Revised Draft

WORK PLAN

ENGINEERING EVALUATION/COST ANALYSIS
ARKEMA REMOVAL ACTION

PORTLAND, OREGON

APPENDIX B
EXPOSURE FACTORS AND PARAMETERS USED TO DEVLEOP SEDIMENT SCREENING VALUES FOR HUMANS

Prepared for

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Table B-1. Exposure Parameters for Human Health Screening Values Based On Incidental Ingestion and Dermal Contact Pathways.

Exposure Route	Parameter	Definition	Units	Dockside Worker RME	Transients RME
Ingestion	EPC	Exposure point concentration, sediment	mg/kg	TBD	TBD
	BW	Body weight	kg	70	70
	EF	Exposure frequency	days/yr	50	365
	ED	Exposure duration	years	25	2
	SIR	Sediment ingestion rate	mg/day	200	200
	ATc	Averaging time, cancer	days	25,550	25,550
	ATnc	Averaging time, noncancer	days	9,125	730
	CF	Conversion Factor	kg/mg	1.E-06	1.E-06
	ITFIc	Intake Factor Ingestion Carcinogens	kg sed/kg bw-d	1.4E-07	8.2E-08
	ITFInc	Intake Factor Ingestion Non-Carcinogens	kg sed/kg bw-d	3.9E-07	2.9E-06

Exposure Route	Parameter	Definition	Units	Dockside Worker RME	Transients RME
Dermal	EPC	Exposure point concentration, sediment	mg/kg	TBD	TBD
	BW	Body weight	kg	70	70
	EF	Exposure frequency	days/yr	50	365
	ED	Exposure duration	years	25	2
	SA	Skin surface area	cm2	3,300	5,700
	AF	Adherence factor	mg/cm2	0.20	0.30
	ABS	Absorption factor[1]	--	chem-specific	chem-specific
	ATc	Averaging time, cancer	days	25,550	25,550
	ATnc	Averaging time, noncancer	days	9,125	730
	CF	Conversion Factor	kg/mg	1.E-06	1.E-06
	ITFDc	Intake Factor Dermal Carcinogens	kg sed/kg bw-d	4.6E-07	7.0E-07
	ITFDnc	Intake Factor Dermal Non-Carcinogens	kg sed/kg bw-d	1.3E-06	2.4E-05

Exposure factors obtained from Kennedy / Jenks 2004b.

[1] Default value = 1. Chemical specific values provided in Table C-3.

Table B-2. Toxicity Values and Calculated Human-Health Sediment Screening Concentrations Based on Direct Exposure via Ingestion and Skin Contact.

				Toxicity Values[5]		Carcinogenic Risk Screening Concentrations (mg/kg dw)		Non-Cancer Risk Screening Concentrations (mg/kg dw)	
Chemical Group	**CAS**	**Chemical**	**Chemical-Specific Modifying Factors**	**CSFo (mg/kg-day)$^{-1}$**	**RfDo (mg/kg-day)**	**Dockside Worker**	**Transients**	**Dockside Worker**	**Transients**
Butyltin	78763-54-9	Butyltin ion	1	--	5.0E-03	--	--	3.0E+03	1.8E+02
Butyltin	14488-53-0	Dibutyltin ion	1	--	5.0E-03	--	--	3.0E+03	1.8E+02
Butyltin	1461-25-2	Tetrabutyltin	1	--	3.0E-04	--	--	1.8E+02	1.1E+01
Butyltin	36643-28-4	Tributyltin ion	1	--	3.0E-04	--	--	1.8E+02	1.1E+01
Conventional	7790-98-9	Perchlorate	0.001 [1]	--	7.0E-04	--	--	1.8E+03	2.4E+02
Dioxin		Total Dioxin TEQ	0.03 [1]	1.5E+05	-- [3]	4.3E-04	6.5E-04	--	--
Metal	7429-90-5	Aluminum	1	--	1.0E+00	--	--	5.9E+05	3.7E+04
Metal	7440-36-0	Antimony	1	--	4.0E-04	--	--	2.4E+02	1.5E+01
Metal	7440-38-2	Arsenic	0.03 [1]	1.5E+00	3.0E-04	4.3E+01	6.5E+01	7.0E+02	8.4E+01
Metal	7440-43-9	Cadmium	0.001 [1]	--	1.0E-03	--	--	2.5E+03	3.5E+02
Metal	16065-83-1	Chromium, trivalent	1	--	1.5E+00	--	--	8.9E+05	5.5E+04
Metal	18540-29-9	Chromium, hexavalent	1	--	3.0E-03	--	--	1.8E+03	1.1E+02
Metal	7440-50-8	Copper	1	--	4.0E-02	--	--	2.4E+04	1.5E+03
Metal	7439-92-1	Lead	1	NA	NA [4]	--	--	--	--
Metal	7439-96-5	Manganese	1	--	1.4E-01	--	--	8.3E+04	5.1E+03
Metal	7439-97-6	Mercury (tissue)	1	--	1.0E-04	--	--	5.9E+01	3.7E+00
Metal	7439-97-6	Mercury (sediment)	1	--	3.0E-04	--	--	1.8E+02	1.1E+01
Metal	7440-02-0	Nickel	1	--	2.0E-02	--	--	1.2E+04	7.3E+02
Metal	7782-49-2	Selenium	1	--	5.0E-03	--	--	3.0E+03	1.8E+02
Metal	7440-22-4	Silver	1	--	5.0E-03	--	--	3.0E+03	1.8E+02
Metal	7440-28-0	Thallium	1	--	6.6E-05	--	--	3.9E+01	2.4E+00
Metal	7440-66-6	Zinc	1	--	3.0E-01	--	--	1.8E+05	1.1E+04
PAH	91-57-6	2-Methylnaphthalene	0.13 [1]	--	4.0E-03	--	--	7.2E+03	6.6E+02
PAH	83-32-9	Acenaphthene	0.13 [1]	--	6.0E-02	--	--	1.1E+05	9.9E+03
PAH	208-96-8	Acenaphthylene	0.13 [1]	--	6.0E-02	--	--	1.1E+05	9.9E+03
PAH	120-12-7	Anthracene	0.13 [1]	--	3.0E-01	--	--	5.4E+05	5.0E+04
PAH	56-55-3	Benz(a)anthracene	0.13 [1]	7.3E-01	--	6.9E+01	7.9E+01	--	--
PAH	50-32-8	Benzo(a)pyrene	0.13 [1]	7.3E+00	--	6.9E+00	7.9E+00	--	--
PAH	205-99-2	Benzo(b)fluoranthene	0.13 [1]	7.3E-01	--	6.9E+01	7.9E+01	--	--
PAH	191-24-2	Benzo(g,h,i)perylene	0.13 [1]	--	3.0E-02	--	--	5.4E+04	5.0E+03
PAH	207-08-9	Benzo(k)fluoranthene	0.13 [1]	7.3E-02	--	6.9E+02	7.9E+02	--	--
PAH	218-01-9	Chrysene	0.13 [1]	7.3E-03	--	6.9E+03	7.9E+03	--	--
PAH	53-70-3	Dibenz(a,h)anthracene	0.13 [1]	7.3E+00	--	6.9E+00	7.9E+00	--	--

Table B-2. Toxicity Values and Calculated Human-Health Sediment Screening Concentrations Based on Direct Exposure via Ingestion and Skin Contact.

				Toxicity Values[5]		Carcinogenic Risk Screening Concentrations (mg/kg dw)		Non-Cancer Risk Screening Concentrations (mg/kg dw)	
Chemical Group	**CAS**	**Chemical**	**Chemical-Specific Modifying Factors**	**CSFo (mg/kg-day)$^{-1}$**	**RfDo (mg/kg-day)**	**Dockside Worker**	**Transients**	**Dockside Worker**	**Transients**
PAH	206-44-0	Fluoranthene	0.13 [1]	--	4.0E-02	--	--	7.2E+04	6.6E+03
PAH	86-73-7	Fluorene	0.13 [1]	--	4.0E-02	--	--	7.2E+04	6.6E+03
PAH	193-39-5	Indeno(1,2,3-cd)pyrene	0.13 [1]	7.3E-01	--	6.9E+01	7.9E+01	--	--
PAH	91-20-3	Naphthalene	0.13 [1]	--	2.0E-02	--	--	3.6E+04	3.3E+03
PAH	85-01-8	Phenanthrene	0.13 [1]	--	3.0E-02	--	--	5.4E+04	5.0E+03
PAH	129-00-0	Pyrene	0.13 [1]	--	3.0E-02	--	--	5.4E+04	5.0E+03
PCBs	1336-36-3	Total PCB Aroclors	0.14 [1]	2.0E+00	2.0E-05	2.4E+01	2.8E+01	3.5E+01	3.2E+00
PCBs		Total PCB Congeners	0.14 [1]	--	2.0E-05	--	--	3.5E+01	3.2E+00
PCBs		Total PCB Congeners, adjustec	0.14 [1]	2.0E+00	--	2.4E+01	2.8E+01	--	--
PCBs		Total PCB TEQ	0.14 [1]	1.5E+05	--	3.3E-04	3.7E-04	--	--
Pesticide	309-00-2	Aldrin	1	1.7E+01	3.0E-05	9.8E-01	7.5E-01	1.8E+01	1.1E+00
Pesticide	319-84-6	alpha-Hexachlorocyclohexane	1	6.3E+00	8.0E-03	2.6E+00	2.0E+00	4.8E+03	2.9E+02
Pesticide	319-85-7	beta-Hexachlorocyclohexane	1	1.8E+00	6.0E-04	9.2E+00	7.1E+00	3.6E+02	2.2E+01
Pesticide	319-86-8	delta-Hexachlorcyclohexane	1	--	--	--	--	--	--
Pesticide	60-57-1	Dieldrin	1	1.6E+01	5.0E-05	1.0E+00	8.0E-01	3.0E+01	1.8E+00
Pesticide	72-20-8	Endrin	1	--	3.0E-04	--	--	1.8E+02	1.1E+01
Pesticide	7421-93-4	Endrin aldehyde	1	--	3.0E-04	--	--	1.8E+02	1.1E+01
Pesticide	53494-70-5	Endrin ketone	1	--	3.0E-04	--	--	1.8E+02	1.1E+01
Pesticide	58-89-9	gamma-Hexachlorocyclohexan	0.04 [1]	1.3E+00	3.0E-04	4.9E+01	7.0E+01	6.8E+02	7.8E+01
Pesticide	76-44-8	Heptachlor	1	4.5E+00	5.0E-04	3.7E+00	2.9E+00	3.0E+02	1.8E+01
Pesticide	1024-57-3	Heptachlor epoxide	1	9.1E+00	1.3E-05	1.8E+00	1.4E+00	7.7E+00	4.8E-01
Pesticide	72-43-5	Methoxychlor	1	--	5.0E-03	--	--	3.0E+03	1.8E+02
Pesticide	8001-35-2	Toxaphene	1	1.1E+00	1.0E-03	1.5E+01	1.2E+01	5.9E+02	3.7E+01
Pest - Chlor	5103-71-9	alpha-Chlordane	0.04 [1]	NA	NA	--	--	--	--
Pest - Chlor	27304-13-8	Oxychlordane	0.04 [1]	NA	NA	--	--	--	--
Pest - Chlor	12789-03-6	Total Chlordane	0.04 [1]	3.5E-01	5.0E-04	1.8E+02	2.6E+02	1.1E+03	1.3E+02
Pest - Chlor	5103-74-2	trans-Chlordane	0.04 [1]	NA	NA	--	--	--	--
Pest - Chlor	39765-80-5	trans-Nonachlor	0.04 [1]	NA	NA	--	--	--	--
Pest - DDD	53-19-0	2,4'-DDD	0.03 [1,2]	NA	NA	--	--	--	--
Pest - DDD	72-54-8	4,4'-DDD	0.03 [1,2]	NA	NA	--	--	--	--
Pest - DDD		Total DDD	0.03 [1,2]	2.4E-01	5.0E-04	2.7E+02	4.1E+02	1.2E+03	1.4E+02
Pest - DDE	72-55-9	4,4'-DDE	0.03 [1,2]	NA	NA	--	--	--	--
Pest - DDE		Total DDE	0.03 [1,2]	3.4E-01	5.0E-04	1.9E+02	2.9E+02	1.2E+03	1.4E+02
Pest - DDT	789-02-6	2,4'-DDT	0.03 [1]	NA	NA	--	--	--	--

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Chemical Group	**CAS**	**Chemical**	**Chemical-Specific Modifying Factors**	**CSFo (mg/kg-day)$^{-1}$**	**RfDo (mg/kg-day)**	**Dockside Worker**	**Transients**	**Dockside Worker**	**Transients**
Pest - DDT	50-29-3	4,4'-DDT	0.03 [1]	NA	NA	--	--	--	--
Pest - DDT		Total DDT	0.03 [1]	3.4E-01	5.0E-04	1.9E+02	2.9E+02	1.2E+03	1.4E+02
Pest - Endo	959-98-8	alpha-Endosulfan	1	NA	NA	--	--	--	--
Pest - Endo	33213-65-9	beta-Endosulfan	1	NA	NA	--	--	--	--
Pest - Endo	1031-07-8	Endosulfan sulfate	1	NA	NA	--	--	--	--
Pest - Endo	115-29-7	Total Endosulfan	1	--	6.0E-03	--	--	3.6E+03	2.2E+02
Phenol	106-44-5	4-Methylphenol	1	--	5.0E-02	--	--	3.0E+04	1.8E+03
Phenol	87-86-5	Pentachlorophenol	0.25 [1]	1.2E-01	3.0E-02	3.3E+02	3.3E+02	4.2E+04	3.3E+03
Phenol	108-95-2	Phenol	1	--	3.0E-01	--	--	1.8E+05	1.1E+04
Phthalate	117-81-7	Bis(2-ethylhexyl) phthalate	1	1.4E-02	2.0E-02	1.2E+03	9.2E+02	1.2E+04	7.3E+02
Phthalate	85-68-7	Butylbenzyl phthalate	1	--	2.0E-01	--	--	1.2E+05	7.3E+03
Phthalate	84-66-2	Diethyl phthalate	1	--	8.0E-01	--	--	4.8E+05	2.9E+04
Phthalate	84-74-2	Dibutyl phthalate	1	--	1.0E-01	--	--	5.9E+04	3.7E+03
Phthalate	117-84-0	Di-n-octyl phthalate	1	--	4.0E-02	--	--	2.4E+04	1.5E+03
SVOC	86-74-8	Carbazole	0.1 [1]	2.0E-02	--	2.7E+03	3.3E+03	--	--
SVOC	132-64-9	Dibenzofuran	0.1 [1]	4.0E-03	--	1.3E+04	1.7E+04	--	--
SVOC	118-74-1	Hexachlorobenzene	0.1 [1]	1.6E+00	8.0E-04	3.4E+01	4.1E+01	1.5E+03	1.5E+02
SVOC	87-68-3	Hexachlorobutadiene	0.1 [1]	7.8E-02	2.0E-04	6.9E+02	8.5E+02	3.8E+02	3.8E+01
SVOC	67-72-1	Hexachloroethane	0.1 [1]	1.4E-02	1.0E-03	3.8E+03	4.7E+03	1.9E+03	1.9E+02

[1]Modifying factors are based on chemical-specific dermal absorption efficiency (DA) as defined by Kennedy/Jenks (2004b, Table 15).
Value for perchlorate obtained from United States Environmental Protection Agency. 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance). Waste Management Division, Office of Health Assessment, as listed on ORNL website: http://rais.ornl.gov/cgi-bin/tox/TOX_9801

[2] Dermal absorption is assumed to be the same as that for DDT.

[3]-- Data not avalable (Kennedy/Jenks 2004b).

[4] NA Not applicable. Chemical will not be assessed individually (Kennedy/Jenks 2004b).

[5] Toxicity values obtained from Kennedy/Jenks (2004c). Values were selected based on EPA (2003) hierarchy for Superfund sites:
1) IRIS; 2) PPRTVs; 3) Other EPA and non-EPA sources, such as CalEPA, ATSDR, etc.

Notes: K / J 2004b: PH RI/FS Programmatic Work Plan, Appendix C: Human Health Risk Assessment Approach, April 23, 2004.
K / J 2004c: PH RI/FS Interim Deliverable for Human Health Risk Assessment: Human Health Toxicity Values - FINAL. October 8, 2004.
EPA 2003. OSWER Directive 9285.7-53. Human Health Toxicity Values in Superfund Risk Assessments. December 5, 2003.