

TABLE 1
 Summary of Predicted Hazardous Air Pollutant (HAP) and Particulate Matter Less Than Ten Microns (PM₁₀) Emissions
Screening-Level Ecological Risk Assessment
 COB Energy Facility, Klamath County, Oregon

HAP	Facilitywide Emissions (tons/yr) *					Total All Sources
	CTGs and Duct Burners	Gas Heaters and Auxiliary Boilers	Fire Water Pump	Wellhead Emergency Generator		
Benzene	1.7E-01	5.6E-04	5.0E-05	2.0E-05		0.17
Formaldehyde	3.0E+00	2.0E-02	6.3E-05	2.0E-06		2.98
Hexane	6.9E+00	4.8E-01				7.33
Naphthalene	2.0E-02	1.6E-04				0.02
Toluene	1.7E+00	9.1E-04	2.2E-05	7.2E-06		1.73
Acetaldehyde	5.3E-01		4.1E-05	6.5E-07		0.53
Acrolein	8.5E-02			2.0E-7		0.08
Ethylbenzene	4.2E-01					0.42
PAH	2.9E-02	1.4E-05	9.0E-06	5.4E-06		0.03
Xylenes (total)	8.5E-01		1.5E-05	5.0E-06		0.85
Dichlorobenzene	4.6E-03	3.2E-04				0.005
Arsenic	1.7E-03	5.3E-05				0.002
Cadmium	9.3E-03	2.9E-04				0.010
Chromium	1.2E-02	3.7E-04				0.012
Cobalt	7.1E-04	2.2E-05				0.001
Manganese	3.2E-03	1.0E-04				0.003
Mercury	2.2E-03	6.9E-05				0.002
Nickel	1.8E-02	5.6E-04				0.018
PM ₁₀	2.5E+02	2.0E+00	1.7E-02	2.6E-03		247

* See Section 3.7.1.4 and Table 3.7.5 in the *COB Energy Facility Environmental Impact Statement* (BPA, 2003) for a summary of hazardous air pollutant (HAP) emissions.

CTG = combustion turbine generator

TABLE 2

Summary Statistics of Estimated Hazardous Air Pollutants (HAPs) and Particulate Matter Less Than Ten Microns (PM₁₀) Concentrations in Soil and Two Surface Water Sources (Generic Reservoir and Generic River) Over 30 Years
 Screening-Level Ecological Risk Assessment
 COB Energy Facility, Klamath County, Oregon

Analyte	Max	99% percentile	95% percentile	90% percentile	Mean	50% percentile (median)	Min
Soil (mg/kg) ^a							
Arsenic	0.012	8.4E-03	3.2E-03	1.8E-03	9.1E-04	4.9E-04	1.5E-05
Cadmium	0.061	0.042	0.016	9.1E-03	4.5E-03	2.4E-03	7.4E-05
Chromium	0.074	0.051	0.019	0.011	5.4E-03	2.9E-03	8.9E-05
Cobalt	6.1E-03	4.2E-03	1.6E-03	9.1E-04	4.5E-04	2.4E-04	7.4E-06
Manganese	0.018	0.013	4.8E-03	2.7E-03	1.4E-03	7.3E-04	2.2E-05
Mercury	0.012	8.4E-03	3.2E-03	1.8E-03	9.1E-04	4.9E-04	1.5E-05
Nickel	0.11	0.076	0.029	0.016	8.2E-03	4.4E-03	1.3E-04
PM ₁₀	1500	1000	390	220	110	60	1.8
Surface Water - Generic Reservoir (mg/L) ^b							
Arsenic	3.0E-05	2.1E-05	7.8E-06	4.5E-06	2.2E-06	1.2E-06	3.7E-08
Cadmium	1.5E-04	1.0E-04	3.9E-05	2.2E-05	1.1E-05	6.0E-06	1.8E-07
Chromium	1.8E-04	1.2E-04	4.7E-05	2.7E-05	1.3E-05	7.2E-06	2.2E-07
Cobalt	1.5E-05	1.0E-05	3.9E-06	2.2E-06	1.1E-06	6.0E-07	1.8E-08
Manganese	4.5E-05	3.1E-05	1.2E-05	6.7E-06	3.3E-06	1.8E-06	5.5E-08
Mercury	3.0E-05	2.1E-05	7.8E-06	4.5E-06	2.2E-06	1.2E-06	3.7E-08
Nickel	2.7E-04	1.9E-04	7.0E-05	4.0E-05	2.0E-05	1.1E-05	3.3E-07
PM ₁₀	3.72	2.55	0.96	0.55	0.27	0.15	0.00
Surface Water - Generic River (mg/L) ^c							
Arsenic	3.0E-04	2.1E-04	7.8E-05	4.5E-05	2.2E-06	1.2E-05	3.7E-07
Cadmium	1.5E-03	1.0E-03	3.9E-04	2.2E-04	1.1E-05	6.0E-05	1.8E-06
Chromium	1.8E-03	1.2E-03	4.7E-04	2.7E-04	1.3E-05	7.2E-05	2.2E-06
Cobalt	1.5E-04	1.0E-04	3.9E-05	2.2E-05	1.1E-06	6.0E-06	1.8E-07
Manganese	4.5E-04	3.1E-04	1.2E-04	6.7E-05	3.3E-06	1.8E-05	5.5E-07
Mercury	3.0E-04	2.1E-04	7.8E-05	4.5E-05	2.2E-06	1.2E-05	3.7E-07
Nickel	2.7E-03	1.9E-03	7.0E-04	4.0E-04	2.0E-05	1.1E-04	3.3E-06
PM ₁₀	37.2	25.5	9.6	5.5	2.7	1.5	0.045

Notes:

^a HAP and PM₁₀ concentrations are calculated based on the entire air modeling domain with no abiotic or biotic loss of metals from wet and dry deposition. A 1-cm mixing depth and a soil density of 1.5 g/cm³ were assumed (USEPA, 1998b).

^b HAP and PM₁₀ concentrations are calculated over a generic reservoir receiving the maximum wet and dry deposition of the entire modeling domain with no abiotic or biotic loss of metals from total and wet deposition. A 20-foot mixing depth and a water density of 1.0 g/cm³ were assumed.

^c HAP and PM₁₀ concentrations are calculated over a generic river receiving the maximum wet and dry deposition of the entire modeling domain with no abiotic or biotic loss of metals from total and wet deposition. A 2-foot mixing depth and a water density of 1.0 g/cm³ were assumed.

TABLE 3

Calculation of Maximum Soil Concentration from Wastewater Application to 31 Acres During the 30-Year Life of the Energy Facility

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Parameter/Analyte	(From Aquifer) Raw Water		Laboratory		RO Reject (75% Recovery)		RO Reject Estimated from			Wastewater Values for		Maximum Estimated Soil Concentration ^c (mg/kg)	
	Max Value	Units	MRL ^a	Units	Max Value	Units	Raw/Reject	Nondetects	Units	ERA ^b	Units		
Flow Rate	208	gpm	--	--	49	gpm				49			
Inorganics													
Aluminum			100	ug/L				0.1954	mg/L	0.1954	mg/L	9.65	
Ammonia as N			0.1	mg/L	<	0.00	mg/L		0.1954	mg/L	0.1954	mg/L	9.65
Antimony			2	ug/L				0.00391	mg/L	0.00391	mg/L	0.193	
Arsenic			2	ug/L				0.00391	mg/L	0.00391	mg/L	0.193	
Barium			25	ug/L				0.04885	mg/L	0.04885	mg/L	2.413	
Beryllium			4	ug/L				0.00782	mg/L	0.00782	mg/L	0.386	
Boron	<	0.275	mg/L	275	ug/L	<	0.54	mg/L	1.964		0.540	mg/L	26.68
Cadmium			0.5	ug/L				0.00098	mg/L	0.00098	mg/L	0.048	
Calcium	14.8	mg/L	500	ug/L	<	28.92	mg/L	1.954		28.920	mg/L	1429	
Chloride	2.12	mg/L	0.1	mg/L	<	4.14	mg/L	1.953		4.140	mg/L	204.5	
Chromium III			1	ug/L				0.00195	mg/L	0.00195	mg/L	0.097	
Chromium VI			2	ug/L				0.00391	mg/L	0.00391	mg/L	0.193	
Cobalt			10	ug/L				0.01954	mg/L	0.01954	mg/L	0.965	
Copper			10	ug/L	<	0.00	mg/L		0.01954	mg/L	0.01954	mg/L	0.965
Fluoride	<	0.1	mg/L	0.1	mg/L	<	0.20	mg/L	2.000		0.200	mg/L	9.88
Iron	0.0736	mg/L	100	ug/L	<	0.14	mg/L	1.902		0.140	mg/L	6.92	
Lead			3	ug/L				0.00586	mg/L	0.00586	mg/L	0.290	
Magnesium	6.01	mg/L	500	ug/L	<	11.74	mg/L	1.953		11.740	mg/L	580	
Manganese	<	0.01	mg/L	10	ug/L	<	0.02	mg/L	2.000		0.020	mg/L	0.988
Mercury			0.1	ug/L				0.00020	mg/L	0.00020	mg/L	0.010	
Molybdenum			25	ug/L				0.04885	mg/L	0.04885	mg/L	2.413	
Nickel			20	ug/L				0.03908	mg/L	0.03908	mg/L	1.931	
Nitrate as N	0.43	mg/L	0.01	mg/L	<	0.84	mg/L	1.953		0.840	mg/L	41.5	
Nitrite as N	<	0.01	mg/L	0.01	mg/L	<	0.02	mg/L	2.000		0.020	mg/L	0.988
Phosphorous			0.05	mg/L	<	0.05	mg/L			0.050	mg/L	2.470	
Potassium	2.16	mg/L	100	ug/L	<	4.22	mg/L	1.954		4.220	mg/L	208.5	
Selenium			2	ug/L				0.00391	mg/L	0.00391	mg/L	0.193	
Silver			0.5	ug/L				0.00098	mg/L	0.00098	mg/L	0.048	
Sodium	10.3	mg/L	1000	ug/L	<	20.12	mg/L	1.953		20.120	mg/L	994	
Strontium			100	ug/L				0.1954	mg/L	0.1954	mg/L	9.65	
Sulfate	3.22	mg/L	0.1	mg/L		6.29	mg/L	1.953		6.290	mg/L	310.7	
Sulfide			1	mg S ² /L				1.954	mg/L	1.954	mg/L	96.5	
Sulfite			2	mg/L	<	1.00	mg/L		3.908	mg/L	1.00	mg/L	49.4
Thallium			2	ug/L				0.00391	mg/L	0.00391	mg/L	0.193	
Tin			25	ug/L				0.04885	mg/L	0.04885	mg/L	2.413	
Titanium			100	ug/L				0.1954	mg/L	0.1954	mg/L	9.65	
Zinc			20	ug/L				0.03908	mg/L	0.03908	mg/L	1.931	
Organics													
Cyanide, total			0.01	mg/L				0.01954	mg/L	0.01954	mg/L	0.965	
Oil & Grease			5	mg/L	<	0.30	mg/L		9.77	mg/L	0.300	mg/L	14.82
Orthophosphate as P			0.01	mg/L	<	0.05	mg/L		0.01954	mg/L	0.05	mg/L	2.470
Phenol			0.005	mg/L				0.00977	mg/L	0.00977	mg/L	0.483	
TDS	104	mg/L	5	mg/L	0	203	mg/L	1.952		203	mg/L	10028	
TSS			2	mg/L	<	1.00	mg/L		3.908	mg/L	1	mg/L	49.4
Water Properties													
pH	8.4	std Units	--	--		7.5-9	std Units		--		7.5-9	std Units	--
Silica	36.4	mg/L	0.4	mg/L	<	71.120	mg/L	1.954			71.12	mg/L	9222

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Calculation of Maximum Soil Concentration from Wastewater Application to 31 Acres During the 30-Year Life of the Energy Facility

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Parameter/Analyte	(From Aquifer) Raw Water		Laboratory		RO Reject (75% Recovery)		RO Reject Estimated from			Wastewater Values for		Maximum Estimated Soil Concentration ^c (mg/kg)
	Max Value	Units	MRL ^a	Units	Max Value	Units	Ratio Raw/Reject	Nondetects	Units	ERA ^b	Units	
Total Alkalinity	84	mg/L as CaCO ₃	5	mg/L as CaCO ₃	164.120	mg/L as CaCO ₃	1.954			164.12	mg/L as CaCO ₃	21280
Total Organic Content (TOC)			0.5	mg/L	< 1.50	mg/L		0.977	mg/L	1.500	mg/L	194.5

Notes:

^a Laboratory MRL = the method reporting limit provided by the analytical laboratory.

^b Wastewater values used for the Ecological Risk Assessment (ERA) assume that nondetected constituents are present at some concentration below the detection limit. For these constituents, the method reporting limit was multiplied by 1.954 (raw/reject ratio for all other detected metals) to obtain the wastewater value for the ERA.

^c The maximum soil concentration (MSC) (mg constituent/kg soil) was calculated using the following equation: $MSC = (PWC * AWP * L) / (AA * MD * BD)$, where PWC = predicted wastewater values (mg/L); AWP = annual wastewater production (24.3 million gallons or 91,985,506 L); L = life span of the energy plant (30 years); AA = application area (46 acres or 186,200 m²); MD = mixing depth for tilled agricultural land (20 cm or 0.2 m); and BD = literature-based bulk density of soil (1500 kg/m³). This calculation assumes that all constituents accumulate during the 30 years and that nothing is lost to biodegradation, erosion, leaching, or other biotic or abiotic loss mechanisms.

TABLE 4

Assessment Endpoints and Measures of Exposure and Effects

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Assessment Endpoints					
Entity	Attribute	Effect Level	Receptor	Measures of Exposure	Measures of Effects
Aquatic Organisms *	Growth, reproduction or survival	Reduction of attribute	NA	Estimated concentrations of COPECs in water.	Comparison of maximum estimated water concentrations to benchmark values for toxic effects that could affect growth, reproduction, or survival
Plants	Growth, reproduction or survival	20% reduction of attribute	NA	Estimated concentrations of COPECs in soil.	Comparison of maximum estimated soil concentrations to benchmark values for toxic effects that could affect growth, reproduction, or survival.
Soil Invertebrates	Growth, reproduction or survival	20% reduction of attribute	NA	Estimated concentrations of COPECs in soil.	Comparison of maximum estimated soil concentrations to benchmark values for toxic effects that could affect growth, reproduction, or survival.
Birds	Growth, reproduction or survival	20% reduction of attribute	Western Meadowlark	Estimated concentrations of COPECs in soil.	Comparison of exposure estimates (based on maximum estimated soil concentrations) to literature-derived benchmark values.
	Individual health and survival	No acceptable effect	Bald Eagle	Estimated concentrations of COPECs in water.	Comparison of exposure estimates (based on maximum estimated water concentrations) to literature-derived benchmark values.
Mammals	Growth, reproduction or survival	20% reduction of attribute	Deer Mouse	Estimated concentrations of COPECs in soil.	Comparison of exposure estimates (based on maximum estimated soil concentrations) to literature-derived benchmark values.

Note:

* Includes fish such as the shortnose sucker and the Lost River sucker.

COPEC = chemicals of potential ecological concern

NA = not available

TABLE 5

Exposure Parameters for Wildlife Receptors
 Screening-Level Ecological Risk Assessment
 COB Energy Facility, Klamath County, Oregon

Species	Exposure Factors									Feeding Habits and Foraging Range													
	Body Weight			Ingestion rate - dry wt.			Ingestion rate - water			Biotic Dietary Items (% Diet)					Abiotic Media Ingestion (% diet)			Foraging Range					
	Mean (kg)	Notes	Reference	(kg/kg BW/d)	Notes	Reference	(L/kg BW/d)	Notes	Reference	Plants	Terrestrial Invertebrates	Mammals and Birds	Fish	Notes	Major food items	Reference	Soil	Notes	Reference	Hectares	other (miles, km)	Reference	Notes
Birds																							
Western Meadowlark <i>Sturnella neglecta</i>	Mean: 0.110	Data for Colorado	Wiens and Innis 1974	0.04	Daily food consumption for western meadowlarks estimated at 3 times the stomach capacity (3.9 g). Ingestion rate based on body weight of 0.110 kg.	Sample et al. 1997	0.12	Based on a minimum water consumption for weight maintenance of 66% of the ad libitum rate and a body weight of 0.1115 kg.	Sample et al. 1997	36.7	63.3			Data for North America.	Western meadowlarks are ground foragers that consume both plant material (primarily seeds) and invertebrates.	Lanyon 1994	2.08	Data not available for western meadowlarks. Assumed to be similar to value derived for the American robin.	Sample et al. 1997	5.04		Lanyon 1994, Kendeigh 1941, and Schaefer and Picman 1988	Median from 3 studies.
Bald Eagle <i>Haliaeetus leucocephalus</i>	Male: 4.014 Female: 5.089 Both: 4.552 Range: 3.524 - 5.756	Data for Alaska	Imler and Kalmbach 1955	0.0163	Average ingestion rate based on diet of chum salmon at temperatures of -10, 5, and 20° C (14, 41, and 68° F).	Stalmaster and Gessaman 1984	0.036	Estimated using allometric equation for birds and a body weight of 4.552 kg.	Calder and Braun 1983			24	66		Opportunistic feeder, primarily fish, waterfowl, and other animals. For this assessment assumed diet of 100 percent fish .	Ofelt 1975	0	Data not available for bald eagle. Assumed to be negligible due to foraging behavior.			radius = 0.64 km	Mahaffy and Frenzel 1987	
Mammals																							
Deer Mouse <i>Peromyscus maniculatus</i>	Male: 0.026 Female: 0.023	Means for values reported for California	Silva and Downing 1995	0.45	Maximum value reported. Represents lactating female.	EPA 1993	0.14	Estimated using allometric equation for mammals and a body weight of 0.026 kg.	Calder and Braun 1983	50	50			Approximate diet of mice in Colorado over all seasons.	Seeds and terrestrial invertebrates, mainly insects.	EPA 1993	2	assumed comparable to white-footed mouse	adapted from Beyer et al. 1994	0.1 - 0.2		Brylski 1990	

Note:

Bold values were used for the exposure calculations.

TABLE 6

Bioaccumulation Values and Models for Plants, Soil Invertebrates, and Aquatic Organisms for Calculation of Wildlife Exposure

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Analytes	N	BAF	Regression Model		Form	Transfer Type	Comments	Reference
			Slope (B1)	Intercept (B0)				
Plants								
Antimony	17	0.1487				soil-plant	90 th percentile value	CH2M HILL, 2002
Arsenic		--	0.564	-1.992	Len(plant) = B0+B1(Len[soil])	soil-plant	represents bioaccumulation into aboveground plant	Bechtel-Jacobs, 1998
Beryllium		--						
Cadmium		--	0.546	-0.476	Len(plant) = B0+B1(Len[soil])	soil-plant	represents bioaccumulation into aboveground plant	Bechtel-Jacobs, 1998
Chromium	28	0.041				soil-plant	median of 28 values	Bechtel-Jacobs, 1998
Cobalt	28	0.0075					median of 28 values	Bechtel-Jacobs, 1998
Cyanide		1					assumed value	
Iron	27	1				soil-seed	90 th percentile value; seeds surrogate for plants	CH2M HILL, 2002
Magnesium	8	7.333					mean value (90 th Percentile highly skewed)	CH2M HILL, 2002
Manganese	28	0.0792					median of 28 values	Bechtel-Jacobs, 1998
Mercury		--	0.544	-0.996	Len(plant) = B0+B1(Len[soil])	soil-plant	represents bioaccumulation into aboveground plant	Bechtel-Jacobs, 1998
Nickel		--	0.748	-2.224	Len(plant) = B0+B1(Len[soil])	soil-plant	represents bioaccumulation into aboveground plant	Bechtel-Jacobs, 1998
Phenol		5.5963			BAF=10 ^{1.31-0.385(log10Kow)}	soil-plant	calculated with log Cow of 1.46 using model from USEPA 2000	
Silver		1					assumed value	
Thallium		1					assumed value	
Tin		1					assumed value	
Arthropods								
Antimony	6	0.025				soil-insect	90 th percentile value	CH2M HILL, 2002
Arsenic	44	0.1258				soil-insect	90 th percentile value	CH2M HILL, 2002
Beryllium	24	0.0286				soil-insect	90 th percentile value	CH2M HILL, 2002
Cadmium	210	4.078				soil-insect	90 th percentile value	CH2M HILL, 2002
Chromium	28	0.546				soil-insect	90 th percentile value	CH2M HILL, 2002
Cobalt	24	0.023				soil-insect	90 th percentile value	CH2M HILL, 2002
Cyanide		1					assumed value	
Magnesium	26	1.5047				soil-insect	90 th percentile value	CH2M HILL, 2002
Manganese	26	0.2267				soil-insect	90 th percentile value	CH2M HILL, 2002
Mercury	24	2				soil-insect	90 th percentile value	CH2M HILL, 2002
Nickel	28	0.5118				soil-insect	90 th percentile value	CH2M HILL, 2002
Phenol		26.58			BAF=10 ^{A(logKow-0.6)/(foc*10^{0.983*logKow+0.00028})}	soil-earthworm	calculated with log Cow of 1.46 using model from Sample et al. 1997; foci assumed to be 0.01	
Silver	22	0.12				soil-insect	90 th percentile value	CH2M HILL, 2002
Thallium	18	0.256				soil-insect	90 th percentile value	CH2M HILL, 2002
Tin		1					assumed value	
Aquatic Organisms								
Arsenic	17	--	--	--	--	water-fish	BCF, trophic level 3 and 4 BAF	Sample et al, 1997
Cadmium	12400	--	--	--	--	water-fish	BCF, trophic level 3 and 4 BAF	Sample et al, 1997
Chromium	3	--	--	--	--	water-fish	Based on Chromium 6+	Sample et al, 1997
Cobalt	--	--	--	--	--			
Manganese	--	--	--	--	--			
Mercury	27900	--	--	--	--	water-fish	Trophic level 3 BAF	Sample et al, 1997
Nickel	106	--	--	--	--	water-fish	BCF, trophic level 3 and 4 BAF	Sample et al, 1997

Note:

All biological accumulation factors (BAFs) were assumed to be in dry weight.

TABLE 7

Screening-Level Benchmark Values for Soil and Water

*Screening-Level Ecological Risk Assessment**COB Energy Facility, Klamath County, Oregon*

Analyte	Oregon ODEQ Soil Screening Level Values (mg/kg) ^a				Oregon ODEQ Aquatic Screening Level Values (mg/L) ^b	
	Plants	Invertebrates	Birds	Mammals	Aquatic Biota	Birds
Inorganics						
Aluminum	50	600	450	107		
Antimony	5	--	--	15		
Arsenic	10	60	10	29	0.15	18
Barium	500	3000	85	638		
Beryllium	10	--	--	83		
Boron	0.5	20	120	3500		
Cadmium	4	20	6	125	0.0022	10
Chromium III	1	0.4	4	340000	0.011	7.2
Chromium VI	--	--	--	410		
Cobalt	20	1000		150	0.023	--
Copper	100	50	190	390		
Fluoride	200	30	32	2285		
Iron	10	200		--		
Lead	50	500	16	4000		
Manganese	500	100	4125	11000	0.12	7242
Mercury	0.3	0.1	1.5	73	0.00077	3.3
Molybdenum	2	200	15	14		
Nickel	30	200	320	625	0.052	562
Selenium	1	70	2	25		
Silver	2	50	--	--		
Strontium	--	--	--	32875		
Thallium	1	--	--	1		
Tin	50	2000	--	--		
Titanium	--	1000	--	--		
Zinc	50	200	60	20000		
Organics						
Phenol	70	30	--	--		

Notes:

^a Screening values from the Oregon Department of Environmental Quality (ODEQ) *Guidance for Ecological Risk Assessment: Level II Screening Level Values* (ODEQ, 2001).

^b Screening values from the ODEQ *Guidance for Ecological Risk Assessment: Level II Screening Level Values* (ODEQ, 2001). Only values required for screening of air emissions deposition in surface water presented. Wastewater application will not impact surface water.

-- not available

TABLE 8

Summary of Wildlife Toxicity Data for Analytes Lacking Oregon Department of Environmental Quality (ODEQ) Screening-Level Values or Requiring Further Evaluation

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Analyte	Analyte/surrogate	Study	Test species	Body Weight (kg)	Endpoint	Endpoint 2	Duration	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Notes
Birds										
Arsenic	Sodium arsenate	Stanley et al. 1994	mallard duck	1	reproduction	ducklings/successful nest	4 wks prior to pairing through 14 d post hatch (chronic)	9.3	40.3	CH2M HILL 2000 (ALT BTAG)
Arsenic	Sodium arsenate	Stanley et al., 1994	mallard duck	1	reproduction	ducklings/successful nest	4 wks prior to pairing through 14 d post hatch (chronic)	5.5	22.01	EFA West 1998 (BTAG)
Arsenic	Sodium arsenite	USFWS 1964	mallard duck	1	mortality	mortality	128 d (chronic)	5.14	12.84	
Cadmium	Cadmium Chloride	Cain et al., 1983	mallard duck	0.8	hematology	hematological effects	12 wks (chronic)	0.08	NA	EFA West 1998 (BTAG)
Cadmium	Cadmium Chloride	Richardson et al., 1974	Japanese quail	0.084	growth	body weight	6 wks (chronic)	NA	10.43	EFA West 1998 (BTAG)
Cadmium	Cadmium Chloride	White and Finley 1978	mallard duck	1.153	reproduction	eggs/hen	90 d (critical life-stage = chronic)	1.45	20.03	CH2M HILL 2000 (ALT BTAG)
Chromium	CrK(SO ₄) ²	Haseltine et al., 1985	black duck	1.25	reproduction	duckling survival	10 mo (chronic)	1	5	
Cobalt		Diaz et al., 1994	broiler chicken	0.45	growth	weight	14 d (critical life-stage = chronic)	12.36	24.72	assumed BW for 120 day-old chicken
Iron		NRC 1980 in McDowell 1992	white leghorn chicken	1.5	NA	maximum tolerable level	chronic	70.5	NA	
Manganese	Manganese Oxide	Laskey and Edens 1985	Japanese quail	0.072	growth	growth	75 d (chronic)	977	NA	CH2M HILL 2000 (ALT BTAG)
Manganese	Manganese Oxide	Laskey and Edens 1985	Japanese quail	0.072	behavior	aggressive behavior	75 d (chronic)	98	977	
Manganese	Manganese oxide	Laskey and Edens, 1985	Japanese quail	0.072	growth, behavior	weight gain, aggressive behavior	75 d (chronic)	77.6	776	EFA West 1998 (BTAG)
Mercury	MeHg Dicyandiamide	USEPA, 1995	mallard duck	1	reproduction	number eggs and ducklings	3 gen (chronic)	0.039	0.18	EFA West 1998 (BTAG)
Mercury	MeHgCl	Heinz, 1976; Heinz and Hoffman, 1998	mallard duck	1	reproduction	duckling 7 day survival	2.5 mo - 2 gen (chronic)	0.068	0.37	CH2M HILL 2000 (ALT BTAG)
Nickel	Nickel sulfate	Cain and Pafford 1981	mallard	0.782	physiological	tremors, joint edema	90 d (chronic)	17.6	77.4	CH2M HILL 2000 (ALT BTAG)
Nickel	Nickel sulfate	Cain and Pafford, 1981	mallard	0.58	physiological	tremors, joint edema	90 d (chronic)	1.38	55.3	EFA West 1998 (BTAG)
Nickel	Nickel sulfate	Weber and Reid 1968	chicks	0.45	growth	growth	4 wks (chronic)	25.3	42.2	
Silver		USEPA 1997	mallard duck	1	NR	NA	14 days (acute)	17.8	NA	multiplied acute value (1780) by 0.01
Thallium		Schafer 1972	starling	0.82	survivorship	% survival	acute	0.053	NA	multiplied acute value (5.3) by 0.01
Tin	bis (Tributyltin) oxide (TBTO)	Schlatterer et al. 1993	Japanese quail	0.15	reproduction	reduced egg hatchability	6 wks (chronic)	6.8	16.9	
Mammals										
Iron		Sobotka et al., 1996	rat	0.35		subchronic NOAEL	subchronic	2.8	NA	multiplied subchronic value (28) by 0.1
Silver	AgNO ₃	Rungby and Dascher 1984	mouse	0.03	behavior	activity	125 d (chronic)	2.38	23.8	
Tin	bis (Tributyltin) oxide (TBTO)	Davis et al. 1987	mouse	0.03	reproduction	reduced fetal weight and survival	d 6-15 of gestation (chronic)	23.4	35	
Cyanide	Potassium cyanide	Tewe and Maner 1981	rat	0.35	reproduction	fetal growth	gestation and lactation (chronic)	68.7	NA	
Phenol		Bishop et al. 1997	Mouse	0.03	reproduction, body weight	reproduction, weight gain	6 mo (chronic)	17.1	NA	

Note:

Highlighted studies used in risk evaluation.

TABLE 9

Receptor-Specific NOAELs and LOAELs Estimated from Literature-Derived Data Using Allometric Scaling Methods Presented in Sample et al. (1996) and Sample and Arenal (1999).^a

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Receptor	Analyte	Study	Test species	Test Body Weight (kg)	Test NOAEL (mg/kg/d)	Test LOAEL ^b (mg/kg/d)	Scaling Factor	Receptor Body Weight (kg)	Receptor NOAEL	Receptor LOAEL ^b
Birds										
Western Meadowlark	Arsenic	Stanley et al. 1994	mallard duck	1	9.3	40.3	1.2	0.11	5.98	25.92
	Cadmium	White and Finley 1978	mallard duck	1.153	1.45	20.03	1.2	0.11	0.91	12.52
	Chromium III	Haseltine et., al., 1985	black duck	1.25	1	5	1.2	0.11	0.62	3.08
	Cobalt	Diaz et al., 1994	broiler chicken	0.45	12.36	24.72	1.2	0.11	9.33	18.65
	Iron	NRC 1980 in McDowell 1992	white leghorn chicken	1.5	70.5	NA	1.2	0.11	41.81	NA
	Manganese	Laskey and Edens 1985	Japanese quail	0.072	977	NA	1.2	0.11	1063.42	NA
	Mercury	Heinz, 1976; Heinz and Hoffman, 1998	mallard duck	1	0.068	0.37	1.2	0.11	0.04	0.24
	Nickel	Cain and Pafford 1981	mallard	0.782	17.6	77.4	1.2	0.11	11.89	52.29
	Silver	USEPA 1997	mallard duck	1	17.8	NA	1.2	0.11	11.45	NA
	Thallium	Schafer 1972	starling	0.82	0.053	NA	1.2	0.11	0.04	NA
	Tin	Schlatterer et al. 1993	Japanese quail	0.15	6.8	16.9	1.2	0.11	6.39	15.88
Mammals										
Deer Mouse	Iron	Sobotka et al., 1996	rat	0.35	2.8	NA	0.94	0.023	3.30	NA
	Silver	Rungby and Dascher 1984	mouse	0.03	2.38	23.8	0.94	0.023	2.42	24.18
	Tin	Davis et al. 1987	mouse	0.03	23.4	35	0.94	0.023	23.78	35.56
	Cyanide, total	Tewe and Maner 1981	rat	0.273	68.7	NA	0.94	0.023	79.69	NA
	Phenol	Bishop et al. 1997	Mouse	0.03	17.1	NA	0.94	0.023	17.37	NA

^a Calculations are based on toxicity values and body weights for test species from Table 8 and body weights for receptors from Table 5. Scaling factors of 0.94 and 1.2 were applied for mammals and birds, respectively (Sample and Arenal, 1999). Allometric equation is in the form of $NOAEL_{receptor} = NOAEL_{test} (BW_{test}/BW_{receptor})^{(1-scaling\ factor)}$.

^b NA = Toxicity values for this analyte were not available.

References:

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TABLE 10

Comparison of Oregon Department of Environmental Quality (ODEQ) Soil Screening Level Values to Estimated Soil Concentrations (Incremental, Background, and Total) From Air Emissions Deposition
 Screening-Level Ecological Risk Assessment
 COB Energy Facility, Klamath County, Oregon

Analyte	Maximum			Oregon Screening Level Values ^b				Hazard Quotients - Incremental ^c				Hazard Quotients - Background ^c				Hazard Quotients - Total ^c			
	Incremental	Background	Total (Incremental + Background)	Soil				Soil				Soil				Soil			
	(mg/kg)	(mg/kg) ^a	(mg/kg)	Plant	Invertebrate	Bird	Mammal	Plant	Invertebrate	Bird	Mammal	Plant	Invertebrate	Bird	Mammal	Plant	Invertebrate	Bird	Mammal
Arsenic	0.193	4.1	4.11	10	60	10	29	0.019	0.003	0.019	0.007	0.410	0.068	0.410	0.141	0.411	0.069	0.411	0.142
Cadmium	0.048	1	1.06	4	20	6	125	0.012	0.002	0.008	0.000	0.250	0.050	0.167	0.008	0.265	0.053	0.177	0.008
Chromium	0.097	45	45.07	1	0.4	4	340000	0.097	0.241	0.024	0.000	45.000	112.500	11.250	0.000	45.074	112.684	11.268	0.000
Cobalt	0.965	15	15.01	20	1000	--	150	0.048	0.001	--	0.006	0.750	0.015	0.100	0.100	0.750	0.015	0.100	0.100
Manganese	0.988	600	600.02	500	100	4125	1100	0.002	0.010	0.000	0.001	1.200	6.000	0.145	0.545	1.200	6.000	0.145	0.545
Mercury	0.010	0.06	0.07	0.3	0.1	1.5	73	0.032	0.097	0.006	0.000	0.200	0.600	0.040	0.001	0.241	0.723	0.048	0.001
Nickel	1.931	32.5	32.61	30	200	320	625	0.064	0.010	0.006	0.003	1.083	0.163	0.102	0.052	1.087	0.163	0.102	0.052

Notes:
^a Background values are the mean of Klamath County background concentrations reported by USGS (Boerngen, J. G. and H. T. Shacklette, 1981. Chemical Analyses of Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey, Open-File Report 81-197.). Italicized and bold values are Washington Statewide Background levels (San Jaun, C. 1994. Natural Background Soil Metals Concentrations in Washington State. Toxics Cleanup Program, Washington State Department of Ecology. Publication # 94-115, October.) and were used when Klamath County values were not available.
^b Screening values from the Oregon Department of Environmental Quality (Guidance for Ecological Risk Assessment: Level II Screening Level Values, December 2001).
^c Hazard Quotient (HQ) = soil concentration (Incremental, Background, or Total)/Oregon screening level value. Incremental HQs represent risk estimate from wastewater only; background HQs represent risk estimate from background levels; and total HQs represent the combined incremental and background risk.

-- Not available
 Highlighted values represent exceedance of the screening levels.

TABLE 11

Exposure and Hazard Quotient (HQ) Calculations for Air Emissions Constituents Lacking Oregon Department of Environmental Quality (ODEQ) Screening Values for Birds or for Analytes that Exceed ODEQ Screening Values and for Bald Eagles. ^a

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Analytes	Maximum Soil Concentration (mg/kg)	Maximum Water Concentration (mg/L)	Bioaccumulation Values						Exposure Estimates ^e						Literature Benchmarks		NOAEL HQ	LOAEL HQ			
			Plants ^b			Invertebrates ^c			Fish ^d	B1	B0	Plant	Invert	Fish	Soil	Water			Total	NOAEL	LOAEL
			Regression Model			Regression Model															
			BAF	B1	B0	BAF	B1	B0	BCF												
Western Meadowlark																					
Incremental																					
Chromium	0.290	0.000181	0.041			0.306			3	0.7338	-1.4599	0.0002	0.0022	0.0000	0.0002	0.0000	0.0027	0.615	3.075	0.004	0.001
Cobalt	0.965	0.000015	0.0075			0.122			--			0.0016	0.0265	NA	0.0087	0.0000	0.0368	1.413	14.129	0.026	0.003
Background																					
Chromium	45	0.000181	0.041			0.306			3	0.7338	-1.4599	0.0273	0.3470	0.0000	0.0374	0.0000	0.4118	0.615	3.075	0.670	0.134
Cobalt	15	0.000015	0.0075			0.122			1			0.0017	0.0461	NA	0.0125	0.0000	0.0603	9.325	18.650	0.006	0.003
Total																					
Chromium	45.290	0.000181	0.041			0.306			3	0.7338	-1.4599	0.0275	0.3492	0.0000	0.0377	0.0000	0.4144	0.615	3.075	0.674	0.135
Cobalt	15.965	0.000015	0.0075			0.122			1			0.0018	0.0491	NA	0.0133	0.0000	0.0641	9.325	18.650	0.007	0.003
Bald Eagle																					
Arsenic	0.012	0.000030		0.564	-1.992		0.706	-1.421	17			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	12.593	54.569	0.000	0.000
Cadmium	0.061	0.000151		0.546	-0.476		0.795	2.114	12400			0.0000	0.0000	0.0306	0.0000	0.0000	0.0306	1.908	26.361	0.016	0.001
Chromium	0.074	0.000181	0.041			0.306			3	0.7338	-1.4599	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.295	6.475	0.000	0.000
Cobalt	0.006	0.000015	0.0075			0.122			1			0.0000	0.0000	NA	0.0000	0.0000	0.0000	19.634	39.269	0.000	0.000
Manganese	0.018	0.000045	0.0792				0.682	-0.809	1			0.0000	0.0000	NA	0.0000	0.0000	0.0000	2239.074	NA	0.000	NA
Mercury	0.012	0.000030		0.544	-0.996		0.118	-0.684	27900			0.0000	0.0000	0.0138	0.0000	0.0000	0.0138	0.092	0.501	0.149	0.027
Nickel	0.111	0.000272		0.748	-2.224	1.059			106	0.4658	-0.2462	0.0000	0.0000	0.0005	0.0000	0.0000	0.0005	25.033	110.088	0.000	0.000

Notes:

^a Because bald eagles utilizing the McFall Reservoir are of concern, the maximum values for the generic reservoir (i.e., 20-ft mixing depth) were used in the exposure calculation

^b Bioaccumulation values for plants from CH2M HILL (2002).

^c Bioaccumulation values for invertebrates (arthropods) from CH2M HILL (2002).

^d Bioaccumulation values for fish from Sample et al. 1997 for all analytes, except cobalt and manganese. No bioaccumulation values were available for these analytes; therefore a value of 1 was assumed.

^e Exposure estimates calculated using the life-history parameters presented in Table 5.

NA = not available

TABLE 12

Comparison of Aquatic Screening Values to Maximum Estimated Surface Water Concentrations (Generic Reservoir and Generic River) From Air Emissions Deposition

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Analyte	Maximum Concentration (mg/L)	Oregon DEQ Screening Level Values ^a		Hazard Quotients ^b	
		Aquatic Biota	Birds	Aquatic Biota	Birds
Generic Reservoir (20-ft mixing depth)					
Arsenic	0.0000302	0.15	18	0.000	0.000
Cadmium	0.0001512	0.0022	10	0.069	0.000
Chromium	0.0001814	0.011	7.2	0.016	0.000
Cobalt	0.0000151	0.023	--	0.001	
Manganese	0.0000454	0.12	7242	0.000	0.000
Mercury	0.0000302	0.00077	3.3	0.039	0.000
Nickel	0.0002721	0.052	562	0.005	0.000
Generic River (2-ft mixing depth)					
Arsenic	3.0E-04	0.15	18	0.002	0.000
Cadmium	1.5E-03	0.0022	10	0.687	0.000
Chromium	1.8E-03	0.011	7.2	0.165	0.000
Cobalt	1.5E-04	0.023	--	0.007	
Manganese	4.5E-04	0.12	7242	0.004	0.000
Mercury	3.0E-04	0.00077	3.3	0.393	0.000
Nickel	2.7E-03	0.052	562	0.052	0.000

Notes:

^a Screening values from the Oregon Department of Environmental Quality (ODEQ) (Guidance for Ecological Risk Assessment: Level II Screening Level Values, December 2001).

^b Hazard Quotient (HQ) = maximum water concentration/ODEQ or NAWQC values.

-- Not available

Highlighted values represent exceedance of the screening levels.

TABLE 13

Comparison of Oregon Department of Environmental Quality (DEQ) Soil Screening Level Values to Estimated Soil Concentrations (Incremental, Background, and Total) Assuming a 20-cm Mixing Depth for Tilled Agricultural Land

Screening-Level Ecological Risk Assessment

COB Energy Facility, Klamath County, Oregon

Analyte	Incremental Soil Concentration (mg/kg)		Total (Incremental) + Background (mg/kg)	Oregon DEQ Screening Level Values ^b				Hazard Quotients -Incremental ^c				Hazard Quotients - Background ^c				Hazard Quotients -Total ^c			
	Concentration (mg/kg)	Background (mg/kg) ^a		Plants	Inverts	Birds	Mammals	Plants	Inverts	Birds	Mammals	Plants	Inverts	Birds	Mammals	Plants	Inverts	Birds	Mammals
Inorganics																			
Aluminum	9.653	100000	100009.65	50	600	450	107	0.193	0.016	0.021	0.090	2000.000	166.667	222.222	934.579	2000.193	166.683	222.244	934.670
Ammonia as N	9.653	--	9.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Antimony	0.193	0	0.19	5	--	--	15	0.039	--	--	0.013	0.000	--	--	0.039	--	--	--	0.013
Arsenic	0.193	4.05	4.24	10	60	10	29	0.019	0.003	0.019	0.007	0.405	0.068	0.405	0.140	0.424	0.071	0.424	0.146
Barium	2.413	700	702.41	500	3000	85	638	0.005	0.001	0.028	0.004	1.400	0.233	8.235	1.097	1.405	0.234	8.264	1.101
Beryllium	0.386	1	1.39	10	--	--	83	0.039	--	--	0.005	0.100	--	--	0.012	0.139	--	--	0.017
Boron	26.677	20	46.68	0.5	20	120	3500	53.354	1.334	0.222	0.008	40.000	1.000	0.167	0.006	93.354	2.334	0.389	0.013
Cadmium	0.048	1	1.05	4	20	6	125	0.012	0.002	0.008	0.000	0.250	0.050	0.167	0.008	0.262	0.052	0.175	0.008
Calcium	1428.7	38000	39428.69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloride	204.52	--	204.52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium III	0.097	41.9	42.00	1	0.4	4	340000	0.097	0.241	0.024	0.000	41.900	104.750	10.475	0.000	41.997	104.991	10.499	0.000
Chromium VI	0.193	--	0.19	--	--	--	410	--	--	--	0.000	--	--	--	--	--	--	--	0.000
Cobalt	0.965	15	15.97	20	1000	--	150	0.048	0.001	--	0.006	0.750	0.015	--	0.100	0.798	0.016	--	0.106
Copper	0.965	70	70.97	100	50	190	390	0.010	0.019	0.005	0.002	0.700	1.400	0.368	0.179	0.710	1.419	0.374	0.182
Fluoride	9.880	200	209.88	200	30	32	2285	0.049	0.329	0.309	0.004	1.000	6.667	6.250	0.088	1.049	6.996	6.559	0.092
Iron	6.916	43106	43112.92	10	200	--	--	0.692	0.035	--	--	4310.600	215.530	--	--	4311.292	215.565	--	--
Lead	0.290	10	10.29	50	500	16	4000	0.006	0.001	0.018	0.000	0.200	0.020	0.625	0.003	0.206	0.021	0.643	0.003
Magnesium	580.0	20000	20579.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	0.988	600	600.99	500	100	4125	11000	0.002	0.010	0.000	0.000	1.200	6.000	0.145	0.055	1.202	6.010	0.146	0.055
Mercury	0.010	0.06	0.07	0.3	0.1	1.5	73	0.032	0.097	0.006	0.000	0.200	0.600	0.040	0.001	0.232	0.697	0.046	0.001
Molybdenum	2.413	3	5.41	2	200	15	14	1.207	0.012	0.161	0.172	1.500	0.015	0.200	0.214	2.707	0.027	0.361	0.387
Nickel	1.931	32.5	34.43	30	200	320	625	0.064	0.010	0.006	0.003	1.083	0.163	0.102	0.052	1.148	0.172	0.108	0.055
Nitrate as N	41.497	--	41.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrite as N	0.988	--	0.99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phosphorous	2.470	750	752.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	208.47	13500	13708.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	0.193	0.1	0.29	1	70	2	25	0.193	0.003	0.097	0.008	0.100	0.001	0.050	0.004	0.293	0.004	0.147	0.012
Silver	0.048	--	0.05	2	50	--	--	0.024	0.001	--	--	--	--	--	--	0.024	0.001	--	--
Sodium	994.0	22500	23493.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Strontium	9.653	700	709.65	--	--	--	32875	--	--	--	0.000	--	--	--	0.021	--	--	--	0.022
Sulfate	310.74	--	310.74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	96.53	--	96.53	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfite	49.401	--	49.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	0.193	0	0.19	1	--	--	1	0.193	--	--	0.193	0.000	--	--	0.000	0.193	--	--	0.193
Tin	2.413	--	2.41	50	2000	--	--	0.048	0.001	--	--	--	--	--	--	0.048	0.001	--	--
Titanium	9.653	--	9.65	--	1000	--	--	--	0.010	--	--	--	--	--	--	--	0.010	--	--
Zinc	1.931	45	46.93	50	200	60	20000	0.039	0.010	0.032	0.000	0.900	0.225	0.750	0.002	0.939	0.235	0.782	0.002
Organics and Other Constituents																			
Cyanide, total	0.965	--	0.96530	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oil & Grease	14.820	--	14.82	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Orthophosphate as P	2.470	--	2.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	0.483	--	0.48265	70	30	--	--	0.007	0.016	--	--	--	--	--	0.007	0.016	--	--	--
TDS	10028	--	10028.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TSS	49.40	--	49.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

^a Background values are the mean of Klamath County background concentrations reported by USGS (Boerngen, J. G. and H. T. Shacklette, 1981. Chemical Analyses of Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey, Open-File Report 81-197.). Italicized and bold values are Washington Statewide Background levels (San Jaun, C. 1994. Natural Background Soil Metals Concentrations in Washington State. Toxics Cleanup Program, Washington State Department of Ecology, Publication # 94-115, October.) and were used when Klamath County values were not available.

^b Screening values from the Oregon Department of Environmental Quality (Guidance for Ecological Risk Assessment: Level II Screening Level Values, December 2001).

^c Hazard Quotient (HQ) = soil concentration (Incremental, Background, or Total)/Oregon screening level value. Incremental HQs represent risk estimate from wastewater only; background HQs represent risk estimate from background levels; and total HQs represent the combined incremental and background risk.

-- Not available

Highlighted values represent exceedance of the screening levels.

TABLE 14

Exposure and Hazard Quotient (HQ) Calculations for Wastewater Constituents Lacking Oregon Department of Environmental Quality (ODEQ) Screening Values for Birds and Mammals
 Screening-Level Ecological Risk Assessment
 COB Energy Facility, Klamath County, Oregon

Analytes	Maximum Soil Concentration (mg/kg)	Bioaccumulation Values		Exposure Estimates ^c				Literature Benchmarks			NOAEL HQ	LOAEL HQ
		Plants ^a	Invertebrates ^b	Plant	Invert	Soil	Total	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Source		
Incremental												
Western Meadowlark												
Antimony	0.19	0.1487	0.025	0.0004	0.0001	0.0002	0.0007					
Beryllium	0.39		0.0286		0.0003	0.0003	0.0006					
Cobalt	0.97	0.55	0.023	0.0079	0.0006	0.0008	0.0092	9.325	18.650	Diaz et al. 1994	0.001	0.000
Iron	6.92	1	0.027	0.1024	0.0047	0.0058	0.1128	41.807	NA	NRC 1980 in McDowell 1992	0.003	NA
Magnesium	579.97	7.333	1.5047	62.9435	21.9917	0.4825	85.4178					
Silver	0.05	1	0.12	0.0007	0.0001	0.0000	0.0009	11.447	NA	USEPA 1997	0.000	NA
Strontium	9.65					0.0080	0.0080					
Thallium	0.19	1	0.256	0.0029	0.0012	0.0002	0.0043	0.035	NA	Schafer 1972	0.120	NA
Tin	2.41	1	1	0.0357	0.0608	0.0020	0.0985	6.391	15.884	Schlatterer et al. 1993	0.015	0.006
Titanium	9.65					0.0080	0.0080					
Cyanide, total	0.96530	1	1	0.0143	0.0243	0.0008	0.0394					
Oil & Grease	14.82					0.0123	0.0123					
Orthophosphate as P	2.47					0.0021	0.0021					
Phenol	0.48265	5.5963	26.58	0.0400	0.3233	0.0004	0.3637					
Deer Mouse												
Iron	6.92	1	0.027	1.5561	0.0420	0.0622	1.6604	3.297	NA	Sobotka et al. 1996	0.504	NA
Magnesium	579.97	7.333	1.5047	956.9121	196.3542	5.2198	1158.4860					
Silver	0.05	1	0.12	0.0109	0.0013	0.0004	0.0126	2.418	24.182	Rungby and Dascher 1984	0.005	0.001
Tin	2.41	1	1	0.5430	0.5430	0.0217	1.1077	23.776	35.562	Davis et al. 1987	0.047	0.031
Titanium	9.65					0.0869	0.0869					
Cyanide, total	0.96530	1	1	0.2172	0.2172	0.0087	0.4431	79.693	NA	Tewe and Maner 1981	0.006	NA
Oil & Grease	14.82					0.1334	0.1334					
Orthophosphate as P	2.47					0.0222	0.0222					
Phenol	0.48265	5.5963	26.58	0.6077	2.8865	0.0043	3.4986	17.375	NA	Bishop et al. 1997	0.201	NA
Background												
Western Meadowlark												
Antimony		0.1487	0.025	0.0000	0.0000	0.0000	0.0000					
Beryllium	1		0.0286		0.0007	0.0008	0.0016					
Cobalt	15	0.55	0.023	0.1221	0.0087	0.0125	0.1433	9.325	18.650	Diaz et al. 1994	0.015	0.008
Iron	43106	1	0.027	637.9688	29.3293	35.8642	703.1623	41.807	NA	NRC 1980 in McDowell 1992	16.819	NA
Magnesium	20000	7.333	1.5047	2170.5680	758.3688	16.6400	2945.5768					
Silver		1	0.12	0.0000	0.0000	0.0000	0.0000	11.447	NA	USEPA 1997	0.000	NA
Strontium	700					0.5824	0.5824					
Thallium	0	1	0.256	0.0000	0.0000	0.0000	0.0000	0.035	NA	Schafer 1972	0.000	NA
Tin		1	1	0.0000	0.0000	0.0000	0.0000	6.391	15.884	Schlatterer et al. 1993	0.000	0.000
Titanium						0.0000	0.0000					
Cyanide, total		1	1	0.0000	0.0000	0.0000	0.0000					
Oil & Grease						0.0000	0.0000					
Orthophosphate as P						0.0000	0.0000					
Phenol		5.5963	26.58	0.0000	0.0000	0.0000	0.0000					
Deer Mouse												
Iron	43106	1	0.027	9698.8500	261.8690	387.9540	10348.6730	3.297	NA	Sobotka et al. 1996	3138.963	NA
Magnesium	20000	7.333	1.5047	32998.5000	6771.1500	180.0000	39949.6500					
Silver		1	0.12	0.0000	0.0000	0.0000	0.0000	2.418	24.182	Rungby and Dascher 1984	0.000	0.000
Tin		1	1	0.0000	0.0000	0.0000	0.0000	23.776	35.562	Davis et al. 1987	0.000	0.000
Titanium						0.0000	0.0000					

TABLE 14

Exposure and Hazard Quotient (HQ) Calculations for Wastewater Constituents Lacking Oregon Department of Environmental Quality (ODEQ) Screening Values for Birds and Mammals
 Screening-Level Ecological Risk Assessment
 COB Energy Facility, Klamath County, Oregon

Analytes	Maximum Soil Concentration (mg/kg)	Bioaccumulation Values		Exposure Estimates ^c				Literature Benchmarks			NOAEL HQ	LOAEL HQ
		Plants ^a	Invertebrates ^b	Plant	Invert	Soil	Total	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Source		
Cyanide, total		1	1	0.0000	0.0000	0.0000	0.0000	79.693	NA	Tewe and Maner 1981	0.000	NA
Oil & Grease						0.0000	0.0000					
Orthophosphate as P						0.0000	0.0000					
Phenol		5.5963	26.58	0.0000	0.0000	0.0000	0.0000	17.375	NA	Bishop et al. 1997	0.000	NA
Total												
Western Meadowlark												
Antimony	0.19	0.1487	0.025	0.0004	0.0001	0.0002	0.0007					
Beryllium	1.39		0.0286		0.0010	0.0012	0.0022					
Cobalt	15.97	0.55	0.023	0.1300	0.0093	0.0133	0.1525	9.325	18.650	Diaz et al. 1994	0.016	0.008
Iron	43112.92	1	0.027	638.0712	29.3340	35.8699	703.2751	41.807	NA	NRC 1980 in McDowell 1992	16.822	NA
Magnesium	20579.97	7.333	1.5047	2233.5115	780.3605	17.1225	3030.9946					
Silver	0.05	1	0.12	0.0007	0.0001	0.0000	0.0009	11.447	NA	USEPA 1997	0.000	NA
Strontium	709.65					0.5904	0.5904					
Thallium	0.19	1	0.256	0.0029	0.0012	0.0002	0.0043	0.035	NA	Schafer 1972	0.120	NA
Tin	2.41	1	1	0.0357	0.0608	0.0020	0.0985	6.391	15.884	Schlatterer et al. 1993	0.015	0.006
Titanium	9.65					0.0080	0.0080					
Cyanide, total	0.96530	1	1	0.0143	0.0243	0.0008	0.0394					
Oil & Grease	14.82					0.0123	0.0123					
Orthophosphate as P	2.47					0.0021	0.0021					
Phenol	0.48265	5.5963	26.58	0.0400	0.3233	0.0004	0.3637					
Deer Mouse												
Iron	43112.92	1	0.027	9700.4061	261.9110	388.0162	10350.3334	3.297	NA	Sobotka et al. 1996	3139.467	NA
Magnesium	20579.97	7.333	1.5047	33955.4121	6967.5042	185.2198	41108.1360					
Silver	0.05	1	0.12	0.0109	0.0013	0.0004	0.0126	2.418	24.182	Rungby and Dascher 1984	0.005	0.001
Tin	2.41	1	1	0.5430	0.5430	0.0217	1.1077	23.776	35.562	Davis et al. 1987	0.047	0.031
Titanium	9.65					0.0869	0.0869					
Cyanide, total	0.96530	1	1	0.2172	0.2172	0.0087	0.4431	79.693	NA	Tewe and Maner 1981	0.006	NA
Oil & Grease	14.82					0.1334	0.1334					
Orthophosphate as P	2.47					0.0222	0.0222					
Phenol	0.48265	5.5963	26.58	0.6077	2.8865	0.0043	3.4986	17.375	NA	Bishop et al. 1997	0.201	NA

Notes:

^a Bioaccumulation values for plants from CH2M HILL (2002) for all constituents, except cyanide, silver, thallium, and tin. No bioaccumulation values were available for these analytes; therefore a value of 1 was assumed.

^b Bioaccumulation values for invertebrates (arthropods) from CH2M HILL (2002) for all constituents, except cyanide, and tin. No bioaccumulation values were available for these analytes; therefore a value of 1 was assumed.

^c Exposure estimates calculated using life-history parameters presented in Table 5.

Western Meadowlark
 Body weight = 0.11 (Wiens and Innes 1974)
 Food Ingestion Rate = 0.04 (Sample et al. 1997)
 Diet = 37% plant and 63% invertebrate (Lanyon 1994)
 Soil Ingestion = 2.08% (Sample et al. 1997)

Deer Mouse
 Body weight = 0.023 (Silva and Downing 1995)
 Food Ingestion Rate = 0.45 (USEPA 1993)
 Diet = 50% plant and 50% invertebrate (USEPA 1993)
 Soil Ingestion = 2% (adapted from Beyer et al. 1994)

Highlighted values represent exceedance of the screening levels.