APPENDIX E

Chemical Properties

Chemical	Target Concentration (mg/l)	Source	H (unitless)	Source	T1/2 (days)	Source	Kd (l/kg)	Koc (l/kg)	Source
Ammoniacal Nitrogen as N	0.23	Based on standard of 0.3 mg/l for Ammonium (SI 439/2000)	0.013526976	RBCA Database	2190	Erskine, 2000	0.5		Erskine, 2000
Total Phenols	0.01	UK DWS 2000	1.63726E-05	RBCA Database	10	RBCA Database		28.84031503	RBCA Database
Total Cyanide	0.01	SI 12/2001	0	RBCA Database	29.16666667	Menne, D, 1997	7943282347		RBCA Database
Sulphate	250	SI 439/2000 98/83/EC	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Arsenic	0.01	SI 439/2000 98/83/EC	0	RBCA Database	9.9E+99	Doesn't Degrade	117.4897555		ATSDR, 1992
Lead	0.01	SI 12/2001 98/83/EC	0	RBCA Database (BME)	9.9E+99	Doesn't Degrade	31622.7766		Professional judgement
Nickel	0.02	98/83/EC	0	RBCA Database	9.9E+99	Doesn't Degrade	0		RBCA Database (conservative)
Benzene	0.001	SI 439/2000 98/83/EC	0.229	RBCA Database	720	RBCA Database		58.884	RBCA Database
Toluene	0.05	EQS	0.26	RBCA Database	28	RBCA Database		134.896	RBCA Database
Boron	1	SI 439/2000 98/83/EC	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
phosphorous	2.2	UK DWS 2000	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Selenium	0.01	SI 439/2000 98/83/EC	0	RBCA Database	9.9E+99	Doesn't Degrade	9.54992586		ATSDR, 1992
Styrene	0.05	EQS	0.107638438	RBCA Database	210	RBCA Database		1278.085771	RBCA Database
Xylene m,p	0.03	EQS for Total Styrene	0.29	RBCA Database mixed isomers	360	RBCA Database mixed isomers		239.8832919	RBCA Database mixed isomers
Xylene o	0.03	EQS for Total Styrene	0.217338915	RBCA Database	360	RBCA Database		128.8249552	RBCA Database
Silver	0.00005	EQS	0	RBCA Database	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Strontium	1	UK drinking water standard for Barium	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Zinc	0.1	SI12/2001	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Sulphide	0.00025	EA guidance	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Fluoride	0.5	SI 12/2001	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Trichlorofluoromethane	0.1	Based on EQS for 111 Trichloroethane	2.404337524	RBCA Database	720	RBCA Database		309.0295432	RBCA Database
Chlorobenzene	0.01	Based on WHO Dichloro	0.152590889	RBCA Database	300	RBCA Database		218.7761624	RBCA Database
Ethylbenzene	0.3	WHO health	0.324977353	RBCA Database	228	RBCA Database		363.0780548	RBCA Database
Isopropylbenzene	0.01	Based on tox info	use benzene						
Propylbenzene	0.001	Conservatively based on benzene	use benzene						
1,2,4 Trimethylbenzene	0.01	Professional judgement based on toxicity information	0.058561909	RBCA Database	360	RBCA Database		8128.305162	RBCA Database
1,3,5 Trimethylbenzene	0.01	Professional judgement based on toxicity information	0.058561909	RBCA Database for 124	360	RBCA Database for 124		8128.305162	RBCA Database for 124
1,4 Dichlorobenzene	0.01	WHO ATU	0.065985249	RBCA Database	360	RBCA Database		2137.962089	RBCA Database
sec Butylbenzene	0.001	Conservatively based on benzene	use benzene						
tert Butylbenzene	0.001	Conservatively based on benzene	use benzene		9.99E+99	Non degradable (DOSE)			
n Butylbenzene	0.001	Conservatively based on benzene	use benzene					2454.7	DOSE for Butylbenzene
Bis(2-ethylhexyl)phthalate	0.01	Conservatively based on bis(2-butoxyethyl)phthalate	1.23722E-05	RBCA Database	389	RBCA Database saturated		162181.0097	RBCA Database
4 Methylphenol	0.01	conservatively based on Phenol	use phenol						
2 Methylnapthalene	0.01	Based on Napthalene	0.019919297	RBCA Database for napthalene	258	RBCA Database for napthalene		1995.262315	RBCA Database for napthalene
Napthalene	0.01	Based on Napthalene	0.019919297	RBCA Database for napthalene	258	RBCA Database for napthalene		1995.262315	RBCA Database for napthalene

Chemical	Target Concentration (mg/l)	Source	H (unitless)	Source	T1/2 (days)	Source	Kd (l/kg)	Koc (l/kg)	Source
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Total Cyanide	0.01	SI 12/2001	0	RBCA Database	29.16666667	Menne, D, 1997	7943282347		RBCA Database
Sulphate	250	SI 439/2000 98/83/EC	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Arsenic	0.01	SI 439/2000 98/83/EC	0	RBCA Database	9.9E+99	Doesn't Degrade	117.4897555		ATSDR, 1992
Lead	0.01	SI 12/2001 98/83/EC	0	RBCA Database (BME)	9.9E+99	Doesn't Degrade	31622.7766		Professional judgement
Nickel	0.02	98/83/EC	0	RBCA Database	9.9E+99	Doesn't Degrade	0		RBCA Database (conservative)
Benzene	0.001	SI 439/2000 98/83/EC	0.229	RBCA Database	720	RBCA Database		58.884	RBCA Database
Toluene	0.05	EQS	0.26	RBCA Database	28	RBCA Database		134.896	RBCA Database
Boron	1	SI 439/2000 98/83/EC	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
phosphorous	2.2	UK DWS 2000	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Selenium	0.01	SI 439/2000 98/83/EC	0	RBCA Database	9.9E+99	Doesn't Degrade	9.54992586		ATSDR, 1992
Styrene	0.05	EQS	0.107638438	RBCA Database	210	RBCA Database		1278.085771	RBCA Database
Xylene m,p	0.03	EQS for Total Styrene	0.29	RBCA Database mixed isomers	360	RBCA Database mixed isomers		239.8832919	RBCA Database mixed isomers
Xylene o	0.03	EQS for Total Styrene	0.217338915	RBCA Database	360	RBCA Database		126.8249552	RBCA Database
Silver	0.00005	EQS	0	RBCA Database	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Strontium	1	UK drinking water standard for Barium	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Zinc	0.1	SI 12/2001	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Sulphide	0.00025	EA guidance	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Fluoride	0.5	SI 12/2001	0	Doesn't Volatilise	9.9E+99	Doesn't Degrade	0		Doesn't Partition
Trichlorofluoromethane	0.1	Based on EQS for 111 Trichloroethane	2.404337524	RBCA Database	720	RBCA Database		309.0295432	RBCA Database
Chlorobenzene	0.01	Based on WHO Dichloro	0.152590889	RBCA Database	300	RBCA Database		218.7761624	RBCA Database
Ethylbenzene	0.3	WHO health	0.324977353	RBCA Database	228	RBCA Database		363.0780548	RBCA Database
Isopropylbenzene	0.01	Based on tox info	use benzene						
Propylbenzene	0.001	Conservatively based on benzene	use benzene						
1,2,4 Trimethylbenzene	0.01	Professional judgement based on toxicity information	0.058561909	RBCA Database	360	RBCA Database		8128.305162	RBCA Database
1,3,5 Trimethylbenzene	0.01	Professional judgement based on toxicity information	0.058561909	RBCA Database for 124	360	RBCA Database for 124		8128.305162	RBCA Database for 124
1,4 Dichlorobenzene	0.01	WHO ATU	0.065985249	RBCA Database	360	RBCA Database		2137.962089	RBCA Database
sec Butylbenzene	0.001	Conservatively based on benzene	use benzene						
tert Butylbenzene	0.001	Conservatively based on benzene	use benzene		9.99E+99	Non degradable (DOSE)			
n Butylbenzene	0.001	Conservatively based on benzene	use benzene					2454.7	DOSE for Butylbenzene
Bis(2-ethylhexyl)phthalate	0.01	Conservatively based on bis(2-butoxyethyl)phthalate	1.23722E-05	RBCA Database	389	RBCA Database saturated		162181.0097	RBCA Database
4 Methylphenol	0.01	Phenol	use phenol						
2 Methylnapthalene	0.01	Based on Napthalene	0.019919297	RBCA Database for napthalene	258	RBCA Database for napthalene		1995.262315	RBCA Database for napthalene
Napthalene	0.01	Based on Napthalene	0.019919297	RBCA Database for napthalene	258	RBCA Database for napthalene		1995.262315	RBCA Database for napthalene
Chloroethane	0.001	conservatively based on benzene (no info available)	0.210327982	RBCA Database	58	RBCA Database		17.7827941	RBCA Database
111 Trichloroethane	0.1	EQS freshwater	0.709341431	RBCA Database	648	RBCA Database		281.8382931	RBCA Database
TCE	0.01	SI439/2000	0.41355822	RBCA Database	1683	RBCA Database		125.8925412	RBCA Database
TPH fractions									
aromatic C5-C7	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	0.23	TPH CWG, 1999	730	New Zealand guidelines C7-C9		79.43282347	TPH CWG, 1999
aromatic C8-C10	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	0.48	TPH CWG, 1999	1825	New Zealand guidelines C10-C14		1584.893192	TPH CWG, 1999
aromatic C10-C12	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	0.14	TPH CWG, 1999	1825	New Zealand guidelines C10-C14		2511.886432	TPH CWG, 1999
aromatic C12-C16	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	0.053	TPH CWG, 1999	1825	New Zealand guidelines C10-C14		5011.872336	TPH CWG, 1999
aromatic C16-C21	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	0.043	TPH CWG, 1999	3650	New Zealand guidelines C15-36		15848.93192	TPH CWG, 1999
aromatic C21-C35	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	0.00063	TPH CWG, 1999	3650	New Zealand guidelines C15-36		125892.5412	TPH CWG, 1999
aliphatic C6-C8	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	50	TPH CWG, 1999	730	New Zealand guidelines C7-C9		3981.071706	TPH CWG, 1999
aliphatic C8-C10	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	80	TPH CWG, 1999	1825	New Zealand guidelines C10-C14		31622.7766	TPH CWG, 1999
aliphatic C10-C12	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	120	TPH CWG, 1999	1825	New Zealand guidelines C10-C14		251188.6432	TPH CWG, 1999
aliphatic C12-C16	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	520	TPH CWG, 1999	1825	New Zealand guidelines C10-C14		5011872.336	TPH CWG, 1999
aliphatic C16-C21	0.00071429	UK DWS 2000 for TPH /13 (no of fractions)	4900	TPH CWG, 1999	3650	New Zealand guidelines C15-36		630957344.5	TPH CWG, 1999
PAH									
Indeno(1,2,3-cd)pyrene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	2.09091E-10	RBCA Database	1460	RBCA Database		33884415.61	RBCA Database
Benzo(b)fluoranthene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	0.00082894	RBCA Database	1220	RBCA Database		549540.8739	RBCA Database
Benzo(k)fluoranthene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	4.41276E-07	RBCA Database	4280	RBCA Database		549540.8739	RBCA Database
Benzo(ghi)perylene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	5.77371E-06	RBCA Database	1300	RBCA Database		1584893.192	RBCA Database
Naphthalene	0.01	EQS	0.019919297	RBCA Database	258	RBCA Database		1995.262315	RBCA Database
Acenaphthylene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	0.004701449	RBCA Database	120	RBCA Database		10000	RBCA Database
Acenaphthene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	0.31796642	RBCA Database	204	RBCA Database		7079.457844	RBCA Database
Fluorene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	0.004825171	RBCA Database	120	RBCA Database		7244.359601	RBCA Database
Phenathrene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	0.249506724	RBCA Database	400	RBCA Database		14125.37545	RBCA Database
Anthracene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	2.783752708	RBCA Database	920	RBCA Database		14125.37545	RBCA Database
Fluoranthene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	2.763132317	RBCA Database	880	RBCA Database		38018.93963	RBCA Database
Pyrene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	2.88685E-07	RBCA Database	3600	RBCA Database		38018.93963	RBCA Database
Benzo(a)anthracene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	5.69123E-07	RBCA Database	1360	RBCA Database		1380384.265	RBCA Database
Chrysene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	4.86641E-07	RBCA Database	2000	RBCA Database		199526.2315	RBCA Database
Benzo(a)pyrene	0.00001	SI 439/2000 98/83/EC	4.66021E-05	RBCA Database	1060	RBCA Database		1023292.992	RBCA Database
Di-benz(a,h,)anthracene	0.00000625	SI439/2000 for PAH /16 (no of constituents)	1.57127E-05	RBCA Database	1860	RBCA Database		741310.2413	RBCA Database

Physical Input Parameters for Groundwater Risk Assessment

P20 Spreadsheets

The following physical properties were input to the Tier 1-3 Soil and Tier 3 Groundwater Spreadsheets, to derive soil and groundwater remedial target values.

Site physical properties - Tier 1 Soils

Parameter	Value (or range)	Justification
Water Filled Porosity of Soil Zone	0.16	Typical value for mixed grain and sand (Conner *et al*, 1996 after Peck *et al*, 1974)
Air Filled Porosity of Soil Zone	0.19	Calculated from an assumed total porosity of 35% (Conner *et al*, 1996 for mixed grain and sand) minus Water Filled Porosity above.
Bulk Density of Soil Zone (g/cm^3)	1.7	Median soil value (Conner *et al*, 1996 after ASTM, 1995).
Fraction Organic Carbon	0.00363	Calculated from laboratory data

Site physical properties - Tier 2 Soils

Parameter	Value (or range)	Justification
Infiltration	0.0003 m/d	Estimated from water balance
Hydraulic Conductivity	0.864 m/day	Best estimate from field data

Parameter	Value (or range)			Justification
	Site 1	Site 4	Site 6	
Length of Contaminant Source (m)	130	80	55	Length of site parallel to groundwater flow.
Saturated Aquifer Thickness (m)	10.8	21.7	57.1	Estimated from recorded sand and gravel thickness (GSI, 2001)
Hydraulic Gradient	0.0125	0.0133	0.0125	Field measurement from monitoring well data.
Width of Contaminant Source (m)	190	80	80	Width of site perpendicular to groundwater flow.
Mixing Zone Depth (m)	10	21	56	Professional judgement based on saturated aquifer thickness.

Site physical properties - Tier 3 Soils

Parameter	Value (or range)	Justification
Effective Porosity of Limestone	0.18	Geometric mean of typical maximum and minimum values for sand and gravel (Conner *et al*, 1996 after Domenico *et al* 1990 and Walton, 1988)
Bulk Density of Limestone (g/cm^3)	1.7	Median soil value (Conner *et al*, 1996 after ASTM, 1995).
Distance to Compliance Point (Site 1) (m)	650	Distance between down-gradient site boundary and River Burgess.
Distance to Compliance Point (Site 4) (m)	200	Distance between down-gradient site boundary and River Burgess.
Distance to Compliance Point (Site 6) (m)	100	Down gradient distance to theoretical borehole (preliminarily agreed with EPA 16/4/2003)

Site physical properties - Tier 3 Groundwater

Parameter	Value (or range)	Justification
Effective Porosity of Aquifer	0.182	Geometric mean of typical maximum and minimum values for sand and gravel (Conner *et al*, 1996 after Domenico *et al* 1990 and Walton, 1988).
Hydraulic Conductivity	0.864 m/day	Best estimate from field data
Fraction Organic Carbon	0.00363	Calculated from laboratory data

Parameter	Value (or range)			Justification
	Site 1	Site 4	Site 6	
Hydraulic Gradient	0.0125	0.0133	0.0125	Field measurement from monitoring well data.
Width of Plume (m)	190	80	80	Width of site perpendicular to groundwater flow.
Saturated Aquifer Thickness (m)	10.8	21.7	57.1	Estimated from recorded sand and gravel thickness (GSI, 2001) and measured groundwater level.
Plume Thickness (m)	10	21	56	Professional judgement based on saturated aquifer thickness.
Distance to Compliance Point (m)	650	200	100	See Tier 3 soil.

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