the top of the CDF to minimize infiltration. The CDF would only take Arkema waste.
Effectiveness					
Long-Term Effectiveness and Permanence	Contaminant Migration from CDF After Construction	Contaminant migration modeling was not performed nor presented in draft FS. However, contaminant migration modeling was performed for the Swan Island CDF. This modeling indicates that the CAD can likely be designed to be effective at meeting Remedial Action Objectives (RAOs).	Contaminant migration modeling was performed and presented in the draft FS. Modeling results show that the CDF can be designed to be effective in meeting RAOs.	Contaminant migration modeling was performed and presented in draft FS. Modeling results show that the CDF can be designed to be effective in meeting RAOs.	Contaminant migration modeling was not performed nor presented in draft FS or draft EE/CA. Contaminants located at Arkema are currently identified in disposal decision tree as requiring upland disposal, and this may not be suitable for disposal within a CDF. The mitigation strategy for contaminant migration from CDF included provisions for treatment, but it is not clear with treatment that RAOs can be met.
	Floodway Impacts to Willamette River	Hydrologic and hydraulic (H&H) modeling was not performed nor presented in the draft FS. Although an off channel location, potential impacts on flood rise and/or flood storage may still exist. No mitigation strategy for flood rise impacts was presented.	H&H modeling was not performed nor presented in the draft FS. Although an off channel location, potential impacts on flood rise and/or flood storage may still exist. No mitigation strategy for flood rise impacts was presented.	H&H modeling was performed and presented in the 60% Design Analysis Report (DAR) for the Terminal 4 CDF. Modeling results showed no impacts on flood rise and/or flood storage due to construction of the CDF.	H&H modeling was performed and presented in the draft EE/CA. Modeling results showed negligible impacts on flood rise and/or flood storage due to construction of the CDF.
Short-Term Effectiveness	Water Quality Impacts During Construction	Evaluation of short-term effects not provided in draft FS. Some short-term impacts to water quality are expected. Mitigation strategy for water quality impacts include construction in backwater area away from main channel and interim capping between filling seasons as well as use of other engineered controls/ BMPs.	Evaluation of short-term effects provided in the draft FS as Appendix Jb. Some short-term impacts to water quality are expected. Mitigation strategy for water quality impacts include construction in backwater area away from main channel and interim capping between filling seasons as well as use of other engineered controls/BMPs.	Evaluation of short-term effects provided in the draft FS as Appendix Jb. Some short-term impacts to water quality are expected. Mitigation strategy for water quality impacts include construction in terminal area away from main channel and interim capping between filling seasons as well as use of other engineered controls/BMPs.	Evaluation of short-term effects not provided in the draft FS or draft EE/CA. Potential significant impacts to water quality are expected due to the type of contamination present (including non-aqueous phase liquid [NAPL]) and location on main channel. Mitigation strategy for water quality impacts include use of engineered controls/BMPs. Basalt bedrock within a few feet of top of sediment bed creates challenges for construction of engineered controls and effective isolation of contaminants.

Table 2.4-3
CAD/CDF Disposal Option Summary
Portland Harbor Superfund Site
Portland, Oregon

Process Option Screening Criteria	Process Option Screening Subcriteria	In-water CAD	Nearshore CDFs		
		Swan Island Lagoon	Swan Island Lagoon	Terminal 4	Arkema
Implementability					
Administrative Feasibility	Proponents for CDF Construction	No current proponent exists.	No current proponent exists.	A current proponent exists (Port of Portland).	A current proponent exists (LSS/Arkema).
Administrative Feasibility	Land ownership coordination	Lands within the footprint of the proposed CAD are owned by the State of Oregon and managed by the Department of State Lands (DSL). No current discussion with DSL or surrounding property owners is underway.	Lands within the footprint of the proposed CDF are owned by the State of Oregon and managed by DSL. No current discussion with DSL or surrounding property owners is underway.	Lands within the footprint of the proposed CDF are owned by the State of Oregon and managed by DSL as well as the Port of Portland. The Port of Portland (the CDF proponent) has been in discussions with DSL regarding acquisition of the remaining submersible land from DSL that is necessary to implement the project.	Lands within the footprint of the proposed CDF are owned by the State of Oregon and managed by DSL. No current discussion with DSL or surrounding property owners is underway. However, according to the conceptual CDF plan for Arkema, preliminary discussions with DSL regarding options for leasing lands under DSL management have occurred.
Technical Implementability	CDF Constructability Issues Due to Location	Conceptual design provided in the draft FS. The CAD concept is dependent on a berm to contain contaminated sediments. The location is off channel and the berm should be constructible, but the concept has not advanced sufficiently to determine whether there are technical issues within the backwater area of the Willamette River that cannot be overcome through design.	Conceptual design provided in the draft FS. The CDF concept is dependent on a berm to contain contaminated sediments. The location is off channel and the berm should be constructible, but the concept has not advanced sufficiently to determine whether there are technical issues within the backwater area of the Willamette River that cannot be overcome through design.	Detailed 60% design available. Although the CDF concept is dependent on a berm to contain contaminated sediments, the location is off channel and the berm appears, from design analyses, to be constructible. No significant issues related to the location in the off channel area of the Willamette River have been identified that cannot be overcome through design.	Conceptual design provided in the draft EE/CA. Due to the on-channel location, the CDF concept is dependent on the installation of rigid containment. Basalt bedrock within a few feet of the top of the sediment bed and deeper water near the navigation channel of the Willamette River creates challenges for construction and effective isolation of contaminants with rigid containment. The concept has not advanced sufficiently to conclude that this and other technical issues related to the on-channel location can be overcome through design.
Technical Implementability	Compatibility with Current and Potential Future Land and Waterway Use	CAD would be located in an off-channel (backwater) area of the Willamette River. Use of the potential Swan Island CAD would eliminate ongoing commercial water-dependent uses of this portion of the Site. The completion of the CAD would create approximately 29 acres of shallow water habitat, which may have value from a habitat mitigation or restoration perspective. However, there is a lack of information on whether these potential uses are viable due to a lack of a proponent.	CDF would be located in an off-channel (backwater) area of the Willamette River. Use of the potential Swan Island CDF would eliminate or impact ongoing commercial water-dependent uses of this portion of the Site unless the channel end of the CDF was repurposed as a terminal slip. However, there is a lack of information on whether these potential uses are viable due to a lack of a proponent.	The CDF would be located in an off-channel (slip) area of Terminal 4 adjacent to the navigation channel of the Willamette River. Use of the potential Terminal 4 CDF would eliminate commercial water-dependent uses of Slip 1; however, other slips are available. In addition, the CDF would include additional space for Port of Portland operations.	The CDF would be located in an on-channel location and would be adjacent to the navigation channel of the Willamette River for the purpose of constructing a shipping berth. The conceptual design indicates that the CDF would be constructed on the upland side of the harbor-line, which may enhance future uses of the Arkema property.

Table 2.4-3
CAD/CDF Disposal Option Summary
Portland Harbor Superfund Site
Portland, Oregon

Process Option Screening Criteria	Process Option Screening Subcriteria	In-water CAD	Nearshore CDFs		
		Swan Island Lagoon	**Swan Island Lagoon**	**Terminal 4**	**Arkema**
Costs					
Capital Cost		No cost estimate available in the draft FS or EE/CA.	No cost estimate available in the draft FS or EE/CA.	Detailed cost estimate provided in the draft FS. Disposal cost estimated at $87/cy.	Cost estimate provided in the draft EE/CA. Disposal cost estimated at $166/cy.
O&M Cost		Not directly included in the FS cost estimate.	Not directly included in the FS cost estimate.	Operations and maintenance (O&M) costs of $1.5 million were included in the 60% design estimate.	O&M costs of $245,000 were included in the EE/CA cost estimate.
Summary of Process Option Screening (Retained/Eliminated)					
Draft FS (Prepared by LWG)		Retained	Retained	Retained	Retained
Revised FS Section 2 (Prepared by EPA)		Based on available information, not retained for assembly of remedial alternatives in revised FS due to the following factors: Effectiveness: Lack of information supporting long- and short-term effectiveness. Implementability: Lack of information supporting technical implementability; significant administrative feasibility issues. Cost: Lack of cost information.	Based on available information, not retained for assembly of remedial alternatives in revised FS due to the following factors: Effectiveness: Lack of information supporting long-term effectiveness. Implementability: Lack of information supporting technical implementability; significant administrative feasibility issues. Cost: Lack of cost information.	Based on available information, retained as representative process option for on-site disposal. No significant deficiencies regarding effectiveness, implementability, or cost were identified that cannot be mitigated during development of alternatives.	Based on available information, not retained for assembly of remedial alternatives in revised FS due to the following factors: Effectiveness: Lack of information supporting long-term effectiveness; significant short-term effectiveness issues. Implementability: Significant technical implementability issues.

Notes:
Color Coding
Green - Minor or no issues
Yellow – Moderate issues
Red – Significant issues
CAD – Confined Aquatic Disposal Facility
CDF – Confined Disposal Facility

Table 3.2-1
PTW Highly Toxic Concentration Thresholds
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	**Highly Toxic PTW Threshold (μg/kg) (10^{-3} risk)**
PCBs	200
Dioxin/Furan Congeners	
2,3,7,8-TCDD	0.01
2,3,7,8-TCDF	0.6
1,2,3,7,8-PeCDD	0.01
2,3,4,7,8-PeCDF	0.2
1,2,3,4,6,7,8-HxCDF	0.04
DDx	7,050
cPAHs (BaP Eq)	106,000

Table 3.2-2
PTW Contaminants Reliably Contained
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	PTW Contaminants Reliably Contained
Dioxins/furans	At all concentrations measured at the Site
PAHs	At all concentrations measured at the Site
Chlorobenzene	At concentrations <320 µg/kg
DDx	At all concentrations measured at the Site
Naphthalene	At concentrations <140,000 µg/kg
PCBs	At all concentrations measured at the Site

Table 3.4-1
PCB RALs with Resulting SWACs and Acres
Portland Harbor Superfund Site
Portland, Oregon

PCBs			
		Site-Wide	
Alternative	RAL (µg/kg)	SWAC (µg/kg)	Acres
B	1,000	56	26
C	750	52	34
D	500	47	53
E	200	36	123
F	75	25	336
G	50	21	508
H	9	9	2,037

Table 3.4-2
Total PAHs RALs with Resulting SWACs and Acres
Portland Harbor Superfund Site
Portland, Oregon

Total PAHs			
		Site-Wide	
Alternative	RAL (µg/kg)	SWAC (µg/kg)	Acres
B	170,000	8,737	39
C	130,000	7,484	48
D	69,000	5,216	72
E	35,000	3,987	98
F	13,000	2,812	157
G	5,400	1,990	280
H	970	970	1,028

Table 3.4-3
Dioxin/Furan RALs with Resulting SWACs and Acres
Portland Harbor Superfund Site
Portland, Oregon

Dioxins/Furans									
	2,3,4,7,8-PeCDF			1,2,3,7,8-PeCDD			2,3,7,8-TCDD		
Alternative	RALs (µg/kg)	SWAC (µg/kg)	Acres	RALs (µg/kg)	SWAC (µg/kg)	Acres	RALs (µg/kg)	SWAC (µg/kg)	Acres
B	1	0.003	3	0.003	0.0003	9	0.002	0.0003	7
C	1	0.003	3	0.002	0.0003	16	0.002	0.0003	7
D	1	0.003	3	0.0008	0.0002	43	0.002	0.0003	7
E	0.2	0.002	5	0.0008	0.0002	43	0.0006	0.0002	31
F	0.2	0.002	5	0.0008	0.0002	43	0.0006	0.0002	31
G	0.009	0.0009	28	0.0008	0.0002	43	0.0006	0.0002	31
H	0.0002	0.0002	1036	0.0001	0.0001	291	0.0001	0.0001	1071

Table 3.4-4
DDx RALs with Resulting SWACs and Acres
Portland Harbor Superfund Site
Portland, Oregon

DDx					
		RM7W		Site Wide	
Alternative	RAL (µg/kg)	SWAC (µg/kg)	Acres	SWAC (µg/kg)	Acres
B	650	100	10	22	11
C	550	85	12	21	13
D	450	65	15	20	16
E	300	37	20	18	22
F	160	22	25	16	33
G	40	10	35	11	114
H	6.1	6	64	6	1,130

Table 3.4-5
Summary of RALs for Focused COCs
Portland Harbor Superfund Site
Portland, Oregon

Focused COC	RAL (µg/kg)						
	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H
PCBs	1,000	750	500	200	75	50	9
Total PAHs	170,000	130,000	69,000	35,000	13,000	5,400	970
2,3,7,8-TCDD	0.002	0.002	0.002	0.0006	0.0006	0.0006	0.0001
1,2,3,7,8-PeCDD	0.003	0.002	0.0008	0.0008	0.0008	0.0008	0.0001
2,3,4,7,8-PeCDF	1	1	1	0.2	0.2	0.009	0.0002
DDx	650	550	450	300	160	40	6.1

Table 3.4-6
RALs for Focused COCs - Alternative I
Portland Harbor Superfund Site
Portland, Oregon

Focused COC	RAL (µg/kg)				
	PTW	Alt B + PTW	Alt D	Alt E	Alt F
PCBs	200	200	500	200	75
Total PAHs	870,000	170,000	69,000	35,000	13,000
2,3,7,8-TCDD	0.01	0.002	0.002	0.0006	0.0006
1,2,3,7,8-PeCDD	0.01	0.003	0.0008	0.0008	0.0008
2,3,4,7,8-PeCDF	0.2	0.2	1	0.2	0.2
DDx	7,050	650	450	300	160

Table 3.4-7
Confined Disposal Facility (CDF) Performance Standard Summary
Portland Harbor Superfund Site
Portland, Oregon

Performance Standard	Performance Standard Description (From EPA CDF Performance Standard letter, dated February 18, 2010)	Terminal 4 CDF Performance Evaluation
General	CDF alternatives shall be developed and evaluated that meet the following performance standards. These performance standards establish minimum criteria and are not intended to relieve a CDF project owner, designer, or developer from complying with any and all additional applicable requirements, or any short-term or long-term liability associated with a particular action or project. These performance standards also provide guidance on cost estimating assumptions to be used for the FS.	The 60 percent design of the Terminal 4 CDF meets the intent of the EPA CDF performance standards that were transmitted to the LWG and the Port of Portland on February 18, 2010.
	The contaminants of concern (COCs) to be included in any CDF evaluation shall be consistent with the COCs approved by EPA for the in-water Remedial Investigation/Feasibility Study (RI/FS) or as specifically modified by EPA. The LWG may submit a request for evaluation of a reduced list of contaminants to be evaluated for any particular CDF.	These CDF performance standards only apply to the FS evaluations, and alternative standards may be developed during remedial design.
6	Contain the volume, level, and characteristics of contaminated sediment to be placed within it, using site-specific designs as needed to accommodate the specific contaminated materials proposed for disposal. The CDF shall be designed to achieve these performance standards when filled with the specified design volume of contaminated sediment meeting CDF sediment acceptance criteria that will be established, considering representative sediment contaminant concentrations and contaminant mobility data obtained from, or estimated for, sediments from Portland Harbor sites where dredging is a reasonably anticipated remedial action that would generate sediments requiring confinement.	These elements were addressed for the Terminal 4 CDF through CDF berm, fill, and surface layer design; CDF acceptance criteria; contaminant mobility testing; and long-term water quality analysis and contaminant transport modeling as described in Sections 5 and 6 of the 60% Design Analysis Report[1]. A summary of the contaminant-transport modeling is presented in Appendix D.
7	Minimize physical intrusion into waters of the United States.	Addressed through the navigation and site use evaluation presented in Section 3.7 of the 60% Design Analysis Report.
8	Minimize water flow into and out of the CDF, including preventing or restricting preferential flow paths of clean or contaminated groundwater into or out of the CDF. The evaluation should include identifying, removing, or modifying utilities trenches, storm drain lines, wells, and other conduits within 500 feet of the CDF (or other distance as determined to be appropriate). Utilities, storm drain lines, and other conduits are not allowed under or within the contaminated sediment fill prism.	Addressed through outfall and stormwater re-routing as described in Section 5.8 of the 60% Design Analysis Report and to be finalized in the 100% design document.
9	Achieve confinement of all hazardous substances disposed of in the facility through the groundwater pathway so that the CDF does not contribute any long-term discharge and/or release of contaminants above applicable and relevant and appropriate requirements under federal or state law for surface water in the lower Willamette River.	For the Terminal 4 CDF, contaminant transport modeling was performed to demonstrate that the disposal unit is capable of achieving the performance standards. The long-term water quality analysis and contaminant transport modeling is described in Sections 6.4 and Appendix A of the 60% Design Analysis Report.
10	Limit contaminant concentrations in groundwater (including berm pore water) exiting the CDF to levels below EPA's national recommended chronic water quality criteria for both aquatic organisms and fish consumption by humans (17.5 g/day), more stringent Oregon water quality standards, and MCLs without dilution in the water column. This should include dormant periods between CDF filling and after closure. Analyses for meeting these criteria shall not consider biodegradation of contaminants within the CDF.	For the T4 CDF, contaminant transport modeling was performed to demonstrate that the disposal unit is capable of achieving the performance standards. Refer to the long-term water quality analysis and contaminant transport modeling as described in Sections 6.4 and Appendix A of the 60% Design Analysis Report.
11	CDFs shall be designed in a manner that is consistent with the remedial action objectives (RAOs) and management goals that have been established for the FS. Habitat mitigation and land acquisition assumptions for individual CDFs shall be developed for cost estimating purposes in the FS.	The conceptual design for the Terminal 4 CDF is consistent with the RAOs and management goals. Habitat mitigation is addressed through the habitat mitigation evaluation as described in Section 7 of the 60% Design Analysis Report.

Table 3.4-7
Confined Disposal Facility (CDF) Performance Standard Summary
Portland Harbor Superfund Site
Portland, Oregon

Performance Standard	Performance Standard Description (From EPA CDF Performance Standard letter, dated February 18, 2010)	Terminal 4 CDF Performance Evaluation
12	CDF berms shall be designed to: · Provide a static safety factor of 1.5 or greater and a seismic safety factor of 1.1 or greater. The design seismic event shall correspond to a 10 percent probability of exceedance in 50 years. · Be resistant to erosive forces by the largest of 100-year flood flow, 100-year waves, vessel-induced waves from typical passing vessels, and anticipated propeller wash from vessels that operate in the area. · Have an appropriate gradation to allow transport of groundwater while retaining (filtering) sediment during filling and after closure.	The design of the Terminal 4 CDF berm appears to meet the standards as presented through the stability analysis, erosion resistance analysis, and gradation analysis as described in Section 5 of the 60% Design Analysis Report.
13	Construction of any CDF shall not measurably increase the 100-year flooding stage or decrease flood storage of the Willamette River. The FS shall consider cumulative effects of multiple sites and related remedial actions, including sediment capping.	For the Terminal 4 CDF, the modeling shows no impact on flood rise and flood storage. The flood storage evaluation is presented in Section 5.6 and Appendix I of the 60% Design Analysis Report.
14	Maintain saturated or unsaturated conditions (as appropriate) within the confined contaminated sediments prism, considering reasonably anticipated seasonal and long-term cyclical groundwater levels and site infiltration or zero recharge (as appropriate) from the overlying ground surface, to eliminate or reduce potential mobility of chemicals of concern.	The Terminal 4 CDF has been designed such that contaminated sediment will remain saturated. Mobility of COCs addressed through long-term water quality analysis and contaminant transport modeling as described in Sections 6.4 and Appendix A of the 60% Design Analysis Report.
15	Minimize releases of 303(d) listed contaminants to the extent practicable.	For the T4 CDF, contaminant transport modeling was performed to demonstrate that the disposal unit is capable of achieving the performance standards. Releases of listed contaminants addressed through long-term water quality analysis and contaminant transport modeling as described in Sections 6.4 and Appendix A of the 60% Design Analysis Report.
16	Unless modified by EPA, all CDFs shall be designed to meet these performance standards, ARARs and the final Portland Harbor Record of Decision (ROD) requirements in perpetuity.	Addressed through the ARARs analysis presented in Section 8 of the 60% Design Analysis Report. The Terminal 4 cost proposal includes indefinite long-term monitoring to ensure that all requirements are met in perpetuity.
17	Construct the CDF berm and related components in a manner that minimizes to the extent practicable water quality exceedances within the construction zone and achieves compliance with water quality criteria/standards at and beyond the specified point of compliance.	Addressed through a short-term water quality analysis as described in Section 6.1.1 of the 60% Design Analysis Report.
18	Construct the CDF in a manner that minimizes impacts to fisheries and wildlife by removing fish to the extent practicable from the CDF area before and during berm construction.	For the Terminal 4 CDF, fish exclusion efforts will be undertaken as discussed in the fish removal plan described in Section 5.3 of the 60% Design Analysis Report.
19	Construct the CDF berm with acceptable material. For cost estimating purposes, acceptable material should be based on requirements established in the December 2003 Technical Plans and Specifications (Ecology and the Environment 2003) for the McCormick & Baxter sediment cap located within the Willamette River. Materials will generally be imported clean granular material, but typically all materials shall be free of roots, inappropriate organic material, contaminants, and all other deleterious and objectionable material. However, CDF berm construction material shall have an organic fraction meeting minimum specified values consistent with contaminant transport modeling.	The Terminal 4 berm design addresses these standards through the import material goals presented in Section 5.5 of the 60% Design Analysis Report.
20	Accept only sediments meeting final sediment acceptance criteria. EPA shall approve all sediment to be disposed of in any CDF.	Sediment acceptance criteria will be applied to restrict the material being disposed at the Terminal 4 CDF as discussed in Section 5.10.1 of the 60% Design Analysis Report.

Table 3.4-7
Confined Disposal Facility (CDF) Performance Standard Summary
Portland Harbor Superfund Site
Portland, Oregon

Performance Standard	Performance Standard Description (From EPA CDF Performance Standard letter, dated February 18, 2010)	Terminal 4 CDF Performance Evaluation
21	Plan and manage the CDF filling to avoid any short-term overflow(s), or minimize the overflows to the extent possible. If a CDF overflow during filling cannot be avoided, complete an analysis of overflow discharge rates and duration, contaminant concentrations, and ability to meet water quality criteria at end of pipe. Evaluate best management practices (BMPs) and treatment options needed to meet water quality criteria at the end of the pipe. If EPA agrees that criteria cannot be met at the end of the pipe, then a dilution zone modeling analysis of the discharge impacts shall be completed to demonstrate compliance with water quality criteria. Overflows must meet acute water quality criteria. Chronic water criteria will be used to guide implementation of BMPs to minimize contaminant loadings to the river. The design shall consider engineering controls and treatment options needed to meet chronic discharge criteria at end of pipe.	Short-term overflows are unlikely for mechanically or hydraulically placed materials in the Terminal 4 CDF based on the current design (i.e., amount of freeboard from sediment to top of berm). Short-term water quality analysis is provided in Section 6.1.1 of the 60% Design Analysis Report.
22	During CDF filling, concentrations in groundwater (berm pore water) exiting the CDF must meet acute water quality criteria. Chronic water criteria will be used to guide implementation of BMPs to minimize contaminant loadings to the river. For the CDF, short-term water quality impacts are defined as the period from the beginning of the fill activity until the water level in the CDF reduces to within 0.1 foot of the water level in the river.	Short-term impacts are anticipated to be minimal at the Terminal 4 CDF based on short-term contaminant transport modeling as described in Section 6.3.3 and Appendix A of the 60% Design Analysis Report.
23	Physically close any hydraulic connection between river and the CDF (except through groundwater), except during periods of actual approved overflow.	For the Terminal 4 CDF, the berm will be constructed to an elevation that will isolate the CDF from the river during filling as presented in Section 5.2 of the 60% Design Analysis Report.
24	Prior to final closure of any CDFs, the facility shall be managed in a manner that minimizes impacts to fisheries and wildlife. Potential and short-term exposures of fish and wildlife to contaminated sediments and/or water within a CDF shall be fully assessed and disclosed.	Short term impacts are expected to be minimal. Interim covers will be used for the Terminal 4 CDF. The management plan for the time between filling seasons is discussed in Section 5.10.5 of the 60% Design Analysis Report.
25	Cap contaminated sediments with clean soils/sediment or soils/sediments that meet specific acceptance criteria that are established by EPA.	Addressed through the import material goals presented in Section 5.5 of the Terminal 4 CDF 60% Design Analysis Report.
26	Stormwater discharges or infiltration of stormwater into the CDF is not allowed.	The design for the Terminal 4 CDF addressed this performance standard through outfall and stormwater re-routing and CDF surface layer design as presented in Section 5 of the 60% Design Analysis Report.
27	Monitor CDF(s) in perpetuity, or until reduced monitoring is approved by EPA, to document that the CDF(s) achieves confinement of all hazardous substances placed in it so that the facility does not contribute any discharge and/or release of contaminants above performance standards/ROD criteria for surface water or sediment in the lower Willamette River.	Addressed through the long-term management and monitoring program as described in Section 5.10.6 and Appendix A of the 60% Design Analysis Report.
28	Provide appropriate financial assurance for project development, closure, long- term monitoring, mitigation as needed, and contingency actions.	The performance standard will be incorporated into the development of construction plans. Addressed through the engineering cost estimate presented in Section 10 of the Terminal 4 CDF 60% Design Analysis Report.
29	Implement appropriate institutional controls: · Prevent disturbance of the sediment. · Prevent stormwater infiltration into the CDF or the CDF buffer zone. · Prevent installation of groundwater extraction wells for any purpose within the CDF or the CDF buffer zone. · Restrict development on the CDF. Structures may be constructed over the CDF; however, foundations must remain at least 3 feet above the upper surface of the contaminated sediment zone. Installation of piles driven through the contaminated sediment zone is not allowed. However, EPA is willing to consider proposals for jet grouted piles or other technologies that will not disturb the contaminated sediments.	Appropriate controls would be implemented to protect the integrity of the Terminal 4 CDF and limit exposure. This performance standard is addressed through the institutional control plan presented in Section 12 of the 60% Design Analysis Report.

[1] Anchor QEA, LLC. 2011. Terminal 4 Confined Disposal Facility Design Analysis Report (Prefinal 60 percent Design Deliverable), Port of Portland, Portland Oregon. Prepared for the Port of Portland. August 2011.

Table 3.7-1
Alternative Cost Summary
Portland Harbor Superfund Site
Portland, Oregon

Alternative	Cost Summary[1]					
	DMM Scenario[2]	Total Capital Cost	Total Periodic Cost	Total Non-Discounted Cost	Present Value Cost	Minus 30% Plus 50% Range
B	2	$352,097,000	$290,324,000	$642,421,000	$451,460,000	$316,022,000 to $677,190,000
C	2	$400,933,000	$317,464,000	$718,397,000	$496,760,000	$347,732,000 to $745,140,000
D	2	$556,004,000	$397,028,000	$953,032,000	$653,700,000	$457,590,000 to $980,550,000
E	1	$748,071,000	$412,332,000	$1,160,403,000	$804,120,000	$562,884,000 to $1,206,180,000
	2	$827,465,000	$412,332,000	$1,239,797,000	$869,530,000	$608,671,000 to $1,304,295,000
F	1	$1,550,014,000	$549,512,000	$2,099,526,000	$1,316,560,000	$938,147,000 to $2,010,315,000
	2	$1,629,407,000	$549,512,000	$2,178,919,000	$1,371,170,000	$959,819,000 to $2,056,755,000
G	1	$2,421,152,000	$708,114,000	$3,129,266,000	$1,731,110,000	$1,211,777,000 to $2,596,665,000
	2	$2,500,545,000	$708,114,000	$3,208,659,000	$1,777,320,000	$1,244,124,000 to $2,665,980,000
H	1	$8,869,180,000	$1,284,174,000	$10,153,354,000	$9,445,540,000	$6,611,878,000 to $14,168,310,000
	2	$8,948,573,000	$1,284,174,000	$10,232,747,000	$9,524,940,000	$6,667,458,000 to $14,287,410,000
I	1	$671,966,000	$421,940,000	$1,093,906,000	$745,890,000	$522,123,000 to $1,118,835,000
	2	$751,359,000	$421,940,000	$1,173,299,000	$811,290,000	$567,903,000 to $1,216,935,000

Notes:
1) Additional Cost information is provided in Appendix G.
2) DMM Scenario 1 is a combination of on-site and off-site disposal. DMM Scenario 2 - Off-site disposal only

Table 3.8-1
Summary of Alternatives
Portland Harbor Superfund Site
Portland, Oregon

Alternative	Volume Removed: Dredged/Excavated[1]: Low Estimate (cu yd)	Dredged/Excavated[1]: High Estimate (cu yd)	Dredged/Excavated[1]: Average Estimate (cu yd)	Ex-Situ Treatment[1]: Low Estimate (cu yd)	Ex-Situ Treatment[1]: High Estimate (cu yd)	Ex-Situ Treatment[1]: Average Estimate (cu yd)	Disposal Scenario[2]	Constructed Area: Remove/Contain: Sediment (acres)	Remove/Contain: River Bank (lineal ft)	In-Situ Treatment: Sediment (acres)	ENR: Sediment (acres)	MNR (acres)	Cost[3] (Present Value)	Years to Construct
B	545,000	710,000	628,000	165,500	217,500	191,500	DMM 2	95	9,633	6.7	99.8	1,966	$451,460,000	4
C	650,000	848,000	749,000	165,500	217,500	191,500	DMM 2	117	11,047	5.0	97.4	1,948	$496,760,000	5
D	1,023,000	1,339,000	1,181,000	165,500	217,500	191,500	DMM 2	177	13,887	3.2	87.0	1,900	$653,700,000	6
E	1,749,000	2,300,000	2,024,000	165,500	217,500	191,500	DMM 1	269	18,231	0	59.8	1,838	$804,120,000	7
							DMM 2						$869,530,000	
F	3,948,000	5,223,000	4,586,000	165,500	217,500	191,500	DMM 1	505	23,305	0	28.2	1,634	$1,316,560,000	13
							DMM 2						$1,371,170,000	
G	6,360,000	8,433,000	7,397,000	165,500	217,500	191,500	DMM 1	756	26,362	0	19.5	1,391	$1,731,110,000	19
							DMM 2						$1,777,320,000	
H	25,273,000	33,645,000	29,459,000	165,500	217,500	191,500	DMM 1	2,167	30,048	0	0.0	0	$9,445,540,000	62
							DMM 2						$9,524,940,000	
I	1,517,000	1,988,000	1,753,000	165,500	217,500	191,500	DMM 1	231	19,472	0	59.8	1,876	$745,890,000	7
							DMM 2						$811,290,000	

Notes:
1) Neat volumes are multiplied by an overdredge factor of 1.5 to estimate the "Low Volume with Overdredge" and multiplied by an overdredge factor of 2.0 to estimate the "High Volume with Overdredge"
2) DMM Scenario 1 is a combination of on-site and off-site disposal. DMM Scenario 2 - Off-site disposal only
3) Cost information is provided in Appendix G.

Removal volumes presented in this table are a product of rounded and non-rounded estimates found on Tables 3.8-4 and 3.8-5. Please see the notes under these tables and Appendix D2 for more information.

Table 3.8-2a
Acres Sediment Assigned to Each Technology Type
Portland Harbor Superfund Site
Portland, Oregon

	Containment										Dredging						
	Intermediate Regions						Shallow Regions				NAV		FMD		Intermediate Regions		
	Aquablok	Armored	Engineered Cap	Reactive Cap	Reactive Armored Cap	Signifcantly Augmented Reactive Cap	Aquablok	Armored	Reactive Armored Cap	Significantly Augmented Reactive Cap	Residual Layer	Reactive Residual Layer	Residual Layer	Reactive Residual Layer	Residual Layer	Reactive Residual Layer	Significantly Augmented Reactive Cap
Alternative	(acres)						(acres)				(acres)		(acres)		(acres)		
B	1.4	2.8	0.8	3.1	12.8	1.1	0.4	0.0	0.3	0.1	26.9	7.3	0.4	14.6	0.2	8.5	0.4
C	1.9	4.5	1.6	4.7	15.6	1.1	0.5	0.0	0.3	0.1	32.6	8.1	1.2	17.7	0.4	8.7	0.4
D	3.3	8.8	3.8	6.1	20.4	1.1	0.7	0.1	0.4	0.1	46.4	14.2	4.9	30.0	0.7	9.1	0.4
E	5.2	13.5	4.1	9.4	30.6	1.1	1.0	0.1	0.6	0.1	63.5	15.8	63.2	8.2	3.1	8.6	0.4
F	5.2	44.2	9.5	11.1	44.0	1.1	1.0	0.7	0.9	0.1	156.1	21.9	114.1	15.3	8.5	9.3	0.4
G	5.2	91.3	16.3	13.2	54.5	1.1	1.0	1.0	1.1	0.1	261.8	35.0	140.2	22.8	17.2	9.7	0.4
H	5.2	392.8	44.9	16.0	71.1	1.1	1.0	1.5	1.6	0.1	1,105.7	74.3	205.3	35.4	31.1	10.0	0.4
I	5.2	10.7	1.7	9.6	34.1	1.1	1.0	0.1	0.6	0.1	28.5	10.9	62.2	11.4	3.1	9.5	0.4

Notes:
The acreage presented for river banks does not come directly from the R code. The lengths of river banks were conservatively estimated using property boundaries and the outer limits of the site boundary.
Area calculations were based on simplifying assumptions for bank slope length. Calculations for river banks with full assumptions are presented in Appendix D.
All values rounded to tenths except MNR

Table 3.8-2b
Acres Sediment Assigned to Each Technology Type
Portland Harbor Superfund Site
Portland, Oregon

Alternative	Dredging (continued)					Excavation/Dredging			In-Situ	ENR		MNR				
	Shallow Regions					River Bank			Treatment	FMD	ermediate Regi	NAV Channe	FMD	Shallow Regions	Intermediate Regions	
	Backfill	Reactive Residual Layer	Engineered Cap	Reactive Cap	Significantly Augmented Reactive Cap	Engineered cap	Significantly Augmented Reactive Cap	No Action	Broadcast GAC	Residual Layer	Residual Layer	Dispersion or Deposition	Dispersion or Deposition	Dispersion or Deposition	Dispersion or Deposition	Previously Remediated
	(acres)					(acres)			(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
B	2.8	6.1	0.0	5.0	0.2	8.5	2.0	22.2	6.7	87.8	12.0	1,146	138	159	523	23.2
C	4.6	6.9	0.0	5.9	0.2	10.1	2.0	20.7	5.0	85.5	11.9	1,139	136	156	517	23.2
D	8.0	7.7	1.3	9.2	0.2	13.2	2.0	17.6	3.2	77.0	10.0	1,119	129	146	506	23.2
E	13.5	12.4	1.6	13.2	0.2	17.9	2.0	12.9	0.0	51.1	8.7	1,101	118	131	488	23.2
F	18.0	11.7	10.8	21.0	0.2	23.4	2.0	7.3	0.0	22.3	5.9	1,002	89	109	433	23.2
G	26.0	12.4	20.3	25.9	0.2	26.8	2.0	4.0	0.0	15.4	4.1	883	62	86	360	23.2
H	52.1	11.6	69.2	36.7	0.2	30.8	2.0	-	0.0	0.0	0.0	0	0	0	0	23.2
I	10.9	13.7	3.0	13.4	0.2	19.2	2.0	11.5	0.0	51.1	8.7	1,141	116	131	489	23.2

Notes:
The acreage presented for river banks does not come directly from the R code. The lengths of river banks were conservatively estimated using property boundaries and the outer limits of the site boundary.
Area calculations were based on simplifying assumptions for bank slope length. Calculations for river banks with full assumptions are presented in Appendix D.
All values rounded to tenths except MNR

Table 3.8-3
Summary of Acres Assigned to Each Technology
Portland Harbor Superfund Site
Portland, Oregon

Alternative	Technology						
	Cap (acres)	Dredge (acres)	Dredge/Cap (acres)	River Bank Excavation/Cap (lineal ft)	In-Situ Treatment (acres)	ENR (acres)	MNR (acres)
B	22.8	66.6	5.5	9,633	6.7	99.8	1,966
C	30.2	80.2	6.4	11,047	5.0	97.4	1,948
D	44.8	121.1	10.9	13,887	3.2	87.0	1,900
E	65.6	188.3	15.3	18,231	0	59.8	1,838
F	117.8	355.1	32.3	23,305	0	28.2	1,634
G	184.7	525.0	46.7	26,362	0	19.5	1,391
H	535.3	1525.5	106.4	30,048	0	0	0
I	64.1	150.2	16.9	19,472	0	59.8	1,876

Table 3.8-4
Summary of Dredge Volumes and Material Quantities for each Alternative
Portland Harbor Superfund Site
Portland, Oregon

Alternative	Total Dredge Volume[1]			Ex-Situ Treatment Volume[1]			Material Volumes for Containment, Dredge Residuals Management, and In-Situ Treatment[2]						
	Low Estimate	High Estimate	Average Estimate	Low Estimate	High Estimate	Average Estimate	Sand	Low-Permeability Sand	Organoclay Mats	Beach Mix	Armor	Aquablok	AquaGate + 10% PAC
	(cu yd)			(cu yd)			(cu yd)					(tons)	
B	494,000	659,000	577,000	156,000	208,000	182,000	349,000	3,900	230	12,000	28,000	1,600	50,000
C	592,000	790,000	691,000	156,000	208,000	182,000	392,000	3,900	230	15,000	36,000	2,200	57,000
D	950,000	1,266,000	1,108,000	156,000	208,000	182,000	494,000	3,900	230	22,000	52,000	3,700	79,000
E	1,653,000	2,204,000	1,928,000	156,000	208,000	182,000	663,000	3,900	230	34,000	78,000	5,700	78,000
F	3,825,000	5,100,000	4,463,000	156,000	208,000	182,000	1,126,000	3,900	230	51,000	150,000	5,700	106,000
G	6,221,000	8,294,000	7,258,000	156,000	208,000	182,000	1,659,000	3,900	230	69,000	244,000	5,700	137,000
H	25,115,000	33,487,000	29,301,000	156,000	208,000	182,000	4,719,000	3,900	230	138,000	759,000	5,700	201,000
I	1,414,000	1,885,000	1,650,000	156,000	208,000	182,000	595,000	3,900	230	34,000	79,000	5,700	81,000

Notes:
1) Estimated range of volume for alternatives derived by multiplying the “neat” dredge volume by 1.5 for the low range and by 2 for the high range.
2) All material quantities expressed as in-situ, neat measurements.
The quantities presented above are rounded. See Appendix D.2 for additional information.

Table 3.8-5

Summary of Excavated River Bank Volumes and Material Quantities for each Alternative

Portland Harbor Superfund Site

Portland, Oregon

Alternative	Total Excavated Volume (cu yd)	Ex-Situ Treatment Volume (cu yd)	Material Volumes for Containment, Dredge Residuals Management, and In-Situ Treatment[1]						
			Sand	Low-Permeability Sand	Beach Mix	Armor	Aquablok	AquaGate + 10% PAC	Organoclay Mats
			(cu yd)				(tons)		(cu yd)
B	51,000	9,500	38,000	4,500	7,000	2,000	0	0	260
C	58,000	9,500	44,000	4,500	8,000	2,000	0	0	260
D	73,000	9,500	56,000	4,500	11,000	2,000	0	0	260
E	96,000	9,500	75,000	4,500	14,000	2,000	0	0	260
F	123,000	9,500	98,000	4,500	19,000	2,000	0	0	260
G	139,000	9,500	111,000	4,500	22,000	2,000	0	0	260
H	158,000	9,500	127,000	4,500	25,000	2,000	0	0	260
I	103,000	9,500	81,000	4,500	16,000	2,000	0	0	260

Notes:

1) All material quantities neat measurements.

The quantities presented above do not come directly from the R code. The lengths of river banks were conservatively estimated using property boundaries and the outer limits of the site boundary. Area calculations were based on simplifying assumptions for bank slope length. Calculations for river banks with full assumptions are presented in Appendix D.

Table 3.9-1
Percent Reduction in Site-Wide Sediment SWAC
Portland Harbor Superfund Site
Portland, Oregon

Alternative	PCBs	Total PAHs	DDx	TCDD	PeCDD	PeCDF
	(Percent Reduction)					
B	45	78	64	38	20	90
C	48	81	66	40	24	90
D	55	87	70	44	31	92
E	65	90	74	52	37	94
F	77	94	80	61	49	96
G	83	96	86	69	58	97
H	100	100	100	100	100	100
I	65	82	75	49	27	94

Table 3.9-2
Summary of Area and Volume Information Used for Alternatives Screening
Portland Harbor Superfund Site
Portland, Oregon

Alternative	Construction							Materials							Disposal	Cost Summary	
	Capping	Dredging		ENR	In-Situ Treatment	MNR	Total Area Constructed	Sand	Low-Permeability Sand	Organoclay Mats	Beach Mix	Armor	Aquablok	AquaGate + 10% PAC	DMM Scenario	Present Value Cost	Minus 30% Plus 50% Range
	(acres)	(acres)	(cy)	(acres)	(acres)	(acres)	(acres)	(cy)					(tons)				
B	22.8	72.2	494,000 to 659,000	99.8	6.7	1,966	201	349,000	3,900	230	12,000	28,000	1,600	50,000	2	$451,460,000	$316,022,000 to $677,190,000
C	30.2	86.6	592,000 to 790,000	97.4	5.0	1,948	219	392,000	3,900	230	15,000	36,000	2,200	57,000	2	$496,760,000	$347,732,000 to $745,140,000
D	44.8	132.1	950,000 to 1,266,000	87.0	3.2	1,900	267	494,000	3,900	230	22,000	52,000	3,700	79,000	2	$653,700,000	$457,590,000 to $980,550,000
E	65.6	203.7	1,653,000 to 2,204,000	59.8	0	1,838	329	663,000	3,900	230	34,000	78,000	5,700	78,000	1	$804,120,000	$562,884,000 to $1,206,180,000
															2	$869,530,000	$608,671,000 to $1,304,295,000
F	117.8	387.4	3,825,000 to 5,100,000	28.2	0	1,634	533	1,126,000	3,900	230	51,000	150,000	5,700	106,000	1	$1,316,560,000	$938,147,000 to $2,010,315,000
															2	$1,371,170,000	$959,819,000 to $2,056,755,000
G	184.7	571.7	6,221,000 to 8,294,000	19.5	0	1,391	776	1,659,000	3,900	230	69,000	244,000	5,700	137,000	1	$1,731,110,000	$1,211,777,000 to $2,596,665,000
															2	$1,777,320,000	$1,244,124,000 to $2,665,980,000
H	535.3	1631.9	25,115,000 to 33,487,000	0.0	0	0	2,167	4,719,000	3,900	230	138,000	759,000	5,700	201,000	1	$9,445,540,000	$6,611,878,000 to $14,168,310,000
															2	$9,524,940,000	$6,667,458,000 to $14,287,410,000
I	64.1	167.1	1,414,000 to 1,885,000	59.8	0	1,876	291	595,000	3,900	230	34,000	79,000	5,700	81,000	1	$745,890,000	$522,123,000 to $1,118,835,000
															2	$811,290,000	$567,903,000 to $1,216,935,000

Table 4.1-1

Sediment Decision Unit (SDU) Summary Information

Portland Harbor Superfund Site

Portland, OR

SDU ID	Location	Description	Length (mile)	Acres	SDU Type/Basis	COCs
RM2E	RM 1.6 - 2.8 East	Evraz Oregon Steel Mill	1.3	102.8	Focused COC-based	PCBs
RM3.5E	RM 3.1-4.1 East	Schnitzer	1	51.3	Focused COC-based	PCBs
RM4.5E	RM 4.2 - 5.0 East	Terminal 4	0.9	43.3	Focused COC-based	PAHs/PCBs
RM5.5E	RM 5.0 - 6.0 East	Mar Com	0.9	30	Multiple COC-based	PAHs/PCBs
RM6.5E	RM 6.0 - 7.0 East	Willamette Cove	1.1	89.2	Focused COC-based	PCBs/PeCDD
SwanIs	RM 8.1 - 8.9	Swan Island Lagoon	1.1	117	Focused COC-based	PCBs
RM11E	RM 10.6 - 11.6 East	River Mile 11 East	1.1	28.8	Focused COC-based	PCBs/PeCDD
RM3.9W	Benthic Risk Area	Kinder Morgan	1.1	49.3	Multiple COC-based	PAHs/DDx
RM5W	Benthic Risk Area	Nustar	1.1	24.6	Multiple COC-based	PAHs/DDx
RM6W	RM 5.6 - 6.5 West	Gasco	1	38.1	Focused COC-based	PAHs
RM7W	RM 6.6 - 7.8 West	Arkema	1.4	68.3	Focused COC-based	DDx/PeCDF/TCDD
RM9W	RM 8.3 - 9.7 West	Shaver to Fireboat Cove	1.5	67.9	Focused COC-based	PCBs/PeCDD/TCDD
RM6Nav	RM 5.1 - 6.5 Nav	Navigation Channel	1.7	147	Focused COC-based	PAHs

Table 4.2-1
RAO 2 Post-construction Carcinogenic Risk by SDU
Portland Harbor Superfund Site
Portland, OR

SDU	Alternative						
	A	B	D	E	F	G	I
NoSDU	1E-04	1E-04	1E-04	1E-04	1E-04	8E-05	1E-04
RM2E	7E-04	2E-04	2E-04	1E-04	7E-05	6E-05	1E-04
RM3.5E	5E-04	3E-04	2E-04	1E-04	9E-05	6E-05	1E-04
RM4.5E	4E-04	4E-04	3E-04	2E-04	9E-05	4E-05	2E-04
RM5.5E	3E-04	3E-04	3E-04	3E-04	2E-04	9E-05	2E-04
RM6.5E	4E-04	2E-04	1E-04	1E-04	7E-05	6E-05	1E-04
SwanIs	2E-03	7E-04	5E-04	2E-04	5E-05	3E-05	2E-04
RM11E	2E-03	6E-04	3E-04	2E-04	7E-05	4E-05	2E-04
RM3.9W	1E-04	1E-04	1E-04	1E-04	9E-05	7E-05	1E-04
RM5W	2E-04	2E-04	1E-04	1E-04	1E-04	7E-05	1E-04
RM6Nav	2E-04	1E-04	1E-04	1E-04	5E-05	3E-05	1E-04
RM6W	2E-04	1E-04	9E-05	7E-05	4E-05	2E-05	9E-05
RM7W	2E-02	1E-03	8E-04	3E-04	2E-04	3E-05	2E-04
RM9W	1E-03	5E-04	3E-04	2E-04	6E-05	4E-05	2E-04

NoSDU is the area of the Site outside other SDUs
Residual risk on a river mile scale is 3×10^{-5}

Table 4.2-2
Acceptable Fish Consumption Rates (meals/10 years)
Portland Harbor Superfund Site
Portland, OR

Post-Construction					
	Carcinogenic Risk			Non-Cancer Hazard	
Alternative	1×10^{-6}	1×10^{-5}	1×10^{-4}	HI	HI (infant)
A	1	10	100	6	1
B	6	50	500	24	3
D	6	60	600	32	4
E	11	110	1,100	46	5
F	14	140	1,400	75	8
G	19	190	1,900	101	11
I	9	90	900	44	5
RAO 2 PRGs Achieved					
	30	300	3,000	160	20

Table 4.2-3

RAO 2 Post-construction Non-Cancer Hazard (HI) by SDU

Portland Harbor Superfund Site

Portland, OR

SDU	Alternative						
	A	B	D	E	F	G	I
NoSDU	6	6	6	5	4	4	6
RM2E	38	11	8	6	3	3	6
RM3.5E	27	14	10	7	4	3	7
RM4.5E	16	16	12	8	4	2	8
RM5.5E	13	13	13	12	6	3	6
RM6.5E	15	6	5	4	3	2	5
SwanIs	91	34	22	9	2	1	9
RM11E	78	27	16	8	3	1	8
RM3.9W	4	4	4	4	4	3	4
RM5W	6	6	5	5	4	2	5
RM6Nav	6	6	4	3	1	1	5
RM6W	9	4	3	3	2	1	3
RM7W	479	31	23	10	5	1	5
RM9W	53	23	16	8	3	1	8

NoSDU is the area of the Site outside other SDUs

Residual risk on a river mile scale is 2.

Table 4.2-4

RAO 2 Post-construction Non-Cancer Hazard (HI) for Infant by SDU

Portland Harbor Superfund Site

Portland, OR

SDU	Alternative						
	A	B	D	E	F	G	I
NoSDU	133	130	128	127	104	84	131
RM2E	765	237	171	123	74	57	123
RM3.5E	564	305	226	150	89	63	150
RM4.5E	391	388	290	211	90	41	211
RM5.5E	360	359	359	327	182	96	182
RM6.5E	416	160	120	115	75	59	150
SwanIs	1,868	733	476	193	48	28	193
RM11E	1,605	584	354	184	72	34	184
RM3.9W	107	107	107	106	93	68	106
RM5W	161	159	149	143	106	66	143
RM6Nav	169	148	119	98	46	26	138
RM6W	229	103	87	73	46	22	87
RM7W	22,589	1,198	893	349	175	36	175
RM9W	1,114	493	346	183	60	35	183

NoSDU is the area of the Site outside other SDUs

Residual risk on a river mile scale is 45.

Table 4.2-5
RAO 6 Post-construction Non-Cancer Hazards (HQs) for COCs by SDU
Portland Harbor Superfund Site
Portland, OR

SDU	Alternative A	B	D	E	F	G	I
BEHP							
NoSDU	1	1	1	1	1	1	1
RM2E	1	1	1	1	1	1	1
RM3.5E	8	6	5	3	1	0.4	3
RM4.5E	2	2	1	1	0.5	0.2	1
RM5.5E	1	1	1	1	1	0.4	1
RM6.5E	1	1	1	1	0.4	0.3	1
SwanIs	13	11	8	3	1	1	3
RM11E	1	1	1	1	0.4	0.3	1
RM3.9W	4	4	4	4	3	1	4
RM5W	1	1	0	0	0.3	0.2	0.5
RM6Nav	2	1	1	1	0.3	0.2	1
RM6W	2	1	1	0	0.2	0.1	1
RM7W	3	2	2	2	1	1	1
RM9W	8	7	4	1	0.4	0.2	1
DDx							
NoSDU	0.009	0.009	0.009	0.009	0.008	0.007	0.009
RM2E	0.01	0.009	0.008	0.007	0.006	0.005	0.007
RM3.5E	0.01	0.009	0.008	0.007	0.005	0.004	0.007
RM4.5E	0.02	0.02	0.02	0.01	0.008	0.004	0.01
RM5.5E	0.02	0.02	0.02	0.02	0.008	0.004	0.008
RM6.5E	0.01	0.01	0.008	0.008	0.007	0.006	0.01
SwanIs	0.02	0.02	0.01	0.007	0.002	0.001	0.007
RM11E	0.03	0.02	0.01	0.009	0.005	0.002	0.009
RM3.9W	0.02	0.02	0.02	0.02	0.02	0.01	0.02
RM5W	0.02	0.02	0.02	0.02	0.01	0.006	0.02
RM6Nav	0.02	0.01	0.008	0.006	0.003	0.001	0.01
RM6W	0.1	0.03	0.02	0.02	0.009	0.003	0.02
RM7W	0.8	0.10	0.06	0.03	0.01	0.004	0.01
RM9W	0.05	0.03	0.03	0.02	0.005	0.003	0.02
DDE							
NoSDU	0.009	0.009	0.009	0.009	0.008	0.007	0.009
RM2E	0.012	0.010	0.010	0.009	0.008	0.007	0.009
RM3.5E	0.01	0.008	0.007	0.006	0.005	0.004	0.006
RM4.5E	0.01	0.01	0.01	0.01	0.007	0.003	0.01
RM5.5E	0.01	0.01	0.01	0.01	0.007	0.004	0.007
RM6.5E	0.008	0.007	0.006	0.006	0.005	0.004	0.007
SwanIs	0.01	0.01	0.01	0.007	0.002	0.001	0.007
RM11E	0.009	0.005	0.005	0.004	0.002	0.002	0.004
RM3.9W	0.01	0.01	0.01	0.01	0.01	0.009	0.01
RM5W	0.01	0.01	0.01	0.01	0.008	0.005	0.01
RM6Nav	0.01	0.009	0.007	0.006	0.003	0.001	0.009
RM6W	0.07	0.01	0.009	0.007	0.004	0.002	0.009
RM7W	0.2	0.06	0.04	0.02	0.009	0.003	0.009
RM9W	0.07	0.03	0.03	0.02	0.006	0.003	0.02

Table 4.2-5
RAO 6 Post-construction Non-Cancer Hazards (HQs) for COCs by SDU
Portland Harbor Superfund Site
Portland, OR

SDU	Alternative						
	A	B	D	E	F	G	I
PCBs							
NoSDU	1	1	1	1	1	1	1
RM2E	6	2	1	1	1	0.4	1
RM3.5E	4	2	2	1	1	0.4	1
RM4.5E	2	2	2	1	1	0.2	1
RM5.5E	2	2	2	1	1	0.3	1
RM6.5E	2	1	1	1	0.4	0.3	1
SwanIs	14	5	3	1	0.3	0.2	1
RM11E	12	4	2	1	0.4	0.2	1
RM3.9W	1	1	1	1	1	0.4	1
RM5W	1	1	1	1	0.5	0.3	1
RM6Nav	1	1	1	0	0.2	0.1	1
RM6W	1	1	0.4	0.4	0.2	0.1	0.4
RM7W	4	2	1	1	0.5	0.2	0.5
RM9W	8	4	2	1	0.4	0.2	1
HxCDF							
NoSDU	0.03	0.03	0.03	0.03	0.02	0.02	0.03
RM2E	0.02	0.01	0.01	0.01	0.01	0.007	0.01
RM3.5E	0.03	0.03	0.02	0.02	0.01	0.01	0.02
RM4.5E	0.2	0.2	0.1	0.1	0.04	0.02	0.1
RM5.5E	0.2	0.2	0.2	0.2	0.16	0.1	0.16
RM6.5E	0.2	0.07	0.03	0.03	0.03	0.02	0.06
SwanIs	0.1	0.09	0.06	0.04	0.01	0.008	0.04
RM11E	0.04	0.03	0.03	0.02	0.01	0.009	0.02
RM3.9W	0.03	0.03	0.03	0.03	0.03	0.02	0.03
RM5W	0.1	0.10	0.09	0.09	0.07	0.05	0.09
RM6Nav	0.07	0.06	0.05	0.05	0.03	0.02	0.06
RM6W	0.1	0.06	0.05	0.04	0.03	0.01	0.05
RM7W	43	2	1	0.5	0.2	0.03	0.2
RM9W	0.06	0.04	0.03	0.02	0.01	0.007	0.02
PeCDD							
NoSDU	0.1	0.1	0.1	0.1	0.09	0.08	0.1
RM2E	0.07	0.06	0.05	0.05	0.03	0.03	0.05
RM3.5E	0.25	0.2	0.1	0.1	0.1	0.1	0.1
RM4.5E	0	0.1	0.1	0.1	0.05	0.02	0.1
RM5.5E	0.2	0.2	0.2	0.2	0.2	0.1	0.2
RM6.5E	0.6	0.3	0.2	0.2	0.1	0.1	0.3
SwanIs	0.2	0.2	0.1	0.09	0.04	0.03	0.09
RM11E	0.5	0.4	0.3	0.2	0.2	0.09	0.2
RM3.9W	0.1	0.1	0.1	0.1	0.1	0.07	0.1
RM5W	0.2	0.2	0.1	0.1	0.1	0.07	0.1
RM6Nav	0.2	0.2	0.2	0.1	0.09	0.06	0.2
RM6W	0.1	0.07	0.06	0.05	0.04	0.02	0.06
RM7W	0.4	0.1	0.08	0.06	0.05	0.02	0.05
RM9W	0.4	0.3	0.2	0.1	0.06	0.04	0.1

Table 4.2-5
RAO 6 Post-construction Non-Cancer Hazards (HQs) for COCs by SDU
Portland Harbor Superfund Site
Portland, OR

	Alternative						
SDU	**A**	**B**	**D**	**E**	**F**	**G**	**I**
PeCDF							
NoSDU	0.06	0.06	0.05	0.05	0.05	0.04	0.06
RM2E	0.07	0.05	0.05	0.04	0.02	0.02	0.04
RM3.5E	0.10	0.07	0.05	0.04	0.03	0.03	0.04
RM4.5E	0.3	0.3	0.2	0.2	0.06	0.03	0.18
RM5.5E	0.4	0.4	0.4	0.4	0.3	0.2	0.3
RM6.5E	0.4	0.2	0.1	0.1	0.1	0.1	0.2
SwanIs	0.1	0.1	0.08	0.05	0.02	0.01	0.05
RM11E	0.09	0.07	0.06	0.05	0.03	0.02	0.05
RM3.9W	0.07	0.07	0.07	0.07	0.06	0.05	0.07
RM5W	0.2	0.2	0.2	0.2	0.1	0.1	0.2
RM6Nav	0.3	0.2	0.2	0.2	0.09	0.06	0.2
RM6W	0.4	0.1	0.10	0.07	0.04	0.02	0.1
RM7W	46	2	2	0.6	0.3	0.04	0.3
RM9W	0.2	0.2	0.1	0.08	0.04	0.03	0.08
TCDF							
NoSDU	0.09	0.09	0.09	0.09	0.08	0.07	0.09
RM2E	0.1	0.08	0.07	0.06	0.04	0.03	0.06
RM3.5E	0.1	0.10	0.06	0.05	0.04	0.04	0.05
RM4.5E	0.06	0.06	0.05	0.04	0.03	0.02	0.04
RM5.5E	0.4	0.4	0.4	0.4	0.3	0.2	0.3
RM6.5E	0.2	0.1	0.08	0.08	0.07	0.06	0.1
SwanIs	0.08	0.08	0.06	0.04	0.01	0.01	0.04
RM11E	0.06	0.05	0.04	0.03	0.02	0.01	0.03
RM3.9W	0.1	0.1	0.1	0.1	0.1	0.1	0.1
RM5W	0.3	0.3	0.3	0.3	0.2	0.1	0.3
RM6Nav	0.6	0.4	0.3	0.3	0.2	0.09	0.4
RM6W	0.52	0.20	0.16	0.12	0.07	0.04	0.2
RM7W	70	3	3	1	0.4	0.07	0.4
RM9W	0.2	0.2	0.1	0.08	0.04	0.02	0.1
TCDD							
NoSDU	0.06	0.05	0.05	0.05	0.05	0.04	0.06
RM2E	0.04	0.03	0.03	0.03	0.02	0.02	0.03
RM3.5E	0.07	0.06	0.04	0.03	0.03	0.02	0.03
RM4.5E	0.03	0.03	0.03	0.02	0.01	0.01	0.02
RM5.5E	0.05	0.05	0.05	0.05	0.04	0.03	0.04
RM6.5E	0.10	0.04	0.02	0.02	0.02	0.01	0.04
SwanIs	0.09	0.08	0.07	0.04	0.02	0.01	0.04
RM11E	0.2	0.2	0.1	0.1	0.07	0.05	0.1
RM3.9W	0.1	0.1	0.1	0.1	0.09	0.06	0.1
RM5W	0.2	0.2	0.1	0.1	0.1	0.07	0.1
RM6Nav	0.08	0.08	0.06	0.06	0.03	0.02	0.07
RM6W	0.06	0.04	0.03	0.03	0.02	0.01	0.03
RM7W	1	0.1	0.07	0.06	0.04	0.01	0.04
RM9W	0.6	0.4	0.3	0.1	0.08	0.06	0.1

Table 4.2-6
Percent Groundwater Plume Area Adressed by Alternative
Portland Harbor Superfund Site
Portland, OR

	Alternative					
	B	D	E	F	G	I
% Reactive Cap within SMA	6%	9%	13%	22%	29%	15%
% Reactive residual layer within SMA	10%	14%	19%	24%	33%	18%
Total % groundwater plume Area Adressed	16%	23%	32%	46%	62%	33%

*Groundwater plume area within Site = 243 acres

Table 4.2-7
Percentage of Benthic Risk Area Addressed by Each Alternative
Portland Harbor Superfund Site
Portland, OR

Alternative	Benthic Risk	10x Benthic Risk	100x Benthic Risk
B	7%	48%	81%
D	13%	64%	86%
E	20%	73%	88%
F	36%	87%	89%
G	51%	93%	92%
I	17%	64%	87%

*Benthic risk area within Site = 1,289 acres

Table 4.2-8

Contaminated River Bank Addressed by Each Alternative

Portland Harbor Superfund Site

Portland, OR

Alternative	Length of Contaminated River Bank Addressed	Total Length of Contaminated River Bank	Percent Contaminated River Bank Addressed
B	9,633	30,048	32%
D	13,887	30,048	46%
E	18,231	30,048	61%
F	23,305	30,048	78%
G	26,362	30,048	88%
I	19,472	30,048	65%

Notes:

River bank lengths presented above are rounded to the nearest whole number.

Table 4.2-9
PTW Addressed by Each Alternative
Portland Harbor Superfund Site
Portland, OR

Alternative	Acres PTW Addressed	Total Acres PTW	PTW Addressed
B	64	172	37%
C	74	172	43%
D	98	172	57%
E	172	172	100%
F	172	172	100%
G	172	172	100%
I	172	172	100%

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Summary of Alternative	No action. Fish advisories issued by OHA would remain.	Cap, dredge, in-situ treatment and ENR 201 acres of contaminated sediments and 9,633 lineal feet of river bank. MNR 1,966 acres contaminated sediment. ICs and monitoring would be performed Site-wide, and maintenance of caps and ICs would be performed periodically in perpetuity.	Cap, dredge, in-situ treatment and ENR of 267 acres of contaminated sediments and 13,887 lineal feet of river bank. MNR 1,948 acres contaminated sediment. ICs and monitoring would be performed Site-wide, and maintenance of caps and ICs would be performed periodically in perpetuity.	Cap, dredge, and ENR of 329 acres of contaminated sediments and 18,231 lineal feet of river bank MNR 1,838 acres contaminated sediment. ICs and monitoring would be performed Site-wide, and maintenance of caps and ICs would be performed periodically in perpetuity.	Cap, dredge, and ENR of 533 acres of contaminated sediments and 23,305 lineal feet of river bank. MNR 1,634 acres contaminated sediment. ICs and monitoring would be performed Site-wide, and maintenance of caps and ICs would be performed periodically in perpetuity.	Cap, dredge, and ENR of 776 acres of contaminated sediments and 26,362 lineal feet of river bank. MNR 1,391 acres contaminated sediment. ICs and monitoring would be performed Site-wide, and maintenance of caps and ICs would be performed periodically in perpetuity.	Cap, dredging, and ENR of 291 acres of contaminated sediments and 19,472 lineal feet of river bank. MNR 1,876 acres contaminated sediment. ICs and monitoring would be performed Site-wide, and maintenance of caps and ICs would be performed periodically in perpetuity.
OVERALL PROTECTIVENESS							
Human Health							
Incidental ingestion of and dermal contact (RAO 1)	No reduction in risk.	Post-construction risk of 5 x 10^{-5} does not achieve interim target of 1 x 10^{-5}	Post-construction risk of 2 x 10^{-5} does not achieve interim target of 1 x 10^{-5}	Post-construction risk achieves interim target of 1 x 10^{-5}	Post-construction risk achieves interim target of 1 x 10^{-5}	Post-construction risk achieves interim target of 1 x 10^{-5}	Post-construction risk of 2 x 10^{-5} does not achieve interim target of 1 x 10^{-5}
Consumption fish/shellfish (RAO 2)	No reduction in risks or HI.	Post-construction risk does not achieve interim target of 1 x 10^{-4} Site-wide scale: 4 x 10^{-4} RM scale: 2 x 10^{-3} SDU scale: 1 x 10^{-3} Post-construction child HI does not achieve interim target of 10 Site-Wide scale: 38 RM scale: 45 SDU scale: 31 Post-construction infant HI does not achieve interim target of 1,320 (RM & SDU interim target of 450) Site-wide scale: achieved RM scale: 9,256 SDU scale: 1,198	Post-construction risk does not achieve interim target of 1 x 10^{-4} Site-wide scale: 3 x 10^{-4} RM scale: 8 x 10^{-4} SDU scale: 8 x 10^{-4} Post-construction child HI does not achieve interim target of 10 Site-Wide scale: 29 RM scale: 30 SDU scale: 23 Post-construction infant HI does not achieve interim target of 1,320 (RM & SDU interim target of 450) Site-wide scale: achieved RM scale: 6,925 SDU scale: 893	Post-construction risk does not achieve interim target of 1 x 10^{-4} Site-wide scale: 2 x 10^{-4} RM scale: 4 x 10^{-4} SDU scale: 3 x 10^{-4} Post-construction child HI does not achieve interim target of 10 Site-Wide scale: 21 RM scale: 15 SDU scale: 12 Post-construction infant HI does not achieve interim target of 1,320 (RM & SDU interim target of 450) Site-wide scale: achieved RM scale: 2,070 SDU scale: achieved	Post-construction risk does not achieve interim target of 1 x 10^{-4} Site-wide scale: achieved RM scale: 2 x 10^{-4} SDU scale: 2 x 10^{-4} Post-construction child HI does not achieve interim target of 10 Site-Wide scale: 12 RM scale: achieved SDU scale: achieved Post-construction infant HI does not achieve interim target of 1,320 (RM & SDU interim target of 450) Site-wide scale: achieved RM scale: 932 SDU scale: achieved	Post-construction risk does not achieve interim target of 1 x 10^{-4} Site-wide scale: achieved RM scale: 2 x 10^{-4} SDU scale: achieved Post-construction child HI achieves interim target of 10 on Site-Wide, RM, and SDU scale. Post-construction infant HI achieves interim target of 1,320 on Site-Wide scale, and 450 on a RM and SDU scale.	Post-construction risk does not achieve interim target of 1 x 10^{-4} Site-wide scale: 2 x 10^{-4} RM scale: 4 x 10^{-4} SDU scale: 2 x 10^{-4} Post-construction child HI does not achieve interim target of 10 Site-Wide scale: 21 RM scale: 16 SDU scale: achieved Post-construction infant HI does not achieve interim target of 1,320 (RM & SDU interim target of 450) Site-wide scale: achieved RM scale: 2,027 SDU scale: achieved
Direct contact surface water (RAO 3)	Exceedances of surface water PRGs would continue.	Post-construction, only PCBs do not achieve interim target of 10 times PRG.	Post-construction interim target achieved.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
Migration groundwater to sediment/surface water (RAO 4)	Allows continued contamination of groundwater to sediment/surface water.	Post-construction, 16% of contaminated groundwater area would be addressed.	Post-construction, 23% of contaminated groundwater area would be addressed.	Post-construction, 32% of contaminated groundwater area would be addressed.	Post-construction, 46% of contaminated groundwater area would be addressed.	Post-construction, 62% of contaminated groundwater area would be addressed.	Post-construction, 33% of contaminated groundwater area would be addressed.
Environment							
Benthic organisms (RAO 5)	No reduction in benthic risk.	Post-construction, 48% benthic risk area addressed does not achieve interim target of 50%.	Post-construction interim target achieved.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Consumption of Prey (RAO 6)	No reduction in HQs.	Post-construction ecological HQ does not achieve interim target of 10 RM scale: 34 (BEHP) SDU scale: 11 (BEHP)	Post-construction ecological HQs does not achieve interim target of 10 RM scale: 19 (BEHP) SDU scale: achieved	Post-construction ecological HQs does not achieve interim target of 10 RM scale: 15 (BEHP) SDU scale: achieved	Post-construction ecological HQs achieves interim target of 10 on a RM and SDU scale.	Same as Alternative F.	Post-construction ecological HQs does not achieve interim target of 10 RM scale: 19 (BEHP) SDU scale: achieved

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Direct contact surface water (RAO 7)	Exceedances of surface water PRGs would continue.	Insufficient data to quantify. Time to achieve protectiveness through MNR uncertain.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Migration groundwater to sediment/surface water (RAO 8)	Allows continued contaminant migration of groundwater to sediment/surface water.	Post-construction, 16% of contaminated groundwater area would be addressed.	Post-construction, 23% of contaminated groundwater area would be addressed.	Post-construction, 32% of contaminated groundwater area would be addressed.	Post-construction, 46% of contaminated groundwater area would be addressed.	Post-construction, 62% of contaminated groundwater area would be addressed.	Post-construction, 33% of contaminated groundwater area would be addressed.
Migration river banks (RAO 9)	Allows continued contaminant migration from river banks to sediment/surface water.	Post-construction, 32% of the contaminated river bank would be addressed.	Post-construction, 46% of the contaminated river bank would be addressed.	Post-construction, 61% of the contaminated river bank would be addressed.	Post-construction, 78% of the contaminated river bank would be addressed.	Post-construction, 88% of the contaminated river bank would be addressed.	Post-construction, 65% of the contaminated river bank would be addressed.
COMPLIANCE WITH ARARs							
Chemical-specific ARARs	Surface water and groundwater will exceed WQCs and MCLs.	PCBs, cPAHs, and TCDD eq criteria would not be achieved.	Complies.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.
Location-specific ARARs	No location-specific ARARs	Complies. Would be addressed during design and implementation	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Action-specific ARARs	No action-specific ARARs	Complies. Would be addressed during design and implementation. Mitigation assumed to be needed for 15 acres.	Same as Alternative B. Mitigation assumed to be needed for 25 acres.	Same as Alternative B. Mitigation assumed to be needed for 35 acres.	Same as Alternative B. Mitigation assumed to be needed for 60 acres.	Same as Alternative B. Mitigation assumed to be needed for 86 acres.	Same as Alternative B. Mitigation assumed to be needed for 34 acres.
LONG-TERM EFFECTIVENESS AND PERMANENCE							
Magnitude of Residual Risks							
Incidental ingestion of and dermal contact (RAO 1)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Sediment: Post-construction risk is a factor of 8 greater than the estimated residual risk of 6 x 10^{-6}. Beach: Residual risk is 9 x 10^{-6}. Post-construction risk cannot be quantified.	Sediment: Post-construction risk is a factor of 4 greater than the estimated residual risk of 6 x 10^{-6}. Beach: Same as Alternative B.	Sediment: Post-construction risk is a factor of 2 greater than the estimated residual risk of 6 x 10^{-6}. Beach: Same as Alternative B.	Sediment: Post-construction risk is a factor of 2 greater than the estimated residual risk of 6 x 10^{-6}. Beach: Same as Alternative B.	Sediment: Post-construction risk achieves the estimated residual risk of 6 x 10^{-6}. Beach: Same as Alternative B.	Sediment: Post-construction risk is a factor of 3 greater than the estimated residual risk of 6 x 10^{-6}. Beach: Same as Alternative B.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Consumption fish/shellfish (RAO 2)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Site-wide: Post-construction risk is a factor of 5 greater than the residual risk of 8×10^{-5}. Post-construction child HI is a factor of 6 greater than the residual HI of 6. Post-construction infant HI is a factor of 6 greater than the residual HI of 132. RM Scale: Post-construction risk is a factor of 53 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 22 greater than the residual HI of 2. Post-construction infant HI is a factor of 206 greater than the residual HI of 45. SDU Scale: Post-construction risk is a factor of 35 greater than the residual risk of 3×10^{-5}. Post-construction HI is a factor of 17 greater than the residual HI of 2. Post-construction HI is a factor of 27 greater than the residual HI of 45. Fish consumption advisory would continue until RAO is achieved.	Site-wide: Post-construction risk is a factor of 4 greater than the residual risk of 8×10^{-5}. Post-construction child HI is a factor of 6 greater than the residual HI of 6. Post-construction infant HI is a factor of 5 greater than the residual HI of 132. RM Scale: Post-construction risk is a factor of 38 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 15 greater than the residual HI of 2. Post-construction infant HI is a factor of 154 greater than the residual HI of 45. SDU Scale: Post-construction risk is a factor of 26 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 11 greater than the residual HI of 2. Post-construction infant HI is a factor of 20 greater than the residual HI of 45. Fish consumption advisory would continue until RAO is achieved.	Site-wide: Post-construction risk is a factor of 3 greater than the residual risk of 8×10^{-5}. Post-construction child HI is a factor of 4 greater than the residual HI of 6. Post-construction infant HI is a factor of 2 greater than the residual HI of 132. RM Scale: Post-construction risk is a factor of 14 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 7 greater than the residual HI of 2. Post-construction infant HI is a factor of 46 greater than the residual HI of 45. SDU Scale: Post-construction risk is a factor of 11 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 6 greater than the residual HI of 2. Post-construction infant HI is a factor of 8 greater than the residual HI of 45. Fish consumption advisory would continue until RAO is achieved.	Site-wide: Post-construction risk achieves the residual risk of 8×10^{-5}. Post-construction child HI is a factor of 2 greater than the residual HI of 6. Post-construction infant HI is a factor of 2 greater than the residual HI of 132. RM Scale: Post-construction risk is a factor of 7 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 4 greater than the residual HI of 2. Post-construction infant HI is a factor of 21 greater than the residual HI of 45. SDU Scale: Post-construction risk is a factor of 6 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 3 greater than the residual HI of 2. Post-construction infant HI is a factor of 4 greater than the residual HI of 45. Fish consumption advisory would continue until RAO is achieved.	Site-wide: Post-construction risk achieves the residual risk of 8×10^{-5}. Post-construction child HI is a factor of 2 greater than the residual HI of 6. Post-construction infant HI is a factor of 2 greater than the residual HI of 132. RM Scale: Post-construction risk is a factor of 5 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 3 greater than the residual HI of 2. Post-construction infant HI is a factor of 10 greater than the residual HI of 45. SDU Scale: Post-construction risk is a factor of 2 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 2 greater than the residual HI of 2. Post-construction infant HI is a factor of 2 greater than the residual HI of 45. Fish consumption advisory would continue until RAO is achieved.	Site-wide: Post-construction risk is a factor of 3 greater than the residual risk of 8×10^{-5}. Post-construction child HI is a factor of 4 greater than the residual HI of 6. Post-construction infant HI is a factor of 3 greater than the residual HI of 132. RM Scale: Post-construction risk is a factor of 13 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 8 greater than the residual HI of 2. Post-construction infant HI is a factor of 23 greater than the residual HI of 45. SDU Scale: Post-construction risk is a factor of 7 greater than the residual risk of 3×10^{-5}. Post-construction child HI is a factor of 4 greater than the residual HI of 2. Post-construction infant HI is a factor of 5 greater than the residual HI of 45. Fish consumption advisory would continue until RAO is achieved.
Direct contact surface water (RAO 3)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Post-construction, surface water contaminant concentrations from contaminated sediment in the Site is a factor of 13 greater than the PRG for PCBs, a factor of 6 greater than the PRG for TCDD eq, and a factor of 1.2 greater than the PRG for cPAHs.	Post-construction, surface water contaminant concentrations from contaminated sediment in the Site is a factor of 10 greater than the PRG for PCBs, and a factor of 5 greater than the PRG for TCDD eq.	Post-construction, surface water contaminant concentrations from contaminated sediment in the Site is a factor of 7 greater than the PRG for PCBs, and a factor of 4 greater than the PRG for TCDD eq.	Post-construction, surface water contaminant concentrations from contaminated sediment in the Site is a factor of 4 greater than the PRG for PCBs, and a factor of 3 greater than the PRG for TCDD eq.	Post-construction, surface water contaminant concentrations from contaminated sediment in the Site is a factor of 3 greater than the PRG for PCBs, and a factor of 3 greater than the PRG for TCDD eq.	Post-construction, surface water contaminant concentrations from contaminated sediment in the Site is a factor of 7 greater than the PRG for PCBs, and a factor of 5 greater than the PRG for TCDD eq.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Migration groundwater to sediment/surface water (RAO 4)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Post-construction, 84% of contaminated groundwater area not addressed. The magnitude residual risk is uncertain because it is likely that not all contaminated pore water will be addressed.	Same as Alternative B, except: Post-construction, 77% of contaminated groundwater area not addressed.	Same as Alternative B, except: Post-construction, 68% of contaminated groundwater area not addressed.	Same as Alternative B, except: Post-construction, 54% of contaminated groundwater area not addressed.	Same as Alternative B, except: Post-construction, 38% of contaminated groundwater area not addressed.	Same as Alternative B, except: Post-construction, 67% of contaminated groundwater area not addressed.
Benthic organisms (RAO 5)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Post-construction, 52% benthic risk area not addressed. Degree of recovery is uncertain because it is likely that an insufficient amount of the benthic risk areas will be addressed.	Same as Alternative B, except: Post-construction, 36% benthic risk area not addressed.	Same as Alternative B, except: Post-construction, 27% benthic risk area not addressed.	Same as Alternative B, except: Post-construction, 13% benthic risk area not addressed.	Same as Alternative B, except: Post-construction, 7% benthic risk area not addressed.	Same as Alternative B, except: Post-construction, 36% benthic risk area not addressed.
Consumption of Prey (RAO 6)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	The residual HQ once PRGs are achieved is 1 for each COC. RM scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 34 PCBs and TCDF – factor of 6 PeCDF – factor of 4 HxCDF – factor of 3 SDU scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 11 PCBs – factor of 5 TCDF – factor of 3 PeCDF and HxCDF – factor of 2	The residual HQ once PRGs are achieved is 1 for each COC. RM scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 19 PCBs and TCDF – factor of 4 PeCDF – factor of 3 HxCDF – factor of 2 SDU scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 8 PCBs and TCDF – factor of 3 PeCDF– factor of 2	The residual HQ once PRGs are achieved is 1 for each COC. RM scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 15 PCBs – factor of 2 SDU scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 4	The residual HQ once PRGs are achieved is 1 for each COC. RM scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 5 SDU scale: Post-construction HQ achieves the residual estimate for all COCs.	The residual HQ once PRGs are achieved is 1 for each COC. Post-construction HQs achieve the residual estimate for all COCs.	The residual HQ once PRGs are achieved is 1 for each COC. RM scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 19 PCBs – factor of 2 SDU scale: Post-construction HQ is greater than the residual estimate for the following COCs: BEHP – factor of 4
Direct contact surface water (RAO 7)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Insufficient data to quantify. Time to achieve protectiveness through MNR uncertain.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Migration groundwater to sediment/surface water (RAO 8)	Existing risk remains. Ability for natural recovery unlikely since in-river sources remain.	Post-construction, 84% of contaminated groundwater area not addressed. The magnitude residual risk is uncertain because it is likely that not all contaminated pore water will be addressed.	Same as alternative B, although: Post-construction, 77% of contaminated groundwater area not addressed.	Same as alternative B, although: Post-construction, 68% of contaminated groundwater area not addressed.	Same as alternative B, although: Post-construction, 54% of contaminated groundwater area not addressed.	Same as alternative B, although: Post-construction, 38% of contaminated groundwater area not addressed.	Same as alternative B, although: Post-construction, 67% of contaminated groundwater area not addressed.
Migration river banks (RAO 9)	Existing risk remains.	Post-construction, 68% of contaminated river banks would not be addressed. The magnitude residual risk is uncertain because it is likely that not all contaminated river banks will be addressed with this alternative.	Same as Alternative B, although: Post-construction, 54% of contaminated river banks would not be addressed.	Same as Alternative B, although: Post-construction, 39% of contaminated river banks would not be addressed.	Same as Alternative B, although: Post-construction, 22% of contaminated river banks would not be addressed.	Same as Alternative B, although: Post-construction, 12% of contaminated river banks would not be addressed.	Same as Alternative B, although: Post-construction, 35% of contaminated river banks would not be addressed.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Adequacy and Reliability of Controls	No engineering controls over existing contamination. Existing fish advisories are unlikely to be protective to humans.	Removal, capping, and treatment technologies are proven and reliable technologies. Long-term monitoring and eventual partial or complete replacement of caps/ENR amendments to ensure continued effectiveness long-term. ICs include fish consumption advisories and land-use restrictions and/or RNAs to protect caps. Effectiveness monitoring of controls includes periodic sampling of environmental media and fish. Periodic inspections of buoys of other devices used to delineate RNAs.	Same as Alternative B, although additional O&M, ICs and monitoring would be required due to the increase in the acreage of caps.	Same as Alternative D, although additional O&M, ICs and monitoring would be required due to the increase in the acreage of caps.	Same as Alternative E, although additional O&M, ICs and monitoring would be required due to the increase in the acreage of caps.	Same as Alternative F, although additional O&M, ICs and monitoring would be required due to the increase in the acreage of caps.	Same as Alternative E.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT							
Treatment Process Used and Material Treated	None	Activated carbon, organophilic clay, solidification/stabilization, thermal desorption for removed PTW in contaminated sediment and riverbank soils, as required.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Amount Destroyed or Treated	None	Ex-situ treatment: 192,000 cy In-situ treatment: 70 acres	Same as Alternative B, although: In-situ treatment: 108 acres	Same as Alternative B, although: In-situ treatment: 109 acres	Same as Alternative B, although: In-situ treatment: 145 acres	Same as Alternative B, although: In-situ treatment: 184 acres	Same as Alternative B, although: In-situ treatment: 113 acres
Reduction in Toxicity, Mobility, or Volume	None	6.7 acres broadcast activated carbon 23.0 acres reactive caps 36.5 acres reactive residual layer 3.8 acres significantly augmented reactive cap	Same as Alternative B, although: 3.2 acres broadcast activated carbon 40.0 acres reactive caps 61.0 acres reactive residual layer	Same as Alternative D, although: 60.0 acres reactive caps 45.0 acres reactive residual layer	Same as Alternative D although: 83.2 acres reactive caps 58.3 acres reactive residual layer	Same as Alternative D although: 100.8 acres reactive caps 79.8 acres reactive residual layer	Same as Alternative D although: 63.8 acres reactive caps 45.5 acres reactive residual layer

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Irreversible Treatment	None	Activated carbon in-situ treatment considered permanent and irreversible Low-temperature thermal desorption, with secondary treatment such as catalytic oxidation or carbon absorption) is considered permanent and irreversible Solidification/stabilization form stable solids that are non-hazardous or less-hazardous than the original materials	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Type and Quantity of Residuals Remaining after Treatment	Contaminated sediment and soil remains.	Post-construction, 37 percent of PTW would be addressed.	Post-construction, 57 percent of PTW would be addressed.	All PTW addressed.	Same as Alternative E.	Same as Alternative E.	Same as Alternative E.
SHORT-TERM EFFECTIVENESS							
Community Protection	Continued risks to community from no action. OHA fish advisories would continue.	Impacts to community 4 months per year for 4 years. Temporary noise, light, odors, air quality impacts. Disruptions to commercial and recreational river use, potential for waterborne accidents during construction. Controllable, addressed through implementation of H&S plans and use of BMPs. Fish consumption advisories would continue until RAO achieved.	Same as Alternative B, although: Impacts to community 4 months per year for 6 years.	Same as Alternative B, although: Impacts to community 4 months per year for 7 years.	Same as Alternative B, although: Impacts to community 4 months per year for 13 years.	Same as Alternative B, although: Impacts to community 4 months per year for 19 years.	Same as Alternative E.
Worker Protection	No risk to workers	Risks to workers would be for 4-5 months per year for 4 years. Physical hazards and chemical exposure during construction. Increased accident risks from heavy equipment, transport of materials, and increased vessel traffic. Controllable, addressed through BMPs and H&S Plans.	Same as Alternative B, although: Risks to workers would be for 4-5 months per year for 6 years.	Same as Alternative B, although: Risks to workers would be for 4-5 months per year for 7 years.	Same as Alternative B, although: Risks to workers would be for 4-5 months per year for 13 years.	Same as Alternative B, although: Risks to workers would be for 4-5 months per year for 19 years.	Same as Alternative E.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Environmental Impacts	Continued impact from existing environmental conditions.	Ecological impacts from construction activities for 4 months per year for 4 years. Temporary loss of benthos and habitat, increased emissions from construction and transportation equipment. Exposure to contamination greater than PRGs during MNR period Controllable through BMPs, engineering control measures, emissions control strategies.	Same as Alternative B, although: Ecological impacts from construction activities for 4 months per year for 6 years.	Same as Alternative B, although: Ecological impacts from construction activities for 4 months per year for 7 years.	Same as Alternative B, although: Ecological impacts from construction activities for 4 months per year for 13 years.	Same as Alternative B, although: Ecological impacts from construction activities for 4 months per year for 19 years.	Same as Alternative E.
Time Until Action is Complete	Not applicable.	Estimated construction time 4 years. Estimated time to achieve RAOs is uncertain, but unlikely to occur in a reasonable timeframe.	Estimated construction time 6 years. Estimated time to achieve RAOs is uncertain, but may occur in a reasonable timeframe.	Estimated construction time 7 years. Estimated time to achieve RAOs is uncertain, but likely to occur in a reasonable timeframe.	Same as Alternative E, although: Estimated construction time 13 years.	Same as Alternative E, although: Estimated construction time 19 years.	Same as Alternative E.
IMPLEMENTABILITY							
Ability to Construct and Operate	No Construction or operation.	Technologies have been successfully implemented at other Superfund sites. Would require materials handling of 496,000 cy of clean fill and 628,000 cy contaminated sediment/soil. Coordination among government agencies, private entities and the community necessary to reduce impacts to waterway uses. Structures and debris may complicate, but not significantly delay, construction efforts.	Same as Alternative B, although: Would require materials handling of 727,000 cy of clean fill and 1,181,000 cy contaminated sediment/soil.	Same as Alternative B, although: Would require materials handling of 958,000 cy of clean fill and 2,024,000 cy contaminated sediment/soil.	Same as Alternative B, although: Would require materials handling of 1,565,000 cy of clean fill and 4,586,000 cy contaminated sediment/soil.	Same as Alternative B, although: Would require materials handling of 2,257,000 cy of clean fill and 7,397,000 cy contaminated sediment/soil.	Same as Alternative B, although: Would require materials handling of 900,000 cy of clean fill and contaminated 1,753,000 cy sediment/soil.
Ease of Doing More Action, if Needed	May require ROD amendment in the future.	Increasing the area of construction is relatively easy. Cap replacement or removal of contaminated material due to cap failure is relatively easy.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Ability to Monitor Effectiveness	No monitoring required. Ongoing exposure for receptors consuming contaminated fish and shellfish as well as exposures to other media.	Monitoring of RNAs for 28 acres of caps. Regular monitoring of cap performance on 39 acres of caps required under 5-year reviews. Relies on MNR for 1,966 acres. Requires significant administrative effort. Unlikely that RAOs would be achieved in a reasonable timeframe. Monitoring of consumption advisories and contaminant reductions in fish, water, and sediment necessary.	Same as Alternative B, although: Monitoring of RNAs for 56 acres of caps. Regular monitoring of cap performance on 71 acres of caps required under 5-year reviews. Relies on MNR for 1,900 acres.	Same as Alternative B, although: Monitoring of RNAs for 81 acres of caps. Regular monitoring of cap performance on 101 acres of caps required under 5-year reviews. Relies on MNR for 1,838 acres.	Same as Alternative B, although: Monitoring of RNAs for 151 acres of caps. Regular monitoring of cap performance on 176 acres of caps required under 5-year reviews. Relies on MNR for 1,634 acres.	Same as Alternative B, although: Monitoring of RNAs for 231 acres of caps. Regular monitoring of cap performance on 260 acres of caps required under 5-year reviews. Relies on MNR for 1,391 acres.	Same as Alternative B, although: Monitoring of RNAs for 81 acres of caps. Regular monitoring of cap performance on 102 acres of caps required under 5-year reviews. Relies on MNR for 1,876 acres.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approvals necessary.	Coordination required. Extending work period each year and CWA 404 mitigation requires consultation with ODFW, NMFS, and USF&W, but should be achievable. Coordination with DSL and/or other property owners need to place caps, implement land use restrictions, RNAs, locate staging areas and potential transloading facilities, and demolition and removal or relocation of structures. Waste left in 2,088 acres of the Site. Regulatory approval for offsite permitted disposal facilities and transport/transload should be readily obtainable.	Same as Alternative B, although: Waste left in 2,032 acres of the Site.	Same as Alternative B, although: Waste left in 1,964 acres of the Site.	Same as Alternative B, although: Waste left in 1,780 acres of the Site.	Same as Alternative B, although: Waste left in 1,596 acres of the Site.	Same as Alternative B, although: Waste left in 2,000 acres of the Site.

Criteria	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	Alternative G	Alternative I
Availability of Specialists, Equipment and Materials	None required.	Services, equipment, and materials are locally or regionally available. Offsite treatment and disposal facilities are available and have sufficient capacities for anticipate volume of contaminated sediment and riverbank soils generated for disposal. Experienced environmental dredge and excavator operators, and material placement specialists are assumed. 3 dredges are assumed. 434 barge loads and 42,439 truckloads or 10,576 rail loads are assumed to transport the removed material. If an on-site transload facility were constructed the same number truck loads or rail loads are assumed to transport the removal material. Additionally 309 barge loads, 36,213 truckloads, or 7,834 rail loads are assumed to transport material into the Site.	Same as Alternative B, although: 786 barge loads and 78,707 truckloads or 19,629 rail loads are assumed to transport the removed material Additionally 472 barge loads, 56,702 truckloads, or 12,037 rail loads are assumed to transport material into the Site.	Same as Alternative B, although: DMM 1 416 barge loads are assumed to transport removed material to on-site CDF, 901 barge loads and 90,147 truckloads or 22,489 rail loads are assumed to transport the removed material to off-site disposal facility. Additionally 1,052 barge loads, 97,571 truckloads, or 21,941 rail cars are assumed to transport material into the Site. See Table 4.3-2 for additional specialists, equipment and materials for CDF. DMM 2 1,337 barge loads and 133,764 truckloads or 33,394 rail loads are assumed to transport the removed material. Additionally 661 barge loads, 81,676 truckloads, or 17,022 rail loads are assumed to transport material into the Site.	Same as Alternative B, although: DMM 1 416 barge loads are assumed to transport removed material to on-site CDF, 2,570 barge loads and 257,089 truckloads or 64,225 rail loads are assumed to transport the removed material to off-site disposal facility. Additionally 1,581 barge loads, 168,315 truckloads, or 35,772 rail cars are assumed to transport material into the Site. See Table 4.3-2 for additional specialists, equipment and materials for CDF. DMM 2 3,006 barge loads and 300,706 truckloads or 75,129 rail loads are assumed to transport the removed material. Additionally 1,190 barge loads, 152,420 truckloads, or 30,853 rail loads are assumed to transport material into the Site.	Same as Alternative B, although: DMM 1 416 barge loads are assumed to transport removed material to on-site CDF, 4,401 barge loads and 440,223 truckloads or 110,008 rail loads are assumed to transport the removed material to off-site disposal facility. Additionally 2,171 barge loads, 247,217 truckloads, or 51,265 rail cars are assumed to transport material into the Site. See Table 4.3-2 for additional specialists, equipment and materials for CDF. DMM 2 4,838 barge loads and 483,840 truckloads or 120,913 rail loads are assumed to transport the removed material. Additionally 1,780 barge loads, 231,322 truckloads, or 46,346 rail loads are assumed to transport material into the Site.	Same as Alternative B, although: DMM 1 416 barge loads are assumed to transport removed material to on-site CDF, 724 barge loads and 72,501 truckloads or 18,078 rail loads are assumed to transport the removed material to off-site disposal facility. Additionally 1,002 barge loads, 90,527 truckloads, or 20,578 rail cars are assumed to transport material into the Site. See Table 4.3-2 for additional specialists, equipment and materials for CDF. DMM 2 1,160 barge loads and 116,118 truckloads or 28,982 rail loads are assumed to transport the removed material. Additionally 611 barge loads, 74,632 truckloads, or 15,659 rail loads are assumed to transport material into the Site.
Availability of Technologies	None required.	All technologies readily available.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
COST							
DMM 1							
Capital Cost	$0	NA	NA	$748,071,000	$1,550,014,000	$2,421,152,000	$671,966,000
Periodic Cost	$0	NA	NA	$412,332,000	$549,512,000	$708,114,000	$421,940,000
Present Worth Cost	$0	NA	NA	$804,120,000	$1,316,560,000	$1,731,110,000	$745,890,000
DMM 2							
Capital Cost	$0	$352,097,000	$556,004,000	$748,071,000	$1,550,014,000	$2,421,152,000	$671,966,000
Periodic Cost	$0	$290,324,000	$397,028,000	$412,332,000	$549,512,000	$708,114,000	$421,940,000
Present Worth Cost	$0	$451,460,000	$653,700,000	$869,530,000	$1,371,170,000	$1,777,320,000	$811,290,000

Criteria	Disposal Options		
Disposal option	**On-site CDF**	**Offsite Subtitle D with Existing off-site transload facility**	**Offsite Subtitle D with New on-site transload facility**
Summary of disposal option	On-site CDF would be constructed at Port of Portland Terminal 4 and 670,000 cy dredged/excavated material would be barged for disposal at facility.	Removed material considered for disposal in onsite CDF would be transported to off-site transloading facility via barge and then transported to disposal facility via truck (rail is not currently available).	Removed material considered for disposal in onsite CDF would be transported to on-site transloading facility via barge and then transported to disposal facility via truck (rail is not currently available).
OVERALL PROTECTIVENESS			
Human Health	Protective.	Protective.	Protective.
Environment	Protective.	Protective.	Protective.
COMPLIANCE WITH ARARs			
Chemical-specific ARARs	May not comply since design used superseded water quality criteria.	Not applicable.	Not applicable.
Location-specific ARARs	Complies.	Complies.	Complies.
Action-specific ARARs	Complies. Mitigation assumed to be needed for additional 5 acres.	Complies.	Complies.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risks	No residual risk if properly constructed.	No residual risk.	No residual risk.
Adequacy and Reliability of Controls	Proven technology. Requires additional monitoring and maintenance in perpetuity.	Proven technology. Monitoring and maintenance performed by the permitted disposal facilities.	Proven technology. Monitoring and maintenance performed by the permitted disposal facilities.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT			
Treatment Process Used	Not Applicable.	Not Applicable.	Not Applicable.
Amount Destroyed or Treated	Not Applicable.	Not Applicable.	Not Applicable.

Criteria	**Disposal Options**		
Disposal option	**On-site CDF**	**Offsite Subtitle D with Existing off-site transload facility**	**Offsite Subtitle D with New on-site transload facility**
Reduction in Toxicity, Mobility, or Volume	Not Applicable.	Not Applicable.	Not Applicable.
Irreversible Treatment	Not Applicable.	Not Applicable.	Not Applicable.
Type and Quantity of Residuals Remaining after Treatment	Not Applicable.	Not Applicable.	Not Applicable.
SHORT-TERM EFFECTIVENESS			
Community Protection	Increases impacts to community for 2-3 years to construct berm and cap. Temporary noise, light, odors, air quality impacts. Disruptions to commercial and recreational river use, potential for waterborne accidents during CDF construction and during alternative construction. Controllable, addressed through implementation of H&S plans and use of BMPs.	Increased offsite barge traffic. Disruptions to commercial and recreational river use, potential for waterborne accidents during alternative construction. Controllable, addressed through implementation of H&S plans and use of BMPs.	Increases impacts to community for 2-3 years to construct transload facility. Temporary noise, light, odors, air quality impacts. Increased vehicular traffic, increased accident risk and air-quality issues. Disruptions to commercial and recreational river use, potential for waterborne accidents during alternative construction. Controllable, addressed through implementation of H&S plans and use of BMPs.

Criteria	Disposal Options		
Disposal option	**On-site CDF**	**Offsite Subtitle D with Existing off-site transload facility**	**Offsite Subtitle D with New on-site transload facility**
Worker Protection	Increases impacts to workers for 2-3 years to construct berm and cap. Physical hazards and chemical exposure during construction and disposal. Increased accident risks from heavy equipment, transport of materials, and increased vessel traffic. Controllable, addressed through BMPs and H&S Plans.	Physical hazards and chemical exposure during transloading. Increased accident risks from transport of materials, and increased vessel traffic. Controllable, addressed through BMPs and H&S Plans	Increases impacts to workers for 2-3 years to construct transload facility. Physical hazards and chemical exposure during construction and transloading. Increased accident risks from heavy equipment, transport of materials, and increased vessel traffic. Controllable, addressed through BMPs and H&S Plans
Environmental Impacts	No need to dewater sediment and treat the water. Potential for spills onsite during transport and filling. Loss of 13 acres habitat. Controllable through BMPs, engineering control measures, emissions control strategies.	Need to dewater sediment and treat the water. Potential for spills onsite and offsite during transport. No impacts to aquatic environment. Controllable through BMPs, engineering control measures, emissions control strategies.	Need to dewater sediment and treat the water. Potential for spills onsite during transport and filling. No impacts to aquatic environment. Controllable through BMPs, engineering control measures, emissions control strategies.
Time Until Action is Complete	Increases time until action complete by 2-3 years.	Not applicable.	Increases time until action complete by 2-3 years.

Criteria	Disposal Options		
Disposal option	**On-site CDF**	**Offsite Subtitle D with Existing off-site transload facility**	**Offsite Subtitle D with New on-site transload facility**
IMPLEMENTABILITY			
Ability to Construct and Operate	Technologies have been successfully implemented at other Superfund sites. Would require materials handling of 687,000 cy of construction material and 670,000 cy sediment/soil. Coordination among government agencies, private entities and the community necessary to reduce impacts to waterway uses. Structures may complicate, but not significantly delay, CDF construction efforts.	Technologies existing and have been successfully implemented at other Superfund sites. Would require materials handling of 670,000 cy sediment/soil. Coordination among government agencies, private entities and the community necessary to reduce impacts to waterway uses.	Technologies have been successfully implemented at other Superfund sites. Would require materials handling of construction material and 670,000 cy sediment/soil. Coordination among government agencies, private entities and the community necessary to reduce impacts to waterway and upland uses. Structures may complicate, but not significantly delay, construction efforts.
Ease of Doing More Action, if Needed	Increasing the capacity of the CDF and/or footprint would require a new design and analysis. Additional materials and construction time may be necessary. Increasing the transport of additional material to the CDF is relatively easy.	Increasing the volume transported offsite is relatively easy.	Increasing the volume transported offsite is relatively easy.
Ability to Monitor Effectiveness	Regular monitoring of CDF performance required under 5-year reviews.	No monitoring required.	No monitoring required.
Ability to Obtain Approvals and Coordinate with Other Agencies	Approvals required, but should be obtainable for constructing CDF.	Regulatory approval for offsite permitted disposal facilities should be readily obtainable.	Approvals required, but should be obtainable for constructing onsite transload facility. Regulatory approval for offsite permitted disposal facilities should be readily obtainable.

Criteria	**Disposal Options**		
Disposal option	**On-site CDF**	**Offsite Subtitle D with Existing off-site transload facility**	**Offsite Subtitle D with New on-site transload facility**
Availability of Specialists, Equipment and Materials	Services, equipment, and materials are locally or regionally available. Experienced construction specialists would be required. Additional materials would be required, but should be obtainable. 451 barge loads are assumed to transport CDF construction material into the Site. 416 barge loads are assumed to transport the removed material.	Services and equipment are locally or regionally available. 416 barge loads and 41,600 truckloads are assumed to transport the removed material.	Services, equipment, and materials are locally or regionally available. Experienced construction specialists would be required. 41,600 truckloads or 10,570 rail loads are assumed to transport the removal material.
Availability of Technologies	All technologies readily available.	All technologies readily available.	All technologies readily available.
COST			
Capital Cost[1]	$63,390,000	$111,555,000	$119,523,000
Periodic Cost	Not evaluated.	$0	$0
Present Worth Cost	NA	NA	NA

Notes:

1 This CDF cost includes mitigation cost for 14.3 acres. Assumes that the Port of Portland does not make a profit from disposal and charges $94.61 per cy for disposal. Off-site disposal costs estimated at $166.50 per cy ($111 per ton).

Table 4.3-3
Summary of Comparative Analysis for Remedial Alternatives
Portland Harbor Superfund Site
Portland, Oregon

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Description**	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Present Value Cost (Dollars)**
Contaminated Sediment Alternatives								
A	No Action/No Further Action	–	–	NA	NA	NA	NA	NA
B	Dredge/Cap 95.0 acres; ENR 99.8 acres MNR 1,966 acres; In-situ 6.7 acres Ex-situ 192,000 cy; Disposal 628,000 cy	–	–	○	○	◑	●	$
D	Dredge/Cap 176.9 acres; ENR 87.0 acres MNR 1,900 acres; In-situ 3.2 acres Ex-situ 192,000 cy; Disposal 1,181,000 cy	–	+	◔	◔	◕	◕	$
E	Dredge/Cap 269.3 acres; ENR 59.8 acres MNR 1,838 acres; Ex-situ 192,000 cy; Disposal 2,024,000 cy	+	+	◑	◑	◕	◑	$$
F	Dredge/Cap 505.3 acres; ENR 28.2 acres MNR 1,634 acres; Ex-situ 192,000 cy; Disposal 4,586,000 cy	+	+	◕	◕	◔	◔	$$$
G	Dredge/Cap 756.4 acres; ENR 19.5 acres MNR 1,391 acres; Ex-situ 192,000 cy; Disposal 7,397,000 cy	+	+	●	●	○	○	$$$$
I	Dredge/Cap 231.2 acres; ENR 59.8 acres MNR 1,876 acres; Ex-situ 192,000 cy; Disposal 1,753,000 cy	+	+	◑	◑	◕	◑	$$

Legend for Qualitative Ratings System:

Threshold Criteria	**Balancing Criteria (Relative Performance of Criterion)**	**Balancing Criteria - Cost (Present Value Cost in Dollars)**
– Unacceptable		
+ Acceptable	○ Least	$ $500M through $750M
	◔ Low	$$ $750M through $1,000M
	◑ Moderate	$$$ $1,00M through $1,500M
	◕ Better	$$$$ Greater than $1,500M
	● Best	