Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max	EQS						
											Sample ID	D0-C	D0-C	D0-C	D0-C	D0-C	D0-C
											Depth	0.00-0.00	0.00-0.00	0.00-0.00	0.00-0.00	0.00-0.00	0.00-0.00
											Sampled Date	18/04/2018	03/05/2018	18/05/2018	31/05/2018	11/06/2018	25/06/2018
											Sample Temperature	6.2	12.6	10.2	14	15.2	15
	Carbon																
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40	n/a	8.43	7.96	11	9.61	10.6	11.9
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80	n/a	7.02	6.84	9.96	8.24	10.2	10.7
	Inorganics																
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43	n/a	0.576	0.55	0.791	0.603	0.704	0.796
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00	n/a	452	425	627	487	558	624
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80	n/a	0.565	0.501	0.585	0.526	0.513	0.688
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60	n/a	11.2	12.2	9.52	10.4	8.07	9.88
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70	6-9	7.99	8.44	8.32	7.92	8.14	8.35
	Redox potential	TM110	mV		998	994	0	0.00%		246.00	n/a	106	168	163	143	93	175
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00	n/a	90.7	88.7	118	80.3	108	144
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07	n/a	0.0473	<0.01	<0.01	<0.01	<0.01	<0.01
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00	n/a	36.6	48	82.6	63.5	67.5	69.1
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60	n/a	<1	2.46	4	3.72	6.69	3.3
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00	n/a	34.9	22.2	36	26	37.1	32.4
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00	n/a	235	61.4	28.8	22.5	23.9	7.61
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28	0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17	0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28	0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91	n/a	<0.05	<0.05	<0.05	0.066	<0.05	<0.05
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60	0.3	<0.3	<0.3	<0.3	0.568	<0.3	<0.3
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00	n/a	384	41	30.5	18.5	19.5	12.5
	Metals - (Liquid)																
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00	n/a	25.9	29.2	36.5	24.9	32.9	44.1
	Filtered (Dissolved) Metals																
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03	0.0034	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05	0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35	n/a	<1	<1	<1	<1	<1	<1
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00	n/a	78.2	60.2	83.9	81.9	87.9	87.5
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50	50	2.18	2.62	2.41	2.41	3.53	4.65
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00	n/a	38.3	45.1	56.5	41.7	44.2	57.1
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00	n/a	20.1	28.5	70.3	97.6	47.4	28.4
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21	n/a	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17	1	<0.019	<0.019	<0.019	<0.019	<0.019	0.028
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00	1000	168	158	209	150	179	283
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29	0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70	4.7	5.7	<1	<1	<1	<1	<1
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30	1	2.18	5.92	0.712	2.72	<0.3	1.95
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70	1.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30	123	14.9	13.1	22.4	13.7	15.2	25.8
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06	4	2.11	1.02	2.44	1.92	2.05	2.01
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00	n/a	12.9	28.1	<10	29.2	26.2	23.1
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50	10	<1	<1	<1	<1	<1	<1
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60	20	12.3	17.5	5.35	4.69	5.64	6.18
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00	10.9	<1	<1	1.64	1.46	<1	<1
	Unfiltered (Total) Metals																
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00	n/a	102	61.6	114	51.2	78.6	74.9
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70	50	5.58	3.37	3.19	3.35	4.48	4.43
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00	n/a	67.9	71.5	72.4	52.2	60.8	60
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20	n/a	18.8	12.9	25	16.2	17.9	23.4
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17	n/a	<1	<1	<1	<1	<1	<1
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30	1	11.6	1.61	0.961	0.674	0.622	0.327
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00	1000	154	154	259	176	206	245
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79	0.25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80	4.7	14.4	3.7	<3	<3	<3	<3
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20	1	8.06	6.94	3.39	3.51	2.56	1.32
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00	n/a	257	204	302	261	282	325
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00	123	238	112	162	188	215	123
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40	4	13	3.59	3.4	2.66	2.89	2.47
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00	n/a	204	73.3	84.7	110	137	45.7
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00	1.2	9.18	4.71	2.64	1.59	1.71	<1
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25	1.2	0.00918	0.00471	0.00264	0.00159	0.00171	<0.001
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84	n/a	<4	<4	<4	<4	<4	<4
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70	10	2.58	2.07	1.18	<1	<1	<1
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00	20	28.7	18.4	7.41	7.44	7.7	7.19
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00	10.9	62.3	20	13	15.3	9.36	6.6
	Phenols																
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04	0.0077	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02	n/a	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03	n/a	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04	0.0077	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
	Gasoline Range Organics (GRO)																
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00	n/a	-	-	-	-	-	-
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10	n/a	-	-	-	-	-	-
	TPH Criteria Working Group (TPH CWG)																
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00	n/a	99	98	102	85	95	110
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00	n/a	<50	<50	<50	<50	<50	<50
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00	n/a	<3	<3	<3	<3	<3	<3
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00	10	<7	<7	<7	<7	<7	<7
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4	74	<4	<4	<4	<4	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00	20	<5	<5	<5	<5	<5	<5
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00	n/a	<8	<8	<8	<8	<8	<8
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00	n/a	<3	<3	<3	<3	<3	<3
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00	30	<11	<11	<11	<11	<11	<11
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00	n/a	<28	<28	<28	<28	<28	<28
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10	10	<10	<10	<10	<10	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00	10	<10	<10	<10	<10	<10	<10
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00	10	<10	<10	<10	<10	<10	<10
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00	10	<10	<10	<10	<10	<10	<10
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00	10	<10	<10	<10	<10	<10	<10
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00	10	<10	<10	<10	<10	<10	<10
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00	10	<10	<10	20	<10	<10	<10
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00	n/a	<10	<10	20	<10	<10	<10
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00	10	<10	<10	<10	<10	<10	<10
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10	10	<10	<10	<10	<10	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00	10	<10	<10	<10	<10	<10	<10
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00	10	<10	<10	<10	<10	<10	<10
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00	10	<10	<10	<10	<10	<10	<10
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00	10	<10	<10	<10	<10	<10	<10
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00	10	<10	<10	<10	<10	<10	<10
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00	n/a	<10	<10	<10	<10	<10	<10
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00	n/a	<10	<10	20	<10	<10	<10
	Polyaromatic Hydrocarbons (PAHs)																
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00	2.00000	0.0223	0.055	0.0295	0.0137	0.0203	0.011
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78	0.10000	<0.005	<0.005	<0.005	<0.005	0.00569	<0.005
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73	0.10000	0.00831	0.015	0.0111	0.00617	0.00788	<0.005
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95	0.00630	0.0643	0.111	0.091	0.0508	0.0344	0.0162
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05	0.10000	0.0144	0.0269	0.0164	0.00935	0.00704	<0.005
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60	0.10000	0.0458	0.104	0.0551	0.0275	0.0285	0.0152
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54	0.10000	0.00844	0.019	0.00821	0.00742	0.00666	<0.005
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85	0.10000	0.0282	0.0593	0.0388	0.0244	0.0138	<0.005
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31	0.10000	0.0616	0.125	0.08	0.0486	0.029	0.0144
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98	0.10000	0.0361	0.0631	0.0411	0.0177	0.0106	<0.005
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09	0.00017	0.0485	0.125	0.0397	0.039	0.0348	<0.005
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68	0.00017	0.0231	0.0719	0.0446	0.0168	0.0161	<0.005
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03	0.00017	0.0309	0.0576	0.0405	0.0229	0.0183	<0.002
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56	0.10000	0.00577	0.0107	0.00785	0.00751	<0.005	<0.005
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89	0.00017	0.0359	0.0888	0.0514	0.023	0.0199	<0.005
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20	0.00017	0.0246	0.065	0.0342	0.0251	0.0186	<0.005
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20	n/a	0.458	0.998	0.589	0.34	0.272	<0.082
	Semi-Volatile Organic Compounds (SVOCs)																
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	0.4	<1	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	4.2	<1	<1	<1	<1	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73	n/a	<1	<1	<1	<1	<1	<1
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14	n/a	<1	<1	<1	<1	<1	<1
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	n/a	<1	<1	<1	<1	<1	<1

Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max	D2-N	D2-N	D2-N
											0.00-0.00	0.00-0.00	0.00-0.00
											27/11/2018	10/12/2018	15/01/2019
											9.4	4.2	6.2
	Carbon												
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40	9.76	7.93	7.83
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80	8.89	7.02	6.75
	Inorganics												
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43	0.862	0.631	0.669
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00	674	521	541
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80	0.645	<0.5	0.621
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60	10.3	9.7	12.6
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70	7.89	8.36	8.17
	Redox potential	TM110	mV		998	994	0	0.00%		246.00	196	195	153
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00	252	171	231
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07	<0.01	<0.01	<0.01
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00	33.6	23.8	23.6
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60	<1	<1	-
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00	24.4	24.6	20.7
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00	19.6	27.5	12.9
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28	0.05	0.06	<0.05
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17	<0.05	<0.05	<0.05
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28	0.05	0.06	<0.05
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91	0.052	0.082	<0.05
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60	1.35	1.14	<0.3
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00	12	17.5	10.6
	Metals - (Liquid)												
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00	72.5	52.3	63.4
	Filtered (Dissolved) Metals												
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03	<0.03	<0.03	<0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05	0.0105	<0.01	<0.01
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35	<1	<1	<1
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00	273	120	120
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50	3.37	2.71	1.78
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00	90.9	60.1	57.9
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00	382	93.8	33.3
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21	<0.1	<0.1	<0.1
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17	0.849	0.0606	<0.019
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00	182	123	157
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29	<0.08	<0.08	<0.08
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70	<1	1.63	<1
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30	1.27	2.83	1.98
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70	1.75	<0.2	<0.2
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30	19.5	11.5	13.7
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06	1.77	1.45	1.19
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00	102	50.4	21.7
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50	1.78	3.32	1.85
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60	8.15	8.63	6.09
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00	8.17	2.06	1.21
	Unfiltered (Total) Metals												
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51	<0.02	0.0211	<0.02
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00	150	126	116
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70	3.02	2.13	2.52
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00	89.9	63.5	62
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20	19.7	10.9	14.2
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17	<1	<1	<1
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30	1.22	0.992	0.423
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00	189	118	169
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79	<0.5	<0.5	<0.5
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80	<3	<3	<3
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20	2.06	4.41	<1
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00	763	346	357
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00	389	122	53.8
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40	2.15	2.12	1.66
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00	108	93.7	49
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00	2.45	3.68	1.19
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25	0.00245	0.00368	0.00119
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84	<4	<4	<4
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70	1.89	3.24	2.33
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00	7.66	9.73	7.27
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00	12.6	15.7	10.5
	Phenols												
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04	<0.002	<0.002	<0.002
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02	<0.006	<0.006	<0.006
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03	<0.008	<0.008	<0.008
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04	<0.016	<0.016	<0.016
	Gasoline Range Organics (GRO)												
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00	-	-	-
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10	-	-	-
	TPH Criteria Working Group (TPH CWG)												
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00	90	86	97
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00	<50	<50	<50
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00	<3	<3	<3
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00	<7	<7	<7
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4	<4	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00	<5	<5	<5
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00	<8	<8	<8
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00	<3	<3	<3
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00	<11	<11	<11
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00	<28	<28	<28
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10	<10	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00	<10	<10	<10
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00	<10	<10	<10
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00	<10	<10	<10
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00	<10	<10	<10
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00	<10	<10	<10
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00	<10	<10	<10
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00	<10	<10	<10
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00	<10	<10	<10
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10	<10	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00	<10	<10	<10
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00	<10	<10	<10
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00	<10	<10	<10
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00	<10	<10	<10
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00	<10	<10	114
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00	<10	<10	114
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00	<10	<10	114
	Polyaromatic Hydrocarbons (PAHs)												
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00	0.0442	0.0599	0.0349
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78	0.00998	0.216	0.0126
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73	<0.005	0.041	0.0115
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95	0.0689	0.142	0.0554
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05	0.023	0.0349	0.0111
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60	0.0731	0.104	0.0561
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54	0.0156	0.0757	0.0103
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85	<0.005	0.0514	0.0229
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31	0.0531	0.104	0.04
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98	<0.005	0.0518	0.0207
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09	0.039	0.0781	0.0292
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68	0.0146	0.0293	0.013
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03	0.024	0.0462	0.0153
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56	<0.005	0.00885	<0.005
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89	<0.005	0.0436	0.011
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20	<0.005	0.0322	<0.005
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20	0.365	1.12	0.344
	Semi-Volatile Organic Compounds (SVOCs)												
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73	<1	<1	<1
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14	<1	<1	<1
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61	<1	<1	<1
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30	<1	<1	<1
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00	<4	<2	<2
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81	<1	<1	<1
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05	<1	<1	<1
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00	<1	<1	<1
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55	<1	<1	<1
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5	<5	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90	<1	<1	<1
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11	<1	<1	<1
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%			Not Detected	Not Detected	Not Detected
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00	<10	<10	<10
	Volatile Organic Compounds (VOCs)												
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00	115	112	109
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00	96.6	94.8	104
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00	102	98.9	94.6
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08	<1	<1	<1
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3	<3	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37	<1	<1	<1
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00	<1	<1	<1
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34	<1	<1	<1
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52	<1	<1	<1
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59	<1	<1	<1
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90	<1	<1	<1
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80	<1	<1	<1
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04	<1	<1	<1
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02	<1	<1	<1
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58	<1	<1	<1
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60	<1	<1	<1
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2	-	-	-
	TICS												
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00	-	-	-
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70	-	-	-
	Indane		µg/l		988	3	0	0.00%	0.00	32.40	-	-	-
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50	-	-	-
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00	-	-	-
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90	-	-	-
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60	-	-	-
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40	-	-	-
	Inorganics Extra												
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00	-	-	-
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49	-	-	-
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63	-	-	-
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40	-	-	-
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80	-	-	-
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60	-	-	-
	TPH												
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00	-	-	-
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00	-	-	-
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00	-	-	-
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00	-	-	-
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00	-	-	-
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00	-	-	-
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00	-	-	-
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00	-	-	-
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00	-	-	-
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00	-	-	-
	Miscellaneous Organics												
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02	-	-	-
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39	-	-	-
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05	-	-	-
	Subcontracted: Inorganics												
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00		-	-	<1
	EPH CWG (Speciated)												
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00	<10	<10	<10
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82	<0.01	<0.01	0.0134
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84	0.0583	0.0929	<0.005
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13	<0.005	0.0097	<0.005
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20	0.0206	0.0298	0.0115
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05	0.00625	<0.005	<0.005
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30	0.00775	0.0119	0.00991
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22	<0.005	0.0168	<0.005
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04	<0.005	<0.005	<0.005
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15	0.0167	0.0307	0.0101
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10	<0.005	<0.005	0.00612
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06	<0.005	<0.005	<0.005
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02	<0.002	<0.002	0.00241
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02	<0.005	<0.005	<0.005
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03	<0.005	<0.005	<0.005
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03	<0.005	<0.005	<0.005
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99	0.11	0.192	<0.082
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04	<0.005	<0.005	<0.005
	Glycols												
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00		-	-	-
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	TICs												
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00	-	-	-
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00	-	-	-
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00	-	-	-
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60	-	-	-
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20	-	-	-
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00	-	-	-
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60	-	-	-
	Docosenamide		µg/l		988	4	0	0.00%	0.00	44.00	-	-	-
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00	-	-	-
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40	-	-	-
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00	-	-	-
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00	-	-	-
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00	-	-	-
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40	-	-	-
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50	-	-	-
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40	-	-	-
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00	-	-	-
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00	-	-	-
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00	-	-	-
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00	-	-	-
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10	-	-	-
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50	-	-	-
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10	-	-	-
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20	-	-	-
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60	-	-	-
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70	-	-	-
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10	-	-	-
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10	-	-	-
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50	-	-	-
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90	-	-	-
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10	-	-	-
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50	-	-	-
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00	-	-	-
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60	-	-	-
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00	-	-	-
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70	-	-	-
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50	-	-	-
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70	-	-	-
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60	-	-	-
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20	-	-	-
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30	-	-	-
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00	-	-	-

Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max
	Carbon									
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80
	Inorganics									
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70
	Redox potential	TM110	mV		998	994	0	0.00%		246.00
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00
	Metals - (Liquid)									
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00
	Filtered (Dissolved) Metals									
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00
	Unfiltered (Total) Metals									
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00
	Phenols									
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04
	Gasoline Range Organics (GRO)									
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10
	TPH Criteria Working Group (TPH CWG)									
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00
	Polyaromatic Hydrocarbons (PAHs)									
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20
	Semi-Volatile Organic Compounds (SVOCs)									
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%		
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00
	Volatile Organic Compounds (VOCs)									
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2
	TICS									
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70
	Indane		µg/l		988	3	0	0.00%	0.00	32.40
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40
	Inorganics Extra									
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60
	TPH									
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00
	Miscellaneous Organics									
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05
	Subcontracted: Inorganics									
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00	
	EPH CWG (Speciated)									
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04
	Glycols									
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	TICs									
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60
	Doccosenamide		µg/l		988	4	0	0.00%	0.00	44.00
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00

Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max
	Carbon									
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80
	Inorganics									
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70
	Redox potential	TM110	mV		998	994	0	0.00%		246.00
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00
	Metals - (Liquid)									
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00
	Filtered (Dissolved) Metals									
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00
	Unfiltered (Total) Metals									
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00
	Phenols									
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04
	Gasoline Range Organics (GRO)									
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10
	TPH Criteria Working Group (TPH CWG)									
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00
	Polyaromatic Hydrocarbons (PAHs)									
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20
	Semi-Volatile Organic Compounds (SVOCs)									
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%		
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00
	Volatile Organic Compounds (VOCs)									
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2
	TICS									
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70
	Indane		µg/l		988	3	0	0.00%	0.00	32.40
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40
	Inorganics Extra									
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60
	TPH									
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00
	Miscellaneous Organics									
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05
	Subcontracted: Inorganics									
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00	
	EPH CWG (Speciated)									
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04
	Glycols									
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	TICs									
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60
	Docosenamide		µg/l		988	4	0	0.00%	0.00	44.00
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00

Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max	D5-S3 0.00-0.00 31/05/2018 14	D5-S3 0.00-0.00 11/06/2018 15.2	D5-S3 0.00-0.00 25/06/2018 15
	Carbon												
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40	10.8	12.8	12.4
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80	9.58	11.9	11.3
	Inorganics												
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43	0.725	0.875	0.884
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00	576	707	698
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80	1.11	1.14	1.25
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60	9.69	9.8	10.4
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70	8.26	8.35	9.03
	Redox potential	TM110	mV		998	994	0	0.00%		246.00	127	83	201
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00	219	280	273
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07	0.0242	<0.01	<0.01
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00	56	95.6	91.7
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60	3.04	<1	<1
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00	34.4	43.4	35.8
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00	33.4	14.1	8.93
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28	<0.05	<0.05	<0.05
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17	<0.05	<0.05	<0.05
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28	<0.05	<0.05	<0.05
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91	<0.05	<0.05	<0.05
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60	0.678	0.336	<0.3
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00	23.5	9	7
	Metals - (Liquid)												
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00	68.3	86.4	84.3
	Filtered (Dissolved) Metals												
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03	<0.03	<0.03	<0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05	<0.01	<0.01	<0.01
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35	1.33	2.2	2.42
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00	98.1	113	118
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50	3.94	6.44	6.18
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00	70.1	64.1	63.2
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00	88.9	23.5	11
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21	<0.1	<0.1	<0.1
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17	0.0396	<0.019	<0.019
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00	189	137	148
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29	<0.08	<0.08	<0.08
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70	<1	<1	<1
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30	3.9	6.3	<0.3
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70	0.277	0.203	<0.2
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30	5.5	1.92	1.26
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06	1.84	2.59	2.66
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00	26.3	28.5	26
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50	2.05	3.49	2.49
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60	16.5	42.3	44.4
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00	1.7	<1	2.04
	Unfiltered (Total) Metals												
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51	0.0235	<0.02	<0.02
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00	62	111	90.7
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70	4.86	6.89	6.19
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00	74.6	71.7	65.7
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20	5.51	1.98	1.32
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17	<1	<1	<1
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30	0.915	0.445	0.335
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00	187	141	144
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79	<0.5	<0.5	<0.5
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80	<3	<3	<3
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20	5.07	6.68	5.06
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00	268	291	299
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00	230	54.3	28.7
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40	2.78	3.43	2.72
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00	73	48.8	25.6
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00	5.32	1.99	1.6
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25	0.00532	0.00199	0.0016
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84	<4	<4	<4
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70	1.86	3.13	2.25
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00	18.1	43.9	41.4
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00	19.7	6.54	5.53
	Phenols												
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04	<0.002	<0.002	<0.002
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02	<0.006	<0.006	<0.006
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03	<0.008	<0.008	<0.008
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04	<0.016	<0.016	<0.016
	Gasoline Range Organics (GRO)												
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00	-	-	-
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10	-	-	-
	TPH Criteria Working Group (TPH CWG)												
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00	91	95	97
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00	<50	<50	<50
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00	<3	<3	<3
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00	<7	<7	<7
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4	<4	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00	<5	<5	<5
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00	<8	<8	<8
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00	<3	<3	<3
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00	<11	<11	<11
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00	<28	<28	<28
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10	<10	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00	<10	<10	<10
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00	<10	<10	<10
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00	<10	<10	<10
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00	<10	<10	<10
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00	<10	<10	<10
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00	<10	<10	<10
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00	<10	<10	<10
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00	<10	<10	<10
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10	<10	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00	<10	<10	<10
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00	<10	<10	<10
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00	<10	<10	<10
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00	<10	<10	<10
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00	<10	<10	<10
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00	<10	<10	<10
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00	<10	<10	<10
	Polyaromatic Hydrocarbons (PAHs)												
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00	0.0485	0.0194	0.0235
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78	0.0083	0.0123	0.0117
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73	0.00823	<0.005	<0.005
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95	0.0799	0.0195	0.0231
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05	0.0207	<0.005	<0.005
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60	0.0627	0.01	0.0122
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54	0.0126	0.0106	0.0132
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85	0.0259	<0.005	<0.005
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31	0.0759	0.0331	0.0334
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98	0.03	<0.005	<0.005
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09	0.0454	0.0137	0.0143
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68	0.0229	<0.005	0.00537
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03	0.0248	0.00789	0.0116
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56	<0.005	<0.005	<0.005
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89	0.0363	<0.005	<0.005
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20	0.0201	0.00729	<0.005
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20	0.522	0.134	0.148
	Semi-Volatile Organic Compounds (SVOCs)												
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73	<1	<1	<1
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14	<1	<1	<1
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61	<1	<1	<1
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30	<1	<1	<1
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00	<2	<2	<2
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81	<1	<1	<1
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05	<1	<1	<1
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00	<1	<1	<1
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55	<1	<1	<1
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5	<5	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90	<1	<1	<1
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11	<1	<1	<1
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1	-	-	-
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%			Not Detected	Not Detected	Not Detected
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00	<10	<10	<10
	Volatile Organic Compounds (VOCs)												
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00	99.8	112	113
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00	96.2	98.5	99.3
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00	101	97.9	99.4
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08	<1	<1	<1
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3	<3	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37	<1	<1	<1
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00	<1	<1	<1
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34	<1	<1	<1
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52	1.21	<1	<1
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59	<1	<1	<1
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90	<1	<1	<1
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80	<1	<1	<1
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04	<1	<1	<1
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02	<1	<1	<1
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58	<1	<1	<1
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60	<1	<1	<1
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1	<1	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2	-	-	-
	TICS												
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00	-	-	-
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70	-	-	-
	Indane		µg/l		988	3	0	0.00%	0.00	32.40	-	-	-
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50	-	-	-
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00	-	-	-
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90	-	-	-
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60	-	-	-
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40	-	-	-
	Inorganics Extra												
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00	-	-	-
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49	-	-	-
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63	-	-	-
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40	-	-	-
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80	-	-	-
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60	-	-	-
	TPH												
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00	-	-	-
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00	-	-	-
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00	-	-	-
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00	-	-	-
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00	-	-	-
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00	-	-	-
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00	-	-	-
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00	-	-	-
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00	-	-	-
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00	-	-	-
	Miscellaneous Organics												
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02	-	-	-
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39	-	-	0.0296
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05	-	-	0.00649
	Subcontracted: Inorganics												
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00		-	-	-
	EPH CWG (Speciated)												
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00	<10	<10	<10
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82	-	0.0184	0.0199
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84	-	0.0139	0.00966
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13	-	<0.005	<0.005
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20	-	0.0134	0.0125
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05	-	<0.005	<0.005
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30	-	0.00816	<0.005
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22	-	0.0112	<0.005
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04	-	<0.005	<0.005
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15	-	0.0222	0.017
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10	-	0.00627	<0.005
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06	-	<0.005	<0.005
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02	-	<0.002	<0.002
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02	-	<0.005	<0.005
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03	-	<0.005	<0.005
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03	-	<0.005	<0.005
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99	-	0.105	<0.082
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04	-	0.0112	<0.005
	Glycols												
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00		-	-	-
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00	-	-	-
	TICs												
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00	-	-	-
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00	-	-	-
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00	-	-	-
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60	-	-	-
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20	-	-	-
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00	-	-	-
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60	-	-	-
	Docosenamide		µg/l		988	4	0	0.00%	0.00	44.00	-	-	-
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00	-	-	-
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40	-	-	-
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00	-	-	-
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00	-	-	-
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00	-	-	-
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40	-	-	-
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50	-	-	-
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40	-	-	-
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00	-	-	-
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00	-	-	-
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00	-	-	-
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00	-	-	-
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10	-	-	-
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50	-	-	-
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10	-	-	-
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20	-	-	-
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60	-	-	-
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70	-	-	-
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10	-	-	-
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10	-	-	-
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50	-	-	-
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90	-	-	-
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10	-	-	-
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50	-	-	-
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00	-	-	-
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60	-	-	-
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00	-	-	-
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70	-	-	-
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50	-	-	-
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70	-	-	-
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60	-	-	-
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20	-	-	-
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30	-	-	-
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00	-	-	-

Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max
	Carbon									
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80
	Inorganics									
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70
	Redox potential	TM110	mV		998	994	0	0.00%		246.00
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00
	Metals - (Liquid)									
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00
	Filtered (Dissolved) Metals									
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00
	Unfiltered (Total) Metals									
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00
	Phenols									
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04
	Gasoline Range Organics (GRO)									
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10
	TPH Criteria Working Group (TPH CWG)									
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00
	Polyaromatic Hydrocarbons (PAHs)									
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20
	Semi-Volatile Organic Compounds (SVOCs)									
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%		
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00
	Volatile Organic Compounds (VOCs)									
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2
	TICS									
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70
	Indane		µg/l		988	3	0	0.00%	0.00	32.40
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40
	Inorganics Extra									
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60
	TPH									
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00
	Miscellaneous Organics									
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05
	Subcontracted: Inorganics									
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00	
	EPH CWG (Speciated)									
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04
	Glycols									
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	TICs									
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60
	Docosenamide		µg/l		988	4	0	0.00%	0.00	44.00
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00

Glan Llyn Surface Water Data

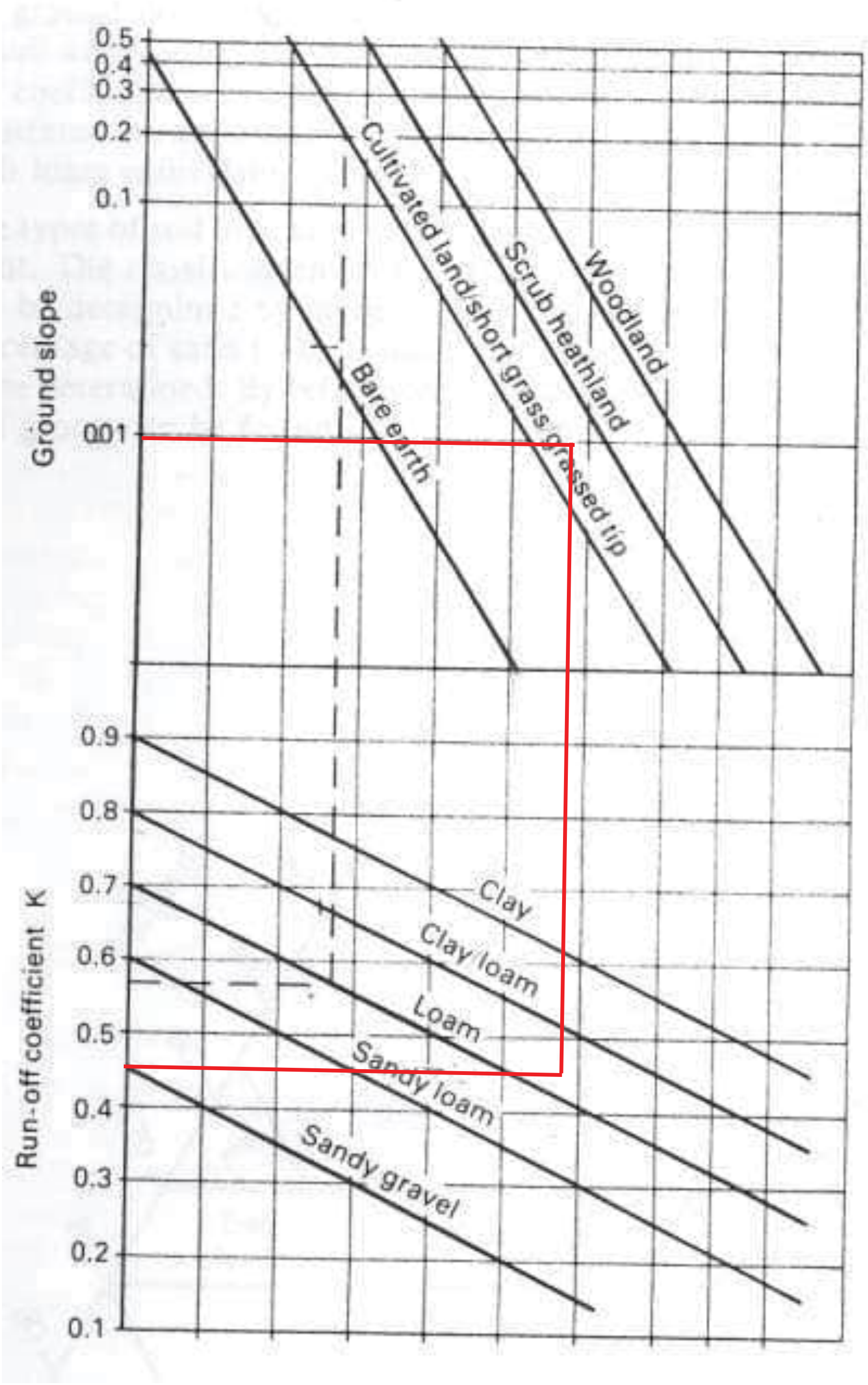
Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max
	Carbon									
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80
	Inorganics									
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70
	Redox potential	TM110	mV		998	994	0	0.00%		246.00
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00
	Metals - (Liquid)									
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00
	Filtered (Dissolved) Metals									
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00
	Unfiltered (Total) Metals									
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00
	Phenols									
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04
	Gasoline Range Organics (GRO)									
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10
	TPH Criteria Working Group (TPH CWG)									
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00
	Polyaromatic Hydrocarbons (PAHs)									
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20
	Semi-Volatile Organic Compounds (SVOCs)									
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%		
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00
	Volatile Organic Compounds (VOCs)									
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2
	TICS									
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70
	Indane		µg/l		988	3	0	0.00%	0.00	32.40
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40
	Inorganics Extra									
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60
	TPH									
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00
	Miscellaneous Organics									
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05
	Subcontracted: Inorganics									
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00	
	EPH CWG (Speciated)									
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04
	Glycols									
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	TICs									
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60
	Docosenamide		µg/l		988	4	0	0.00%	0.00	44.00
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00

Glan Llyn Surface Water Data

Notes	Determinand	Method	Units	LOD	No. of Samples	No. of Samples >LOD	No. of Samples > EQS	% of samples exceeding EQS	Min	Max
	Carbon									
	Carbon, Organic (diss.filt)	TM090	mg/l	<3	998	977	0	0.00%	<3	53.40
	Organic Carbon, Total	TM090	mg/l	<3	998	972	0	0.00%	<3	57.80
	Inorganics									
	Conductivity @ 20 deg.C (diss.filt)	TM120	mS/cm	<0.014	998	995	0	0.00%	<0.014	2.43
	Dissolved solids, Total (meter)	TM123	mg/l	<5	998	995	0	0.00%	<5	2080.00
	Fluoride	TM104	mg/l	<0.5	998	787	0	0.00%	<0.5	1.80
	Oxygen, dissolved	TM046	mg/l	<0.3	998	995	0	0.00%	<0.3	13.60
High pH in c. half of samples	pH	TM256	pH Units	<1	998	992	0	0.00%	<1	11.70
	Redox potential	TM110	mV		998	994	0	0.00%		246.00
	Sulphate	TM184	mg/l	<2	998	995	0	0.00%	<2	1220.00
	Sulphide	TM101	mg/l	<0.01	998	95	0	0.00%	<0.01	0.07
	Chloride	TM184	mg/l	<2	998	995	0	0.00%	<2	259.00
	BOD, unfiltered	TM045	mg/l	<1	998	623	0	0.00%	<1	26.60
	COD, unfiltered	TM107	mg/l	<7	998	982	0	0.00%	<7	304.00
	Turbidity	TM195	ntu	<0.1	998	960	0	0.00%	<0.1	1370.00
Cyanide EQS < LOD	Cyanide, Total	TM227	mg/l	<0.05	998	118	118	11.82%	<0.05	0.28
Cyanide EQS < LOD	Cyanide, Free	TM227	mg/l	<0.05	998	34	34	3.41%	<0.05	0.17
Cyanide EQS < LOD	Cyanide, Complex	TM227	mg/l	<0.05	998	86	86	8.62%	<0.05	0.28
	Phosphate (ortho) as PO4	TM184	mg/l	<0.05	998	244	0	0.00%	<0.05	4.91
	Ammoniacal Nitrogen as NH4	TM099	mg/l	<0.3	998	635	628	62.93%	<0.3	18.60
	Suspended solids, Total	TM022	mg/l	<2	998	950	0	0.00%	<2	690.00
	Metals - (Liquid)									
	Sulphur Dissolved	TM228	mg/l	<1	998	995	0	0.00%	<1	411.00
	Filtered (Dissolved) Metals									
Chromium EQS > LOD	Chromium, Hexavalent	TM241	mg/l	<0.03	998	1	1	0.10%	<0.03	0.03
	Mercury (diss.filt)	TM183	µg/l	<0.01	998	115	0	0.00%	<0.01	0.05
	Antimony (diss.filt)	TM152	µg/l	<0.16	998	222	0	0.00%	<0.16	4.35
	Calcium (diss.filt)	TM228	mg/l	<0.012	998	983	0	0.00%	<0.012	371.00
	Arsenic (diss.filt)	TM152	µg/l	<0.12	998	984	0	0.00%	<0.12	28.50
	Barium (diss.filt)	TM152	µg/l	<0.03	998	983	0	0.00%	<0.03	304.00
	Magnesium (diss.filt)	TM228	mg/l	<0.036	998	899	0	0.00%	<0.036	12300.00
	Beryllium (diss.filt)	TM152	µg/l	<0.07	998	2	0	0.00%	<0.07	0.21
	Iron (diss.filt)	TM228	mg/l	<0.019	998	596	5	0.50%	<0.019	2.17
	Boron (diss.filt)	TM152	µg/l	<9.4	998	983	4	0.40%	<9.4	2070.00
	Cadmium (diss.filt)	TM152	µg/l	<0.1	998	9	1	0.10%	<0.1	0.29
	Chromium (diss.filt)	TM152	µg/l	<0.22	998	197	34	3.41%	<0.22	10.70
	Copper (diss.filt)	TM152	µg/l	<0.85	998	848	704	70.54%	<0.85	15.30
	Lead (diss.filt)	TM152	µg/l	<0.02	998	269	31	3.11%	<0.02	12.70
	Manganese (diss.filt)	TM152	µg/l	<0.04	998	983	0	0.00%	<0.04	76.30
	Nickel (diss.filt)	TM152	µg/l	<0.15	998	935	51	5.11%	<0.15	9.06
	Phosphorus (diss.filt)	TM152	µg/l	<6.3	998	866	0	0.00%	<6.3	1630.00
	Selenium (diss.filt)	TM152	µg/l	<0.39	998	750	2	0.20%	<0.39	16.50
Vanadium EQS>LOD	Vanadium (diss.filt)	TM152	µg/l	<0.24	998	943	255	25.55%	<0.24	95.60
	Zinc (diss.filt)	TM152	µg/l	<0.41	998	816	31	3.11%	<0.41	522.00
	Unfiltered (Total) Metals									
	Mercury (tot.unfilt)	TM183	µg/l	<0.02	998	144	13	1.30%	<0.02	0.51
	Calcium (tot.unfilt)	TM228	mg/l	<0.057	998	975	0	0.00%	<0.057	336.00
	Arsenic (tot.unfilt)	TM191	µg/l	<2	998	858	1	0.10%	<2	53.70
	Barium (tot.unfilt)	TM191	µg/l	<0.5	998	994	0	0.00%	<0.5	585.00
	Magnesium (tot.unfilt)	TM228	mg/l	<0.05	998	994	0	0.00%	<0.05	71.20
	Beryllium (tot.unfilt)	TM191	µg/l	<1	998	2	0	0.00%	<1	2.17
	Iron (tot.unfilt)	TM228	mg/l	<0.024	998	964	217	21.74%	<0.024	42.30
	Boron (tot.unfilt)	TM191	µg/l	<135	998	979	4	0.40%	<135	2030.00
	Cadmium (tot.unfilt)	TM191	µg/l	<0.5	998	4	4	0.40%	<0.5	1.79
	Chromium (tot.unfilt)	TM191	µg/l	<3	998	140	82	8.22%	<3	72.80
	Copper (tot.unfilt)	TM191	µg/l	<4	998	859	859	86.07%	<4	42.20
	Hardness, Total as CaCO3 unfiltered	TM228	mg/l	<0.35	998	967	0	0.00%	<0.35	1160.00
	Manganese (tot.unfilt)	TM191	µg/l	<0.5	998	994	393	39.38%	<0.5	12000.00
	Nickel (tot.unfilt)	TM191	µg/l	<0.5	998	943	140	14.03%	<0.5	27.40
	Phosphorus (tot.unfilt)	TM191	µg/l	<20	998	981	0	0.00%	<20	2740.00
	Lead (tot.unfilt)	TM191	µg/l	<0.5	998	730	659	66.03%	<0.5	246.00
	Lead (tot.unfilt) Calculated bioavailable		µg/l		988	720	0	0.00%	0.00	0.25
	Antimony (tot.unfilt)	TM191	µg/l	<4	998	4	0	0.00%	<4	4.84
	Selenium (tot.unfilt)	TM191	µg/l	<1	998	827	3	0.30%	<1	13.70
	Vanadium (tot.unfilt)	TM191	µg/l	<8	998	852	316	31.66%	<8	141.00
	Zinc (tot.unfilt)	TM191	µg/l	<3	998	861	463	46.39%	<3	780.00
	Phenols									
	Phenol	TM259	mg/l	<0.002	998	21	21	2.10%	<0.002	0.04
	Cresols	TM259	mg/l	<0.006	998	12	0	0.00%	<0.006	0.02
	Xylenols	TM259	mg/l	<0.008	998	21	0	0.00%	<0.008	0.03
	Phenols, Total Detected monohydric	TM259	mg/l	<0.016	998	21	21	2.10%	<0.016	0.04
	Gasoline Range Organics (GRO)									
	Total Aliphatics >C5-C12	TM245	µg/l	<10	988	2	0	0.00%	<10	3660000.00
	Total Aromatics >EC5-EC12	TM245	µg/l	<10	988	0	2	0.20%	<10	<10
	TPH Criteria Working Group (TPH CWG)									
	GRO Surrogate % recovery**	TM245	%		998	960	0	0.00%		130.00
	GRO >C5-C12	TM245	µg/l	<50	998	8	0	0.00%	<50	726.00
	Methyl tertiary butyl ether (MTBE)	TM245	µg/l	<3	998	1	0	0.00%	<3	4.00
	Benzene	TM245	µg/l	<7	998	6	6	0.60%	<7	429.00
	Toluene	TM245	µg/l	<4	998	0	0	0.00%	<4	<4
	Ethylbenzene	TM245	µg/l	<5	998	6	1	0.10%	<5	30.00
	m,p-Xylene	TM245	µg/l	<8	998	2	0	0.00%	<8	9.00
	o-Xylene	TM245	µg/l	<3	998	4	0	0.00%	<3	9.00
	Sum of detected Xylenes	TM245	µg/l	<11	998	2	0	0.00%	<11	18.00
	Sum of detected BTEX	TM245	µg/l	<28	998	6	0	0.00%	<28	459.00
	Aliphatics >C5-C6	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aliphatics >C6-C8	TM245	µg/l	<10	998	4	3	0.30%	<10	19.00
	Aliphatics >C8-C10	TM245	µg/l	<10	998	5	5	0.50%	<10	21.00
	Aliphatics >C10-C12	TM245	µg/l	<10	998	8	8	0.80%	<10	134.00
	Aliphatics >C12-C16 (aq)	TM174	µg/l	<10	998	2	2	0.20%	<10	2080.00
	Aliphatics >C16-C21 (aq)	TM174	µg/l	<10	998	13	13	1.30%	<10	8140.00
	Aliphatics >C21-C35 (aq)	TM174	µg/l	<10	998	24	24	2.40%	<10	49700.00
	Total Aliphatics >C12-C35 (aq)	TM174	µg/l	<10	998	29	0	0.00%	<10	59900.00
	Aromatics >EC5-EC7	TM245	µg/l	<10	998	6	6	0.60%	<10	429.00
	Aromatics >EC7-EC8	TM245	µg/l	<10	998	0	0	0.00%	<10	<10
	Aromatics >EC8-EC10	TM245	µg/l	<10	998	9	8	0.80%	<10	56.00
	Aromatics >EC10-EC12	TM245	µg/l	<10	998	8	8	0.80%	<10	89.00
	Aromatics >EC12-EC16 (aq)	TM174	µg/l	<10	998	11	10	1.00%	<10	107.00
	Aromatics >EC16-EC21 (aq)	TM174	µg/l	<10	998	12	12	1.20%	<10	183.00
	Aromatics >EC21-EC35 (aq)	TM174	µg/l	<10	998	46	43	4.31%	<10	919.00
	Total Aromatics >EC12-EC35 (aq)	TM174	µg/l	<10	998	53	0	0.00%	<10	1200.00
	Total Aliphatics & Aromatics >C5-35 (aq)	TM174	µg/l	<10	998	107	0	0.00%	<10	61100.00
	Polyaromatic Hydrocarbons (PAHs)									
	Naphthalene (aq)	TM178	µg/l	<0.1	998	803	3	0.30%	<0.1	87.00
	Acenaphthene (aq)	TM178	µg/l	<0.015	998	716	115	11.52%	<0.015	0.78
	Acenaphthylene (aq)	TM178	µg/l	<0.011	998	580	23	2.30%	<0.011	0.73
Fluoranthene LOD>WQS	Fluoranthene (aq)	TM178	µg/l	<0.017	998	909	904	90.58%	<0.017	5.95
	Anthracene (aq)	TM178	µg/l	<0.015	998	686	27	2.71%	<0.015	1.05
	Phenanthrene (aq)	TM178	µg/l	<0.022	998	887	190	19.04%	<0.022	3.60
	Fluorene (aq)	TM178	µg/l	<0.014	998	731	48	4.81%	<0.014	0.54
	Chrysene (aq)	TM178	µg/l	<0.013	998	599	67	6.71%	<0.013	2.85
	Pyrene (aq)	TM178	µg/l	<0.015	998	907	180	18.04%	<0.015	4.31
	Benzo(a)anthracene (aq)	TM178	µg/l	<0.017	998	547	57	5.71%	<0.017	2.98
	Benzo(b)fluoranthene (aq)	TM178	µg/l	<0.023	998	778	778	77.96%	<0.023	5.09
	Benzo(k)fluoranthene (aq)	TM178	µg/l	<0.027	998	655	655	65.63%	<0.027	1.68
	Benzo(a)pyrene (aq)	TM178	µg/l	<0.009	998	794	794	79.56%	<0.009	3.03
	Dibenzo(a,h)anthracene (aq)	TM178	µg/l	<0.016	998	292	3	0.30%	<0.016	0.56
	Benzo(g,h,i)perylene (aq)	TM178	µg/l	<0.016	998	550	550	55.11%	<0.016	2.89
	Indeno(1,2,3-cd)pyrene (aq)	TM178	µg/l	<0.014	998	603	603	60.42%	<0.014	2.20
	PAH, Total Detected USEPA 16 (aq)	TM178	µg/l	<0.344	998	825	0	0.00%	<0.344	87.20
	Semi-Volatile Organic Compounds (SVOCs)									
	1,2,4-Trichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,5-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4,6-Trichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dichlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,4-Dimethylphenol (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.73
	2,4-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2,6-Dinitrotoluene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chloronaphthalene (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	3.14
	2-Chlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylnaphthalene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Nitrophenol (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	2.61
	3-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Bromophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloro-3-methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Chloroaniline (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	1.30
	4-Chlorophenylphenylether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Methylphenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitroaniline (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	4-Nitrophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Azobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Acenaphthylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Acenaphthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	bis(2-Chloroethyl)ether (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Chloroethoxy)methane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	bis(2-Ethylhexyl) phthalate (aq)	TM176	µg/l	<2	998	24	24	2.40%	<2	67700.00
	Butylbenzyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzo(a)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(b)fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(k)fluoranthene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	1.81
	Benzo(a)pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Benzo(g,h,i)perylene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Carbazole (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Chrysene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dibenzofuran (aq)	TM176	µg/l	<1	998	2	0	0.00%	<1	1.05
	n-Dibutyl phthalate (aq)	TM176	µg/l	<1	998	4	0	0.00%	<1	8.00
	Diethyl phthalate (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibenzo(a,h)anthracene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Dimethyl phthalate (aq)	TM176	µg/l	<1	998	1	0	0.00%	<1	6.55
	n-Dioctyl phthalate (aq)	TM176	µg/l	<5	998	0	0	0.00%	<5	<5
	Fluoranthene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Fluorene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Hexachlorobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Pentachlorophenol (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenol (aq)	TM176	µg/l	<1	998	3	1	0.10%	<1	21.90
	n-Nitroso-n-dipropylamine (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachloroethane (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Nitrobenzene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Isophorone (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorocyclopentadiene (aq)	TM176	µg/l	<1	998	0	0	0.00%	<1	<1
	Phenanthrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	Indeno(1,2,3-cd)pyrene (aq)	TM176	µg/l	<1	998	2	2	0.20%	<1	2.11
	Pyrene (aq)	TM176	µg/l	<1	988	0	0	0.00%	<1	<1
	SVOC TIC (aq)	TM176	-		998	0	0	0.00%		
	Total SVOC TIC	TM176	µg/l	<10	998	155	0	0.00%	<10	107000.00
	Volatile Organic Compounds (VOCs)									
	Dibromofluoromethane**	TM208	%		998	960	0	0.00%		128.00
	Toluene-d8**	TM208	%		998	960	0	0.00%		110.00
	4-Bromofluorobenzene**	TM208	%		998	960	0	0.00%		110.00
	Dichlorodifluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Vinyl chloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Trichlorofluoromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbon disulphide	TM208	µg/l	<1	998	1	0	0.00%	<1	1.08
	Dichloromethane	TM208	µg/l	<3	998	0	0	0.00%	<3	<3
	Methyl tertiary butyl ether (MTBE)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	trans-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	cis-1,2-Dichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chloroform	TM208	µg/l	<1	998	8	0	0.00%	<1	2.37
	1,1,1-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Carbontetrachloride	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Benzene	TM208	µg/l	<1	998	14	7	0.70%	<1	465.00
	Trichloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromomethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromodichloromethane	TM208	µg/l	<1	998	1	0	0.00%	<1	1.34
	cis-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Toluene	TM208	µg/l	<1	998	3	0	0.00%	<1	2.52
	trans-1,3-Dichloropropene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2-Trichloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Tetrachloroethene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Dibromochloromethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromoethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Chlorobenzene	TM208	µg/l	<1	998	1	0	0.00%	<1	3.59
	1,1,1,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Ethylbenzene	TM208	µg/l	<1	998	10	0	0.00%	<1	21.90
	m,p-Xylene	TM208	µg/l	<1	998	9	0	0.00%	<1	10.80
	o-Xylene	TM208	µg/l	<1	998	8	0	0.00%	<1	9.04
	Styrene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromoform	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Isopropylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,1,2,2-Tetrachloroethane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,3-Trichloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Bromobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Propylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	2-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trimethylbenzene	TM208	µg/l	<1	998	2	0	0.00%	<1	2.02
	4-Chlorotoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trimethylbenzene	TM208	µg/l	<1	998	5	0	0.00%	<1	3.58
	sec-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	4-iso-Propyltoluene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,4-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	n-Butylbenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2-Dibromo-3-chloropropane	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,2,4-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Hexachlorobutadiene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	tert-Amyl methyl ether (TAME)	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Naphthalene	TM208	µg/l	<1	998	4	4	0.40%	<1	37.60
	1,2,3-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	1,3,5-Trichlorobenzene	TM208	µg/l	<1	998	0	0	0.00%	<1	<1
	Sum of detected Xylenes	TM208	µg/l	<2	988	0	0	0.00%	<2	<2
	TICS									
	Octadecanoic acid		µg/l		988	9	0	0.00%		146.00
	Hexadecanoic acid	TM176	µg/l		988	69	0	0.00%	0.00	68.70
	Indane		µg/l		988	3	0	0.00%	0.00	32.40
	Hexadecenoic acid	TM176	µg/l		988	2	0	0.00%	0.00	50.50
	Mixed hydrocarbons (SVOC)	TM176	µg/l		988	99	0	0.00%		2250.00
	Mixed Hydrocarbons (VOC)	TM208	µg/l		988	1	0	0.00%		16.90
	Squalene		µg/l		988	1	0	0.00%	0.00	19.60
	Tetradecanoic acid	TM176	µg/l		988	3	0	0.00%	0.00	29.40
	Inorganics Extra									
	COD, filtered	TM107	mg/l		988	2	0	0.00%	0.00	25.00
	BOD, filtered	TM045	mg/l		988	2	0	0.00%	0.00	3.49
	Ammoniacal Nitrogen as NH3	TM099	mg/l		988	2	0	0.00%	0.00	0.63
	Cyanide, Total (low level)	TM279	µg/l		988	2	0	0.00%	0.00	54.40
	Cyanide, Free (low level)	TM279	µg/l		988	2	0	0.00%	0.00	10.80
	Cyanide, Complex (low level)*	TM279	µg/l		988	2	0	0.00%	0.00	43.60
	TPH									
	Aliphatics >C12-C16 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	299.00
	Aliphatics >C16-C21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	1200.00
	Aliphatics >C21-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	9280.00
	Total Aliphatics >C12-C35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	10800.00
	Aromatics >EC12-EC16 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	56.00
	Aromatics >EC16-EC21 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	178.00
	Aromatics >EC21-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	679.00
	Aromatics >EC16-EC35 (diss.filt)	TM174	µg/l		988	1	0	0.00%	0.00	857.00
	Total Aromatics >EC12-EC35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	913.00
	Total Aliphatics & Aromatics >C5-35 (diss.filt)	TM174	µg/l		988	2	0	0.00%	0.00	11700.00
	Miscellaneous Organics									
	Fluoranthene	TM355	µg/l		988	1	0	0.00%	0.00	0.02
	Fluoranthene	TM355	µg/l		988	33	0	0.00%	0.00	0.39
	Benzo(a)pyrene	TM355	µg/l		988	93	0	0.00%	0.00	0.05
	Subcontracted: Inorganics									
	BOD*	SUB	mg/l		988	0	0	0.00%	0.00	
	EPH CWG (Speciated)									
	Aliphatics >C16-C35 Aqueous	TM174	µg/l		988	29	0	0.00%	0.00	57800.00
	Naphthalene (diss.filt)	TM178	µg/l		988	481	0	0.00%	0.00	4.82
	Acenaphthene (diss.filt)	TM178	µg/l		988	548	0	0.00%	0.00	0.84
	Acenaphthylene (diss.filt)	TM178	µg/l		988	270	0	0.00%	0.00	0.13
	Fluoranthene (diss.filt)	TM178	µg/l		988	678	0	0.00%	0.00	0.20
	Anthracene (diss.filt)	TM178	µg/l		988	301	0	0.00%	0.00	0.05
	Phenanthrene (diss.filt)	TM178	µg/l		988	604	0	0.00%	0.00	0.30
	Fluorene (diss.filt)	TM178	µg/l		988	458	0	0.00%	0.00	0.22
	Chrysene (diss.filt)	TM178	µg/l		988	64	0	0.00%	0.00	0.04
	Pyrene (diss.filt)	TM178	µg/l		988	668	0	0.00%	0.00	0.15
	Benzo(b)fluoranthene (diss.filt)	TM178	µg/l		988	133	0	0.00%	0.00	0.10
	Benzo(k)fluoranthene (diss.filt)	TM178	µg/l		988	59	0	0.00%	0.00	0.06
	Benzo(a)pyrene (diss.filt)	TM178	µg/l		988	142	0	0.00%	0.00	0.02
	Dibenzo(a,h)anthracene (diss.filt)	TM178	µg/l		988	14	0	0.00%	0.00	0.02
	Benzo(g,h,i)perylene (diss.filt)	TM178	µg/l		988	36	0	0.00%	0.00	0.03
	Indeno(1,2,3-cd)pyrene (diss.filt)	TM178	µg/l		988	38	0	0.00%	0.00	0.03
	PAH Sum of EPA 16 detected (Diss filt)	TM178	µg/l		988	409	0	0.00%	0.00	4.99
	Benzo(a)anthracene (diss.filt)	TM178	µg/l		988	66	0	0.00%	0.00	0.04
	Glycols									
	Propylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	
	Ethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Propanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,3-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	1,4-Butanediol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Diethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	Triethylene glycol	TM194	mg/l		988	0	0	0.00%	0.00	0.00
	TICs									
	(methylethyl)Phenol		µg/l		988	1	0	0.00%	0.00	51.00
	[Hexadecatrienal]-cis		µg/l		988	1	0	0.00%	0.00	30.00
	Collection of Hydrocarbons C12-C35		µg/l		988	1	0	0.00%	0.00	107000.00
	Cyclic octaatomic sulfur		µg/l		988	1	0	0.00%	0.00	67.60
	Cyclooctadiene		µg/l		988	1	0	0.00%	0.00	12.20
	Dimethyldodecane		µg/l		988	1	0	0.00%	0.00	12.00
	Dimethyltetradecenol acetate		µg/l		988	2	0	0.00%	0.00	75.60
	Docosenamide		µg/l		988	4	0	0.00%	0.00	44.00
	Eicosane		µg/l		988	1	0	0.00%	0.00	192.00
	Ethylhexanol		µg/l		988	2	0	0.00%	0.00	40.40
	Farnesol		µg/l		988	1	0	0.00%	0.00	281.00
	Heneicosane		µg/l		988	1	0	0.00%	0.00	221.00
	Hexadecane		µg/l		988	5	0	0.00%	0.00	17.00
	Hexadecatrienal		µg/l		988	2	0	0.00%	0.00	18.40
	Hexagol		µg/l		988	1	0	0.00%	0.00	12.50
	Hexahydromethanoindenol		µg/l		988	1	0	0.00%	0.00	14.40
	Isomer of Bicycloheptene ethenyl		µg/l		988	1	0	0.00%	0.00	15.00
	Isomer of Indenol		µg/l		988	1	0	0.00%	0.00	22.00
	Isomer of Indenol dihydro		µg/l		988	1	0	0.00%	0.00	50.00
	Isomers of Hexagol		µg/l		988	1	0	0.00%	0.00	26.00
	Isomers of Hexadecane		µg/l		988	3	0	0.00%	0.00	30.10
	Methylnonadecane		µg/l		988	3	0	0.00%	0.00	15.50
	Methylparaben		µg/l		988	1	0	0.00%	0.00	65.10
	Nonadecane		µg/l		988	1	0	0.00%	0.00	13.20
	Octadecane		µg/l		988	1	0	0.00%	0.00	12.60
	Octadecatrienoic acid methyl ester		µg/l		988	1	0	0.00%	0.00	11.70
	Octadecenamide		µg/l		988	1	0	0.00%	0.00	22.10
	Oleic Acid		µg/l		988	2	0	0.00%	0.00	44.10
	Pentadecanoic acid		µg/l		988	11	0	0.00%	0.00	29.50
	Pentaethylene glycol		µg/l		988	1	0	0.00%	0.00	15.90
	Phenol(methylethyl)		µg/l		988	1	0	0.00%	0.00	11.10
	Phenol(methylethyl)-bis		µg/l		988	2	0	0.00%	0.00	17.50
	Phenol(methylethylidene)bis-		µg/l		988	1	0	0.00%	0.00	29.00
	Phenol, -bis(-methylethyl)-		µg/l		988	1	0	0.00%	0.00	57.60
	Phthalate		µg/l		988	1	0	0.00%	0.00	92.00
	Sitosterol-beta		µg/l		988	2	0	0.00%	0.00	10.70
	Sulfur		µg/l		988	1	0	0.00%	0.00	14.50
	Tetradecadiene		µg/l		988	2	0	0.00%	0.00	44.70
	Tetradecane		µg/l		988	1	0	0.00%	0.00	10.60
	Tetramethylhexadecenol		µg/l		988	1	0	0.00%	0.00	42.20
	Tricyclodecenone		µg/l		988	2	0	0.00%	0.00	14.30
	Tetracosane	TM176	µg/l		988	1	0	0.00%	0.00	237.00

Appendix I: Chemical Input Parameters and Justifications

Runoff Coefficient Nomogram (National Coal Board, 1982)



Determinand-Specific Parameters

Determinand	**Henrys Law Coefficient (H)**	**Ref.**	**Soil Organic Carbon-Water Partitioning Coefficient (koc)**	**Ref.**	**Solid/Liquid Partition Coefficient (Kd)**	**Ref.**
Units	**(cm^3/cm^3)**		**(-)**		**l/kg**	
Inorganic Metals and Metalloids						
Arsenic	1	-	-	-	134	6
Cadmium	1	-	-	-	776	6
Chromium	1	-	-	-	5,336	6
Copper	1	-	-	-	1,199	6
Iron	1	-	-	-	810	5
Lead	1	-	-	-	34,877	6
Manganese	1	-	-	-	720	5
Mercury	1	-	-	-	5,000	6
Nickel	1	-	-	-	7,652	6
Selenium	1	-	-	-	186	6
Vanadium	1	-	-	-	213	6
Zinc	1	-	-	-	33,558	6
Other Inorganics						
Ammoniacal Nitrogen	1	-	-	-	1	5
Cyanide	1	-	-	-	5	7
Organics						
Benzene	0.182	1	27	5	0.64	koc*foc
Toluene	0.221	1	178	1	4.25	koc*foc
Ethylbenzene	0.3	1	432	1	10.31	koc*foc
Xylene*	0.22	1	260	5	6.20	koc*foc
Phenol	0.000068	1	28.8	1	0.69	koc*foc
TPH Criteria Working Group						
TPH Aliphatic >C5-C6	33	2	794	3	19	koc*foc
TPH Aliphatic >C_6-C_8	50	2	3,981	3	95	koc*foc
TPH Aliphatic >C_8-C_{10}	80	2	31,623	3	755	koc*foc
TPH Aliphatic >C_{10}-C_{12}	120	2	25,1189	3	5,996	koc*foc
TPH Aliphatic >C_{12}-C_{16}	520	2	501,1872	3	119,643	koc*foc

TPH Aliphatic >C_{16}-C_{21}	4,900	2	630,957,344	3	15,062,116	koc*foc
TPH Aliphatic >C_{21}-C_{35}	4,900	2	630,957,344	3	15,062,116	koc*foc
TPH Aliphatic >C_{35}-C_{44}	4,900	2	630,957,344	3	15,062,116	koc*foc
TPH Aromatic >C_{5}-C_{7}	0.23	2	79	5	2	koc*foc
TPH Aromatic >C_{7}-C_{8}	0.27	2	251	5	6	koc*foc
TPH Aromatic >C_{8}-C_{10}	0.48	2	1,585	3	38	koc*foc
TPH Aromatic >C_{10}-C_{12}	0.14	2	2,512	3	60	koc*foc
TPH Aromatic >C_{12}-C_{16}	0.05	2	5,012	3	120	koc*foc
TPH Aromatic >C_{16}-C_{21}	0.01	2	15,849	3	378	koc*foc
TPH Aromatic >C_{21}-C_{35}	0.00067	2	125,893	3	3,005	koc*foc
TPH Aromatic >C_{35}-C_{44}	0.00067	2	125,893	3	3,005	koc*foc
TPH Aromatic >C_{40}-C_{44}	0.00067	2	125,893	3	3,005	koc*foc
Polyaromatic Hydrocarbons						
Acenaphthene	0.0049	1	18,621	4	445	koc*foc
Acenaphthylene	0.0034	1	33,113	4	791	koc*foc
Anthracene	0.0016	1	38,019	4	908	koc*foc
Benzo(a)anthracene	0.00024	1	676,083	4	16,139	koc*foc
Benzo(a)pyrene	0.000019	1	426,580	4	10,183	koc*foc
Benzo(b)fluoranthene	0.0002	1	2,238,721	4	53,442	koc*foc
Benzo(k)fluoranthene	0.000034	1	3,311,311	4	79,047	koc*foc
Benzo(g,h,i)perylene	0.00003	1	8,709,636	4	207,915	koc*foc
Chrysene	0.000026	1	691,831	4	16,515	koc*foc
Di-benz(a,h)anthracene	0.0000006	1	933,254	4	22,279	koc*foc
Indeno(1,2,3-cd)pyrene	0.000066	1	16,595,869	4	396,174	koc*foc
Fluoranthene	0.00042	1	117,490	4	2,805	koc*foc
Fluorene	0.0032	1	30,200	4	721	koc*foc
Naphthalene	0.017	1	1,514	4	36	koc*foc
Phenanthrene	0.0013	1	30,200	4	721	koc*foc
Pyrene	0.00037	1	85,114	4	2,032	koc*foc

* Parameterised as total xylene

Determinand-Specific Parameter References:

1 - Environment Agency/Atkins, 2003. Review of the Fate and Transport of Selected Contaminants in the Soil Environment. Tables 2.4, 3.2 & 4.3

2 - Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG), 1999. Human Health Risk-Based Evaluation of Petroleum Release Sites: Implementing the Working Group Approach, Volume 5, Table 1

3 - Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG), 1997. Selection of representative TPH fractions based on fate & transport considerations, Volume 3, Table 7

4 - Geometric mean of koc values from Physical-Chemical Properties and Environmental Fate for Organic Chemicals, Mackay ET. al. 2006. 2nd Ed.

5 - ConSim Help files

6. Site specific Kd

7. Kow x 0.35 after USEPA FIRST User Manual. Kow value from EA Science Report SC040038/SR6.

Appendix J: Table 5-4 CWDQRA Reuse Criteria for 5% & 40% Infiltration

Table 5.4 CWDQRA Reuse Criteria for 5% Infiltration of Incident Rainfall into Engineered Made Ground - Comparison of Calculated CWDQRA Reuse Criteria against Maximum Soil Concentrations Determined (Soils 2017 onwards)

Determinand	**Commercial Area**			**Residential Area**		
	Re-use Criteria C_{mg} (mg/kg)	**Maximum Soil Sample Value* (mg/kg)**	**Average Soil Sample Value* (mg/kg)**	**Re-use Criteria (mg/kg)**	**Maximum Soil Sample Value* (mg/kg)**	**Average Soil Sample Value* (mg/kg)**
Inorganic Metals and Metalloids						
Arsenic	65439.545	397	12.11	16578.248	397	12.11
Cadmium	1886.085	31	0.66	477.815	31	0.66
Chromium	243635.930	3090	123.01	61721.958	3090	123.01
Copper	11652.851	1790	25.56	2952.097	1790	25.56
Iron	7871354.891	2390000	92031	1994104.220	2390000	103039
Lead	406523.383	4220	91.58	102987.352	4220	91.58
Manganese	860650.486	408000	8645	218034.479	408000	8645
Mercury	3399.904	6	0.68	861.321	6	0.68
Nickel	297329.948	313	25.73	75324.631	313	25.73
Selenium	18132.616	52	6.09	4593.660	52	6.09
Vanadium	41486.276	2880	206.93	10510.002	2880	206.93
Zinc	3552996.685	13300	291.45	900104.973	13300	291.45
Other Inorganics						
Ammoniacal Nitrogen	3989.985	1590	62.20	1010.810	1590	62.20
Cyanide	52.153	272	2.53	13.212	272	2.53
Organics						
Benzene	98.257	<0.01		24.89205686	<0.01	
Toluene	3318.139	<0.002		840.6068862	<0.002	
Ethylbenzene	2074.757	<0.003		525.6124567	<0.003	
Xylene	1915.601	3.0		485.292	80.0	
Phenol	78.835	1.0	0.2	19.972	1.0	0.2
TPH Criteria Working Group						
Aliphatics >C5-C6	1886.153	1	0.03	477.8320875	1	0.03
Aliphatics >C6-C8	9279.877	4	0.04	2350.934674	4	0.04
Aliphatics >C8-C10	73381.790	74	0.20	18590.31119	74	0.20
Aliphatics >C10-C12	582509.060	987	2.06	147571.008	987	2.06
Aliphatics >C12-C16	11621414.418	1330	7.40	2944132.472	1330	7.40
Aliphatics >C16-C21	1463028965.50	3530	26.11	370639143.4	3530	26.11
Aliphatics >C21-C35	1463028965.50	3580	73.67	370639143.4	3580	73.67
Aliphatics >C35-C44	1463028965.50	1380	24.12	370639143.4	1380	24.12
Aromatics >EC5-EC7	219.848	5	0.04	55.69550796	5	0.04
Aromatics >EC7-EC8	4574.056	20	0.05	1158.777006	20	0.05
Aromatics >EC8-EC10	3710.689	50	0.15	940.0541488	50	0.15
Aromatics >EC10-EC12	5860.058	658	1.38	1484.568497	658	1.38
Aromatics >EC12-EC16	11656.858	5280	11.65	2953.111706	5280	11.65
Aromatics >EC16-EC21	36785.199	9800	46.76	9319.04624	9800	46.76
Aromatics >EC21-EC35	291947.994	9010	113.58	73961.1839	9010	113.58
Aromatics >EC35-EC44	291947.994	1580	40.00	73961.1839	1580	40.00
Aromatics >EC40-EC44	291947.994	724	14.87	73961.1839	724	14.87
Polyaromatic Hydrocarbons						
Acenaphthylene	432.126	*2100*	2.34950	109.4734647	*2100*	2.34950
Acenaphthene	768.164	193	0.37333	194.6042079	193	0.37333
Anthracene	881.917	*1860*	2.77187	223.4221618	*1860*	2.77187
Benz(a)anthracene	15676.980	1150	3.61643	3971.556563	1150	3.61643
Benzo(a)pyrene	890.247	714	2.91263	225.5324461	*714*	2.91263
Benzo(b)fluoranthene	88.248	*1110*	4.13642	22.35644724	*1110*	4.13642
Benzo(k)fluoranthene	130.528	*373*	1.62573	33.06753518	*373*	1.62573
Benzo(g,h,i)perylene	343.322	333	1.97508	86.97622939	*333*	1.97508
Chrysene	16042.135	1090	3.30131	4064.063898	1090	3.30131
Dibenzo(a,h)anthracene	21640.121	177	0.57527	5482.239877	177	0.57527
Indeno(1,2,3-cd)pyrene	654.187	374	2.03839	165.7296497	*374*	2.03839
Fluoranthene	171.652	*2940*	8.95256	43.48587282	*2940*	8.95256
Fluorene	700.605	*1890*	2.16433	177.4890832	*1890*	2.16433
Naphthalene	709.033	*4680*	8.40311	179.6242411	*4680*	8.40311
Phenanthrene	700.605	*3810*	7.54997	177.4890819	*3810*	7.54997
Pyrene	1973.926	15	0.00781	500.0681883	15	0.00781

***Recent analyses carried out from 2017(Master Results)**

Table 5.4 CWDQRA Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground - Comparison of Calculated CWDQRA Reuse Criteria against Maximum Soil Concentrations Determined (Soils 2017 onwards)

Determinand	Commercial Area			Residential Area		
	Re-use Criteria C_{mg} (mg/kg)	Maximum Soil Sample Value* (mg/kg)	Average Soil Sample Value* (mg/kg)	Re-use Criteria (mg/kg)	Maximum Soil Sample Value (mg/kg)	Average Soil Sample Value* (mg/kg)
Inorganic Metals and Metalloids						
Arsenic	11468.786	397	12.11	2902.688	397	12.11
Cadmium	330.551	31	0.66	83.661	31	0.66
Chromium	42699.080	3090	123.01	10806.907	3090	123.01
Copper	2042.252	1790	25.56	516.883	1790	25.56
Iron	1379515.806	*2390000*	92031	349148.010	*2390000*	92031
Lead	71246.366	4220	91.58	18032.071	4220	91.58
Manganese	150835.652	*408000*	8645	38175.690	*408000*	8645
Mercury	595.859	*6*	0.68	150.809	*6*	0.68
Nickel	52109.372	313	25.73	13188.601	313	25.73
Selenium	3177.881	52	6.06	804.305	52	6.09
Vanadium	7270.791	2880	206.93	1840.198	*2880*	206.93
Zinc	622690.141	13300	291.45	157599.516	13300	291.45
Other Inorganics						
Ammoniacal Nitrogen	699.276	*1590*	62.20	176.983	*1590*	62.20
Cyanide	9.140	*272*	2.53	2.313	*272*	2.53
Organics						
Benzene	17.220	<0.01		4.358	<0.01	
Toluene	581.530	<0.002		147.182	<0.002	
Ethylbenzene	363.617	<0.003		92.030	<0.003	
Xylene	335.724	3.0		84.970	80.0	
Phenol	13.816	1.0	0.2	3.497	1.0	0.2
TPH Criteria Working Group						
Aliphatics >C5-C6	330.563	1	0.03	83.664	1	0.03
Aliphatics >C6-C8	1626.370	4	0.04	411.626	4	0.04
Aliphatics >C8-C10	12860.726	74	0.20	3254.980	74	0.20
Aliphatics >C10-C12	102089.217	987	2.06	25838.230	987	2.06
Aliphatics >C12-C16	2036742.733	1330	7.40	515488.601	1330	7.40
Aliphatics >C16-C21	256407138.283	3530	26.11	64895263.78	3530	26.11
Aliphatics >C21-C35	256407138.283	3580	73.67	64895263.78	3580	73.67
Aliphatics >C35-C44	256407138.283	1380	24.12	64895263.78	1380	24.12
Aromatics >EC5-EC7	38.530	5	0.04	9.752	5	0.04
Aromatics >EC7-EC8	801.639	20	0.05	202.890	20	0.05
Aromatics >EC8-EC10	650.327	50	0.15	164.594	50	0.15
Aromatics >EC10-EC12	1027.020	658	1.38	259.933	*658*	1.38
Aromatics >EC12-EC16	2042.955	*5280*	11.65	517.061	*5280*	11.65
Aromatics >EC16-EC21	6446.891	*9800*	46.76	1631.673	*9800*	46.76
Aromatics >EC21-EC35	51166.143	9010	113.58	12949.875	9010	113.58
Aromatics >EC35-EC44	51166.143	1580	40.00	12949.875	1580	40.00
Aromatics >EC40-EC44	51166.143	724	14.87	12949.875	724	14.87
Polyaromatic Hydrocarbons						
Acenaphthylene	75.733	*2100*	2.34950	19.168	*2100*	2.34950
Acenaphthene	134.627	*193*	0.37333	34.073	*193*	0.37333
Anthracene	154.563	*1860*	2.77187	39.119	*1860*	2.77187
Benz(a)anthracene	2747.512	1150	3.61643	695.380	*1150*	3.61643
Benzo(a)pyrene	156.023	*714*	2.91263	39.489	*714*	2.91263
Benzo(b)fluoranthene	15.466	*1110*	4.13642	3.914	*1110*	4.13642
Benzo(k)fluoranthene	22.876	*373*	1.62573	5.790	*373*	1.62573
Benzo(g,h,i)perylene	60.170	*333*	1.97508	15.229	*333*	1.97508
Chrysene	2811.508	1090	3.30131	711.578	*1090*	3.30131
Dibenzo(a,h)anthracene	3792.598	177	0.57527	959.886	177	0.57527
Indeno(1,2,3-cd)pyrene	114.651	*374*	2.03839	29.018	*374*	2.03839
Fluoranthene	30.083	*2940*	8.95256	7.614	*2940*	8.95256
Fluorene	122.786	*1890*	2.16433	31.077	*1890*	2.16433
Naphthalene	124.264	*4680*		31.450	*4680*	
Phenanthrene	122.786	*3810*		31.077	*3810*	
Pyrene	345.946	15		87.557	15	

***Recent analyses carried out from 2017(Master Results)**

🟥

Indicates maximum soil concentration exceeds calculated Re-use Criteria

Appendix K: Level 3 Groundwater Excel worksheets

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment				
Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**0.00000017**	**mg/l**	**Origin of C_T:**	**Proposed Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Benzo(a)pyrene**	
Target concentration	C_T	**0.00000017**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.29E-05**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00000017	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Benzo(a)pyrene**		from Level 1
Target concentration	**C_T**	**0.00000017**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C_T	0.00000017	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, l**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**0**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

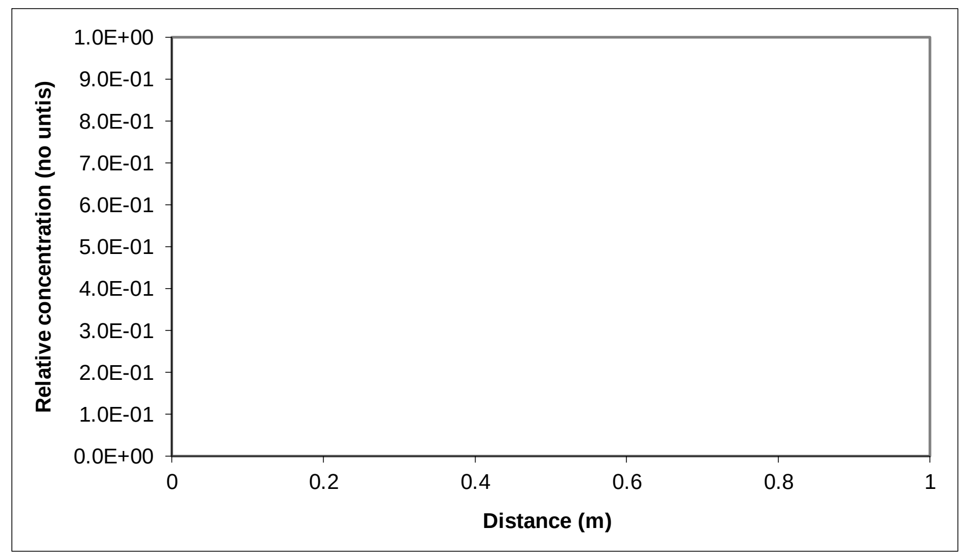
		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used

Environment Agency



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

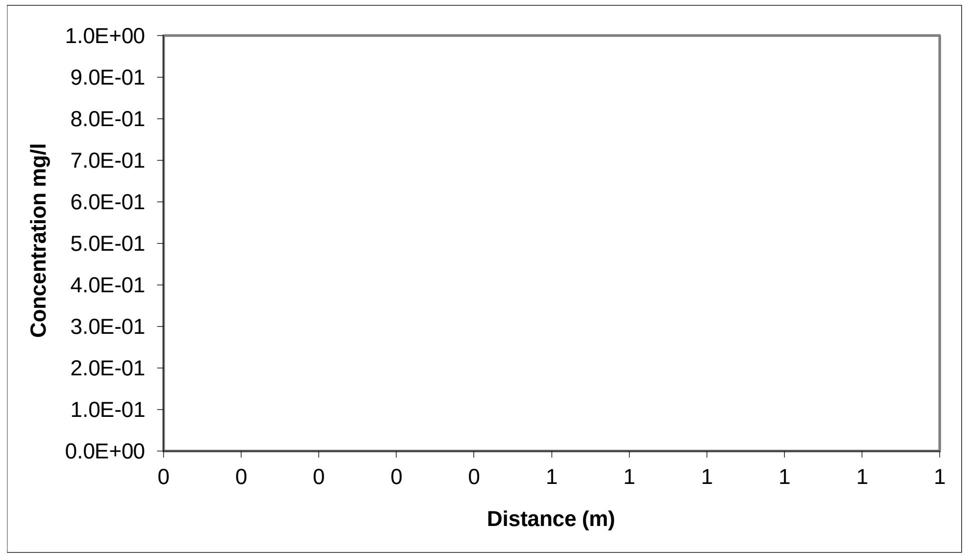
Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg
Level 1 Parameters			
Water filled soil porosity	θ_W	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless
Level 2 Parameters **Dilution Factor**	DF	#DIV/0!	
Level 3 Parameters **Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!	

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		**Benzo(a)pyrene**		from Level 1
Target Concentration	C_T	**1.70E-07**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	2.85E-04	mg/l	*Based on average soil conc of 2.9mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+04	days	*10 year half life estimation*
Calculated decay rate	λ	1.90E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappir*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	*Estimate*
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.02E+04	l/kg	*see options*
Longitudinal dispersivity	ax	2.00E+00	m	*see options*
Transverse dispersivity	az	2.00E-01	m	*see options*
Vertical dispersivity	ay	2.00E-02	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.73E+05	fraction
Decay rate used	λ	1.10E-10	d^{-1}
Rate of contaminant flow due to retardation	u	6.24E-09	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.84E-04	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.55E+00**	

Remedial Targets

Remedial Target	**2.64E-07**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	**20**	**m**	
Concentration of contaminant at compliance point C_{ED}/C_0	**1.84E-04**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	1.02E+04	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.02E+04	l/kg

Define dispersivity (click brown cell and use pull down list)

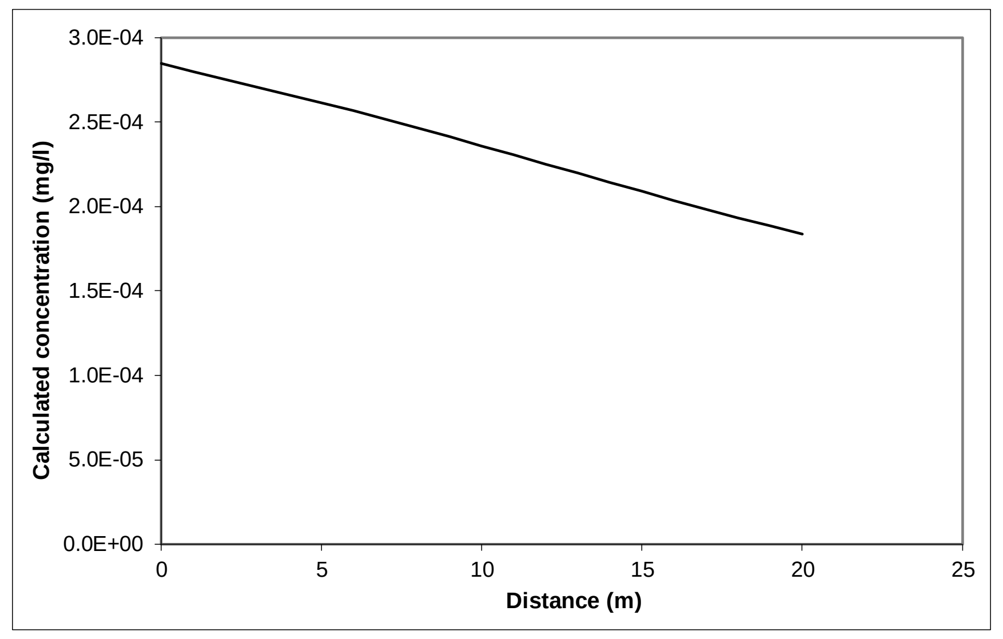
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value		Calc value Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.8E-04**
1.0	**2.80E-04**
2.0	**2.75E-04**
3.0	**2.71E-04**
4.0	**2.66E-04**
5.0	**2.61E-04**
6.0	**2.57E-04**
7.0	**2.52E-04**
8.0	**2.47E-04**
9.0	**2.41E-04**
10.0	**2.36E-04**
11.0	**2.31E-04**
12.0	**2.25E-04**
13.0	**2.20E-04**
14.0	**2.14E-04**
15.0	**2.09E-04**
16.0	**2.04E-04**
17.0	**1.99E-04**
18.0	**1.94E-04**
19.0	**1.89E-04**
20.0	**1.84E-04**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	$m^3/year$

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Benzo(a)pyrene**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	1.70E-07	mg/l
Kd	1.34E+02	l/kg
foc	🟩	fraction
koc	🟩	l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n	🟩	l/kg
Koc,i	🟩	l/kg
pH	🟩	pH units
pKa	🟩	
foc (ionic)	🟩	fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option				User specified value for partition coefficient
		calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical		🟩	🟩	🟩	
Partition coefficient used in Level 1 Assessment				1.34E+02	l/kg

Calculated Remedial Target	**2.29E-05**	**mg/kg**	**for**	**Benzo(a)pyrene**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **Benzo(a)pyrene**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	**Value**	**Units**
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	1.70E-07	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Benzo(a)pyrene**	
Input	**Value**	**Units**
C_T	1.700E-07	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

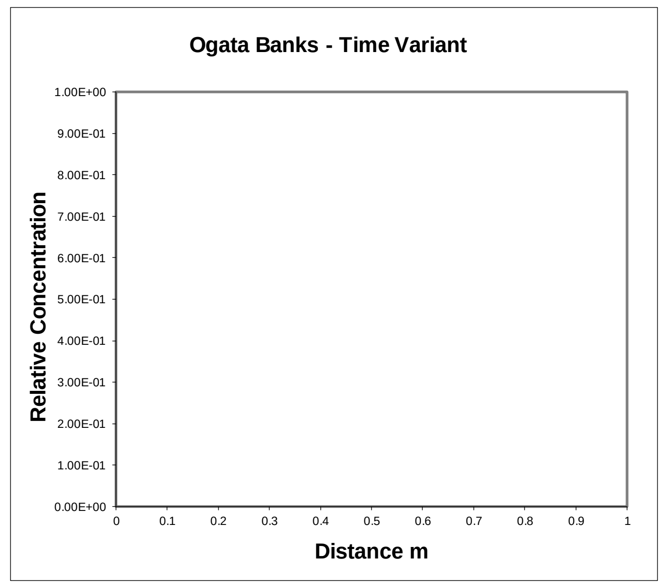
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

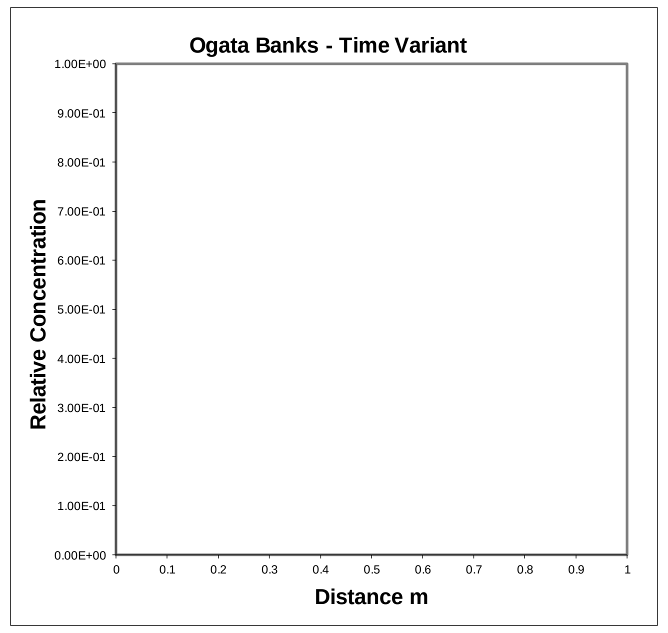
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



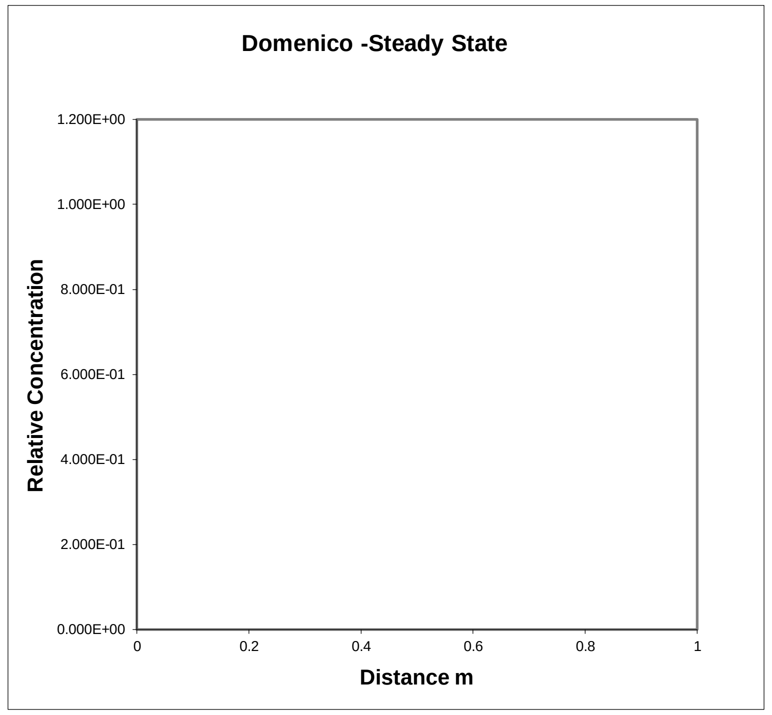
Contaminant **enzo(a)pyrene**

Input	**Value**	**Units**
C_T	1.700E-07	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

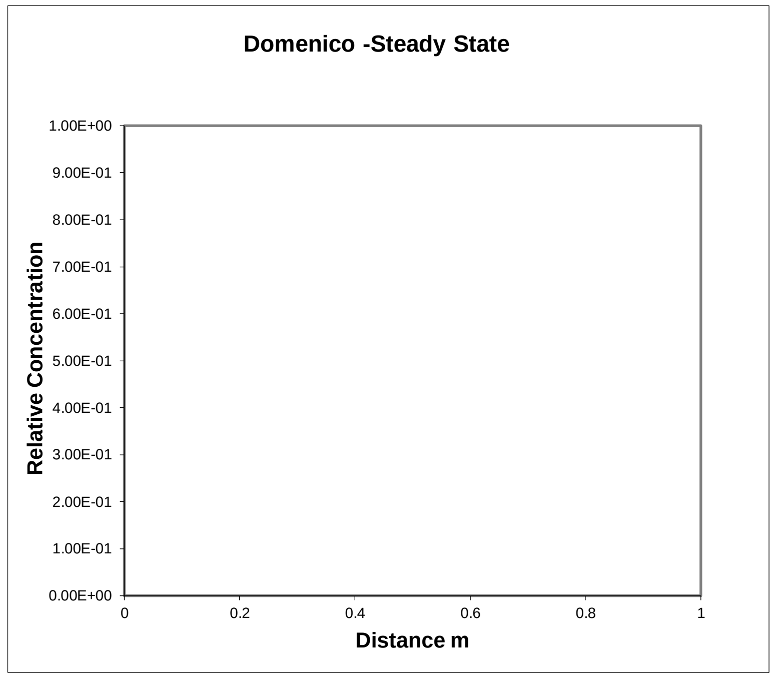


Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

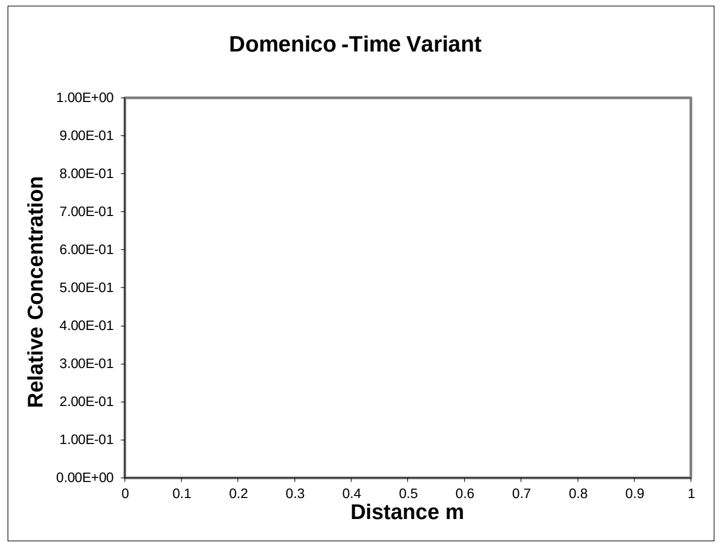
DOMENICO (TIME VARIANT)

Contaminant **enzo(a)pyrene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

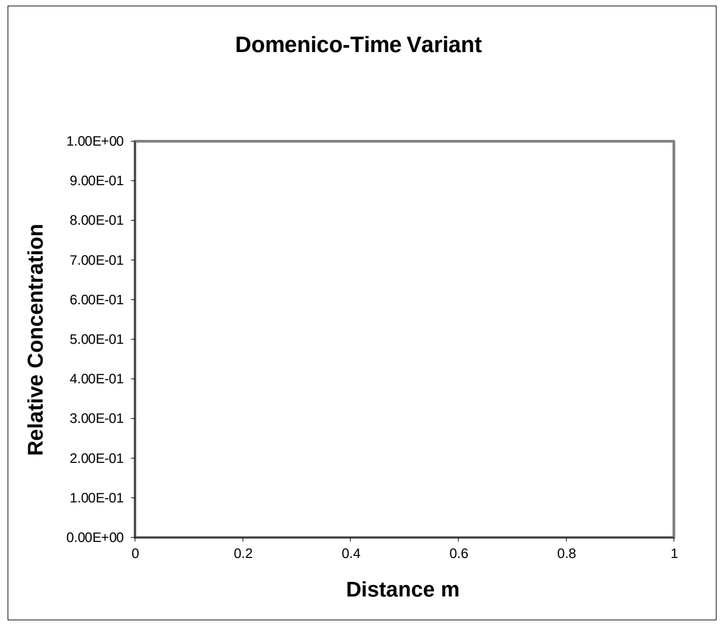
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

Contaminant **Benzo(a)pyrene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	2.85E-04	mg/l
λ	1.10E-10	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	1.02E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

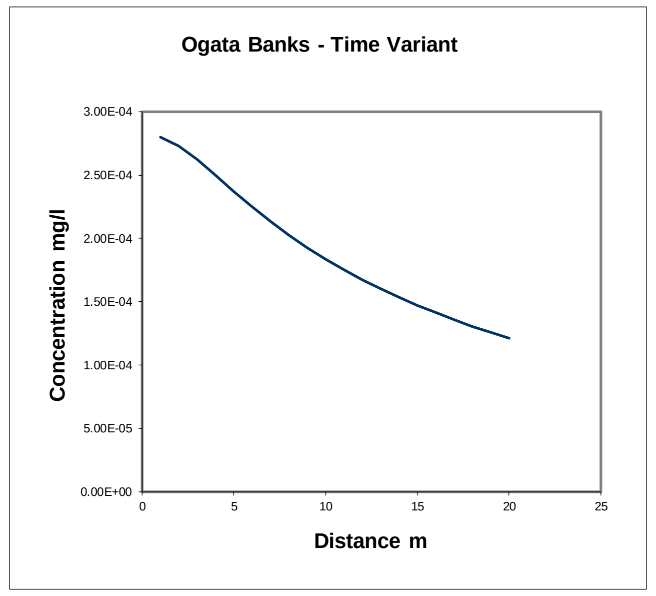
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.73E+05	
u	6.24E-09	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

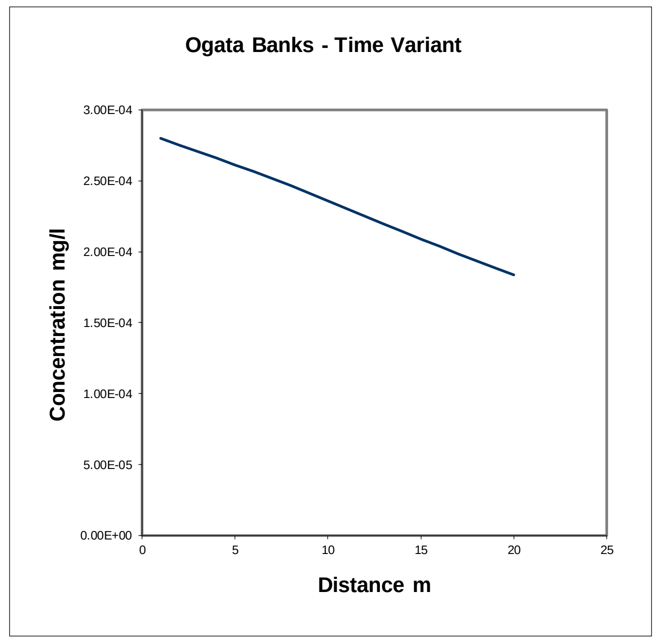
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	3.6E-05	-1.7E-02	9.8E-01	-3.0E+45	2.000	5.2E-01	1.7E+00	3.0E+45	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	2.80E-04
2	2	3.6E-05	-3.4E-02	9.7E-01	-3.0E+45	2.000	1.0E+00	2.8E+00	3.0E+45	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	2.73E-04
3	3	3.6E-05	-5.1E-02	9.5E-01	-3.0E+45	2.000	1.6E+00	4.7E+00	3.0E+45	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	2.62E-04
4	4	3.6E-05	-6.8E-02	9.3E-01	-3.0E+45	2.000	2.1E+00	7.9E+00	3.0E+45	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	2.50E-04
5	5	3.6E-05	-8.5E-02	9.2E-01	-3.0E+45	2.000	2.6E+00	1.3E+01	3.0E+45	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	2.37E-04
6	6	3.6E-05	-1.0E-01	9.0E-01	-3.0E+45	2.000	3.1E+00	2.2E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	2.25E-04
7	7	3.6E-05	-1.2E-01	8.9E-01	-3.0E+45	2.000	3.6E+00	3.7E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	2.13E-04
8	8	3.6E-05	-1.4E-01	8.7E-01	-3.0E+45	2.000	4.1E+00	6.3E+01	3.0E+45	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	2.03E-04
9	9	3.6E-05	-1.5E-01	8.6E-01	-3.0E+45	2.000	4.7E+00	1.0E+02	3.0E+45	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	1.93E-04
10	10	3.6E-05	-1.7E-01	8.4E-01	-3.0E+45	2.000	5.2E+00	1.8E+02	3.0E+45	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	1.84E-04
11	11	3.6E-05	-1.9E-01	8.3E-01	-3.0E+45	2.000	5.7E+00	3.0E+02	3.0E+45	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	1.75E-04
12	12	3.6E-05	-2.0E-01	8.2E-01	-3.0E+45	2.000	6.2E+00	4.9E+02	3.0E+45	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	1.67E-04
13	13	3.6E-05	-2.2E-01	8.0E-01	-3.0E+45	2.000	6.7E+00	8.3E+02	3.0E+45	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	1.60E-04
14	14	3.6E-05	-2.4E-01	7.9E-01	-3.0E+45	2.000	7.2E+00	1.4E+03	3.0E+45	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	1.53E-04
15	15	3.6E-05	-2.6E-01	7.7E-01	-3.0E+45	2.000	7.8E+00	2.3E+03	3.0E+45	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	1.47E-04
16	16	3.6E-05	-2.7E-01	7.6E-01	-3.0E+45	2.000	8.3E+00	3.9E+03	3.0E+45	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	1.41E-04
17	17	3.6E-05	-2.9E-01	7.5E-01	-3.0E+45	2.000	8.8E+00	6.6E+03	3.0E+45	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	1.36E-04
18	18	3.6E-05	-3.1E-01	7.4E-01	-3.0E+45	2.000	9.3E+00	1.1E+04	3.0E+45	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	1.31E-04
19	19	3.6E-05	-3.2E-01	7.2E-01	-3.0E+45	2.000	9.8E+00	1.8E+04	3.0E+45	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	1.26E-04
20	20	3.6E-05	-3.4E-01	7.1E-01	-3.0E+45	2.000	1.0E+01	3.1E+04	3.0E+45	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	1.21E-04



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	3.6E-05	-1.7E-02	9.8E-01	-3.0E+45	2.000	5.2E-01	1.7E+00	3.0E+45	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	2.80E-04
2	2	3.6E-05	-3.4E-02	9.7E-01	-3.0E+45	2.000	1.0E+00	2.8E+00	3.0E+45	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	2.75E-04
3	3	3.6E-05	-5.1E-02	9.5E-01	-3.0E+45	2.000	1.6E+00	4.7E+00	3.0E+45	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	2.71E-04
4	4	3.6E-05	-6.8E-02	9.3E-01	-3.0E+45	2.000	2.1E+00	7.9E+00	3.0E+45	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	2.66E-04
5	5	3.6E-05	-8.5E-02	9.2E-01	-3.0E+45	2.000	2.6E+00	1.3E+01	3.0E+45	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	2.61E-04
6	6	3.6E-05	-1.0E-01	9.0E-01	-3.0E+45	2.000	3.1E+00	2.2E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	2.57E-04
7	7	3.6E-05	-1.2E-01	8.9E-01	-3.0E+45	2.000	3.6E+00	3.7E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	2.52E-04
8	8	3.6E-05	-1.4E-01	8.7E-01	-3.0E+45	2.000	4.1E+00	6.3E+01	3.0E+45	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	2.47E-04
9	9	3.6E-05	-1.5E-01	8.6E-01	-3.0E+45	2.000	4.7E+00	1.0E+02	3.0E+45	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	2.41E-04
10	10	3.6E-05	-1.7E-01	8.4E-01	-3.0E+45	2.000	5.2E+00	1.8E+02	3.0E+45	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	2.36E-04
11	11	3.6E-05	-1.9E-01	8.3E-01	-3.0E+45	2.000	5.7E+00	3.0E+02	3.0E+45	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	2.31E-04
12	12	3.6E-05	-2.0E-01	8.2E-01	-3.0E+45	2.000	6.2E+00	4.9E+02	3.0E+45	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	2.25E-04
13	13	3.6E-05	-2.2E-01	8.0E-01	-3.0E+45	2.000	6.7E+00	8.3E+02	3.0E+45	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	2.20E-04
14	14	3.6E-05	-2.4E-01	7.9E-01	-3.0E+45	2.000	7.2E+00	1.4E+03	3.0E+45	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	2.14E-04
15	15	3.6E-05	-2.6E-01	7.7E-01	-3.0E+45	2.000	7.8E+00	2.3E+03	3.0E+45	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	2.09E-04
16	16	3.6E-05	-2.7E-01	7.6E-01	-3.0E+45	2.000	8.3E+00	3.9E+03	3.0E+45	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	2.04E-04
17	17	3.6E-05	-2.9E-01	7.5E-01	-3.0E+45	2.000	8.8E+00	6.6E+03	3.0E+45	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	1.99E-04
18	18	3.6E-05	-3.1E-01	7.4E-01	-3.0E+45	2.000	9.3E+00	1.1E+04	3.0E+45	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	1.94E-04
19	19	3.6E-05	-3.2E-01	7.2E-01	-3.0E+45	2.000	9.8E+00	1.8E+04	3.0E+45	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	1.89E-04
20	20	3.6E-05	-3.4E-01	7.1E-01	-3.0E+45	2.000	1.0E+01	3.1E+04	3.0E+45	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	1.84E-04



Contaminant	**enzo(a)pyrene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	2.85E-04	mg/l
λ	1.10E-10	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	1.02E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

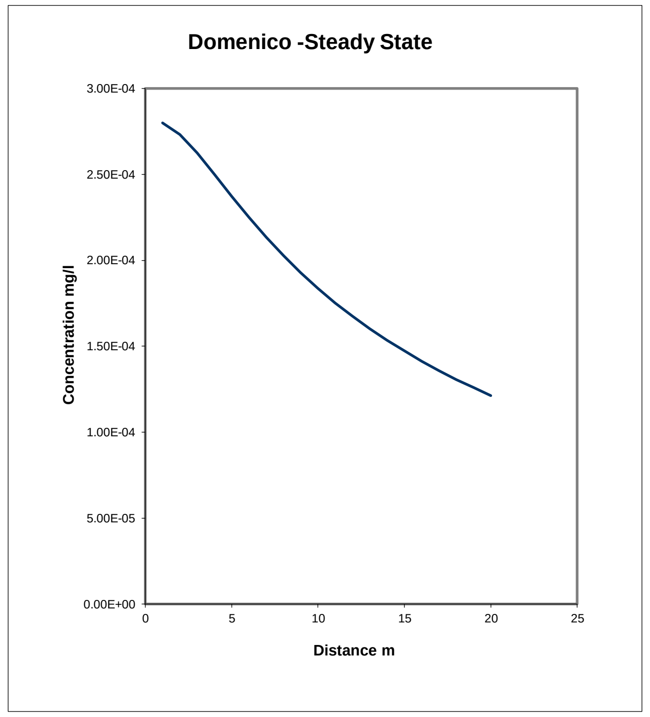
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.73E+05	
u	6.24E-09	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

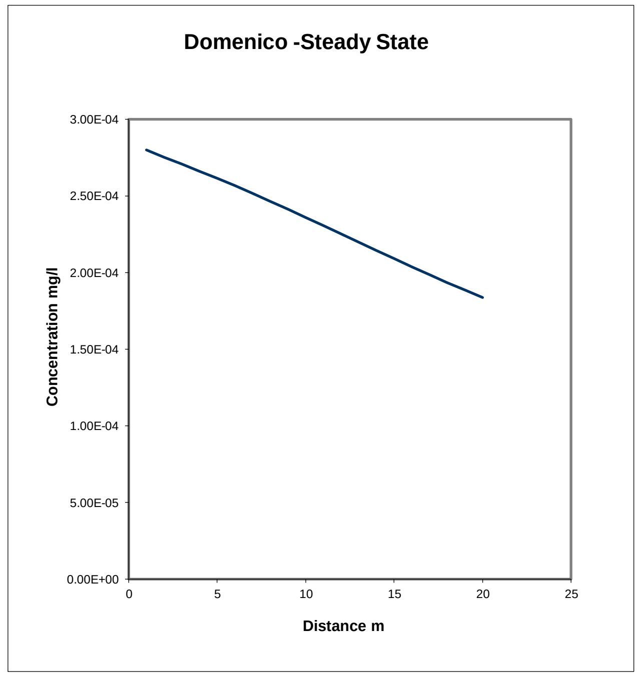
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	7.1E-05	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-0.9998	2.80E-04
2	2	7.1E-05	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	2.73E-04
3	3	7.1E-05	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.9696	2.62E-04
4	4	7.1E-05	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.9392	2.50E-04
5	5	7.1E-05	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.9065	2.37E-04
6	6	7.1E-05	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.8742	2.25E-04
7	7	7.1E-05	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.8436	2.13E-04
8	8	7.1E-05	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.8151	2.03E-04
9	9	7.1E-05	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.7887	1.93E-04
10	10	7.1E-05	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.7643	1.84E-04
11	11	7.1E-05	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.7418	1.75E-04
12	12	7.1E-05	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	1.67E-04
13	13	7.1E-05	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.7017	1.60E-04
14	14	7.1E-05	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.6838	1.53E-04
15	15	7.1E-05	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.6671	1.47E-04
16	16	7.1E-05	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.6515	1.41E-04
17	17	7.1E-05	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.6369	1.36E-04
18	18	7.1E-05	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.6232	1.31E-04
19	19	7.1E-05	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.6104	1.26E-04
20	20	7.1E-05	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.5983	1.21E-04



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	7.1E-05	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	2.80E-04
2	2	7.1E-05	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	2.75E-04
3	3	7.1E-05	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	2.71E-04
4	4	7.1E-05	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-0.9998	2.66E-04
5	5	7.1E-05	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.9992	2.61E-04
6	6	7.1E-05	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.9978	2.57E-04
7	7	7.1E-05	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.9954	2.52E-04
8	8	7.1E-05	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	2.47E-04
9	9	7.1E-05	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.9876	2.41E-04
10	10	7.1E-05	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.9823	2.36E-04
11	11	7.1E-05	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.9763	2.31E-04
12	12	7.1E-05	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.9696	2.25E-04
13	13	7.1E-05	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.9625	2.20E-04
14	14	7.1E-05	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	2.14E-04
15	15	7.1E-05	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.9472	2.09E-04
16	16	7.1E-05	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.9392	2.04E-04
17	17	7.1E-05	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.9311	1.99E-04
18	18	7.1E-05	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.9229	1.94E-04
19	19	7.1E-05	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.9147	1.89E-04
20	20	7.1E-05	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.9065	1.84E-04



DOMENICO (TIME VARIANT)

Contaminant Benzo(a)pyrene

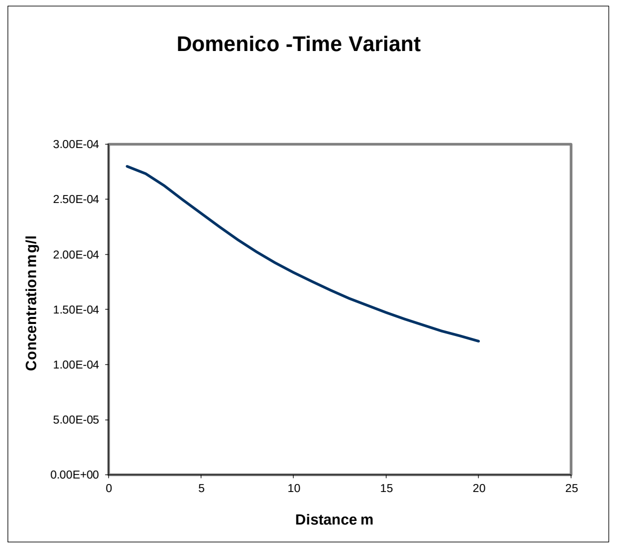
Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	2.85E-04	mg/l
λ	1.10E-10	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	1.02E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	1.73E+05	
u	6.24E-09	m/d

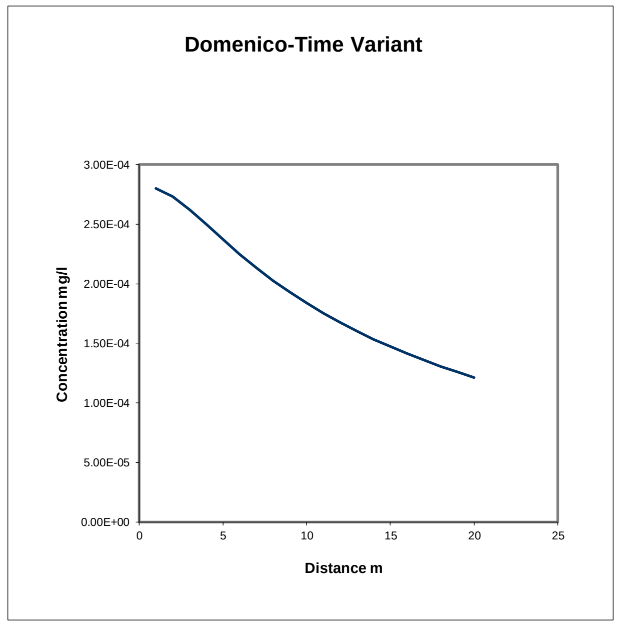
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	3.6E-05	-1.70E-02	9.83E-01	-2.98E+45	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	2.80E-04
2	2	3.6E-05	-3.40E-02	9.67E-01	-2.98E+45	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	2.73E-04
3	3	3.6E-05	-5.10E-02	9.50E-01	-2.98E+45	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	2.62E-04
4	4	3.6E-05	-6.80E-02	9.34E-01	-2.98E+45	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	2.50E-04
5	5	3.6E-05	-8.50E-02	9.18E-01	-2.98E+45	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	2.37E-04
6	6	3.6E-05	-1.02E-01	9.03E-01	-2.98E+45	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	2.25E-04
7	7	3.6E-05	-1.19E-01	8.88E-01	-2.98E+45	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	2.13E-04
8	8	3.6E-05	-1.36E-01	8.73E-01	-2.98E+45	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	2.03E-04
9	9	3.6E-05	-1.53E-01	8.58E-01	-2.98E+45	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	1.93E-04
10	10	3.6E-05	-1.70E-01	8.44E-01	-2.98E+45	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	1.84E-04
11	11	3.6E-05	-1.87E-01	8.29E-01	-2.98E+45	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	1.75E-04
12	12	3.6E-05	-2.04E-01	8.15E-01	-2.98E+45	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	1.67E-04
13	13	3.6E-05	-2.21E-01	8.02E-01	-2.98E+45	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	1.60E-04
14	14	3.6E-05	-2.38E-01	7.88E-01	-2.98E+45	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	1.53E-04
15	15	3.6E-05	-2.55E-01	7.75E-01	-2.98E+45	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	1.47E-04
16	16	3.6E-05	-2.72E-01	7.62E-01	-2.98E+45	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	1.41E-04
17	17	3.6E-05	-2.89E-01	7.49E-01	-2.98E+45	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	1.36E-04
18	18	3.6E-05	-3.06E-01	7.36E-01	-2.98E+45	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	1.31E-04
19	19	3.6E-05	-3.23E-01	7.24E-01	-2.98E+45	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	1.26E-04
20	20	3.6E-05	-3.40E-01	7.12E-01	-2.98E+45	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	1.21E-04



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	3.6E-05	-1.70E-02	9.83E-01	-2.98E+45	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	2.80E-04
2	2	3.6E-05	-3.40E-02	9.67E-01	-2.98E+45	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	2.75E-04
3	3	3.6E-05	-5.10E-02	9.50E-01	-2.98E+45	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	2.71E-04
4	4	3.6E-05	-6.80E-02	9.34E-01	-2.98E+45	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	2.66E-04
5	5	3.6E-05	-8.50E-02	9.18E-01	-2.98E+45	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	2.61E-04
6	6	3.6E-05	-1.02E-01	9.03E-01	-2.98E+45	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	2.57E-04
7	7	3.6E-05	-1.19E-01	8.88E-01	-2.98E+45	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	2.52E-04
8	8	3.6E-05	-1.36E-01	8.73E-01	-2.98E+45	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	2.47E-04
9	9	3.6E-05	-1.53E-01	8.58E-01	-2.98E+45	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	2.41E-04
10	10	3.6E-05	-1.70E-01	8.44E-01	-2.98E+45	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	2.36E-04
11	11	3.6E-05	-1.87E-01	8.29E-01	-2.98E+45	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	2.31E-04
12	12	3.6E-05	-2.04E-01	8.15E-01	-2.98E+45	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	2.25E-04
13	13	3.6E-05	-2.21E-01	8.02E-01	-2.98E+45	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	2.20E-04
14	14	3.6E-05	-2.38E-01	7.88E-01	-2.98E+45	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	2.14E-04
15	15	3.6E-05	-2.55E-01	7.75E-01	-2.98E+45	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	2.09E-04
16	16	3.6E-05	-2.72E-01	7.62E-01	-2.98E+45	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	2.04E-04
17	17	3.6E-05	-2.89E-01	7.49E-01	-2.98E+45	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	1.99E-04
18	18	3.6E-05	-3.06E-01	7.36E-01	-2.98E+45	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	1.94E-04
19	19	3.6E-05	-3.23E-01	7.24E-01	-2.98E+45	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	1.89E-04
20	20	3.6E-05	-3.40E-01	7.12E-01	-2.98E+45	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	1.84E-04



Date:	24/02/2020
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**0.00000017**	**mg/l**	**Origin of C_T:**	**Proposed Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Benzo(b)fluoranthene**		
Target concentration	C_T	**0.00000017**	**mg/l**	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.29E-05**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00000017	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Benzo(b)fluoranthene**		from Level 1
Target concentration	**C_T**	**0.00000017**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(b)fluoranthene		from Level 1
Target Concentration	C_T	0.00000017	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, l**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		**Soil concentration as mg/kg**		
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**0**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

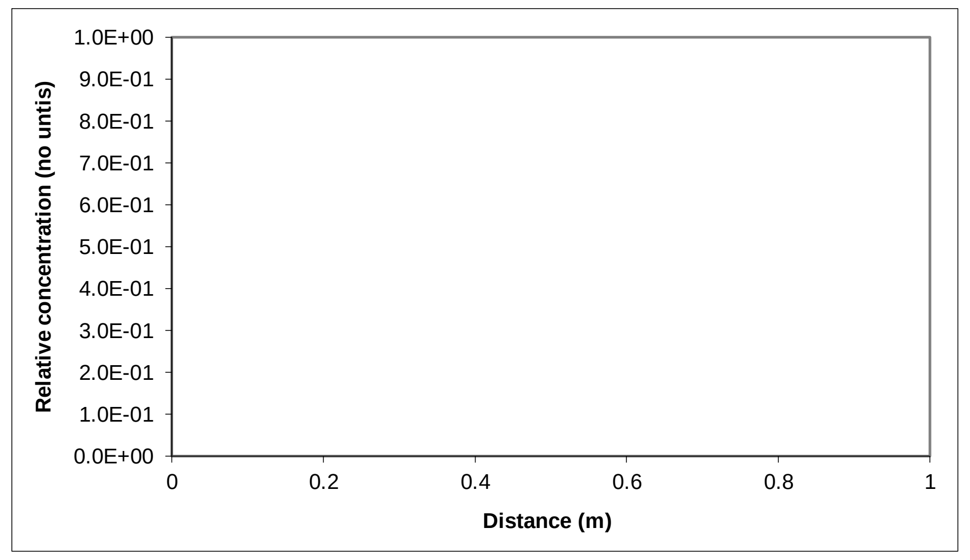
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Relative concentration (No units)**	**Concentration mg/l**
0	**1.0E+00**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg

Level 1 Parameters

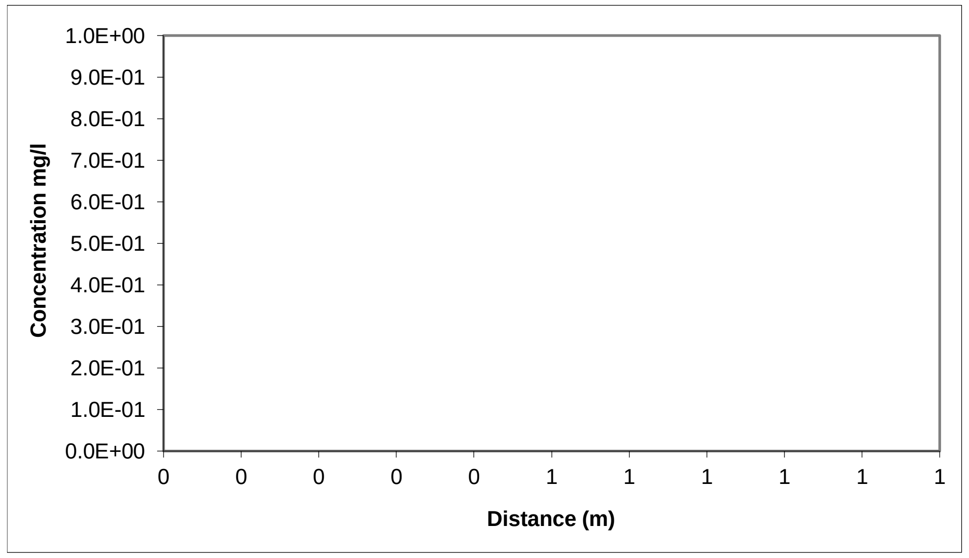
Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless

Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(b)fluoranthene**		from Level 1
Target Concentration	**C_T**	**1.70E-07**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	7.67E-02	mg/l	*Based on average soil conc of 4.1mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+04	days	*10 year half life estimation*
Calculated decay rate	λ	1.90E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappir*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.34E+04	l/kg	*see options*
Longitudinal dispersivity	ax	2.00E+00	m	*see options*
Transverse dispersivity	az	2.00E-01	m	*see options*
Vertical dispersivity	ay	2.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	9.09E+05	fraction
Decay rate used	λ	2.09E-11	d^{-1}
Rate of contaminant flow due to retardation	u	1.19E-09	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.95E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.55E+00**	

Remedial Targets

Remedial Target		**2.64E-07**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**4.95E-02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

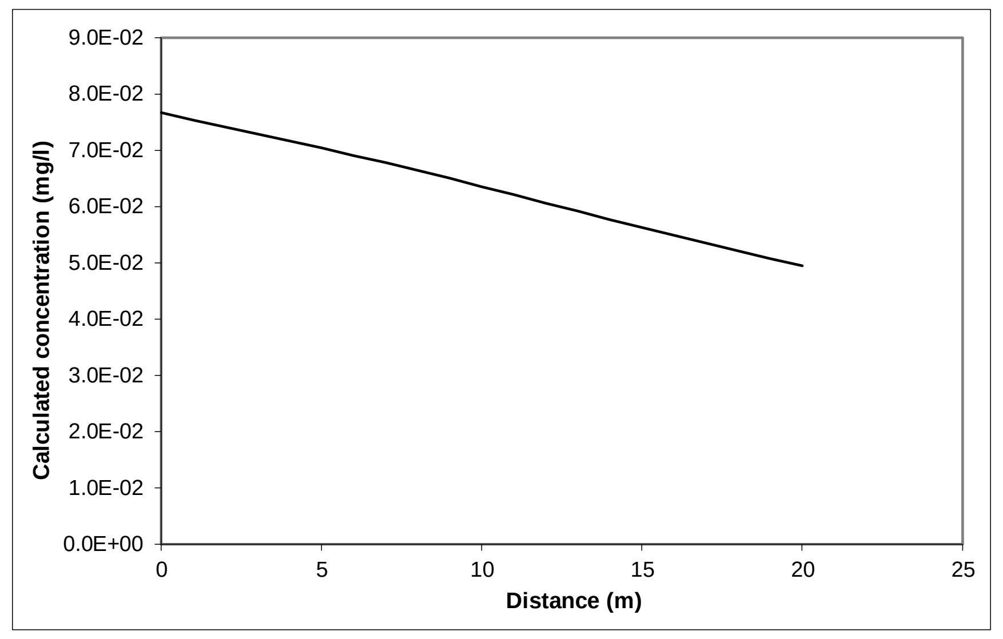
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	5.34E+04	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	5.34E+04	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value		Calc value Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**7.7E-02**
1.0	**7.54E-02**
2.0	**7.41E-02**
3.0	**7.29E-02**
4.0	**7.16E-02**
5.0	**7.04E-02**
6.0	**6.91E-02**
7.0	**6.78E-02**
8.0	**6.64E-02**
9.0	**6.50E-02**
10.0	**6.36E-02**
11.0	**6.21E-02**
12.0	**6.06E-02**
13.0	**5.92E-02**
14.0	**5.77E-02**
15.0	**5.63E-02**
16.0	**5.49E-02**
17.0	**5.35E-02**
18.0	**5.21E-02**
19.0	**5.08E-02**
20.0	**4.95E-02**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	$m^3/year$

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **nzo(b)fluoranthene**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	1.70E-07	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option	User specified value for partition coefficient		
	calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical				
Partition coefficient used in Level 1 Assessment			1.34E+02	l/kg

Calculated Remedial Target	**2.29E-05**	**mg/kg**	**for**	**Benzo(b)fluoranthene**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **enzo(b)fluoranthene**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	Value	Units
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	1.70E-07	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

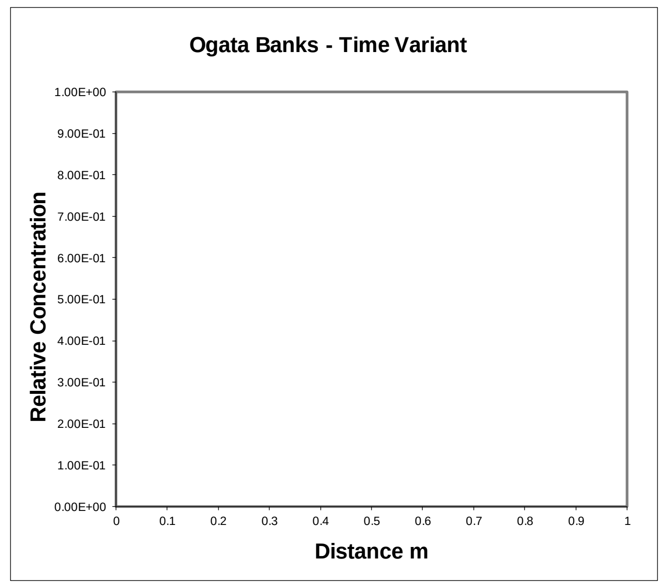
Contaminant **nzo(b)fluoranthene**

Input	Value	Units
C_T	1.700E-07	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

OGATA BANKS SOLUTION

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

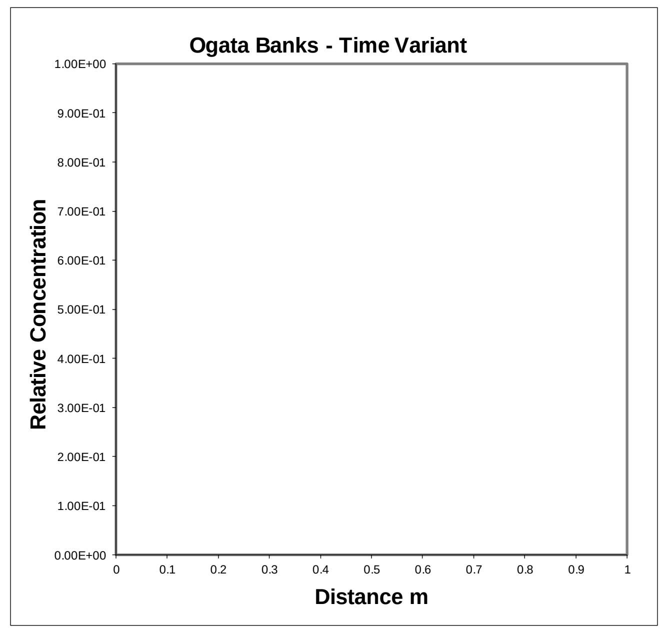
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

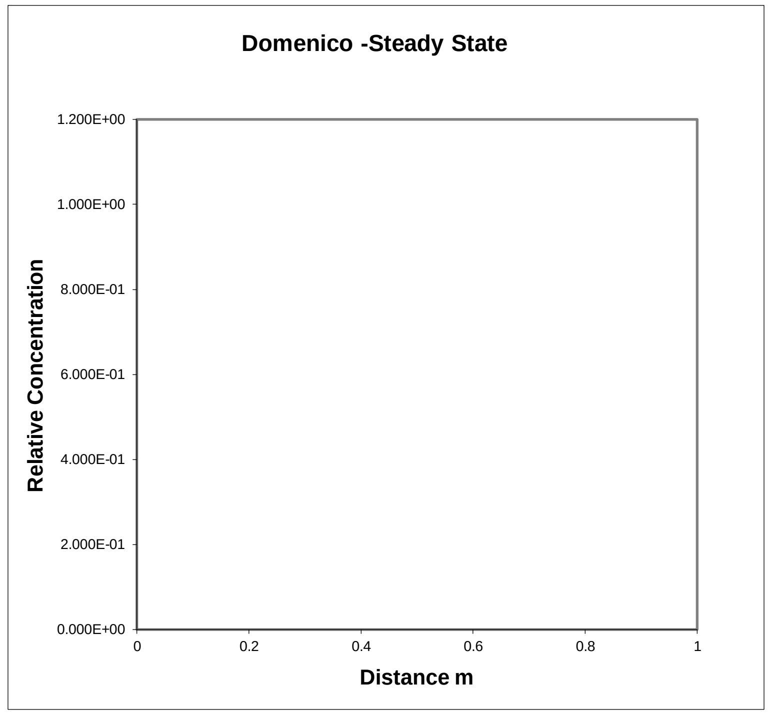
Contaminant **zo(b)fluoranthene**

Input	Value	Units
C_T	1.700E-07	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

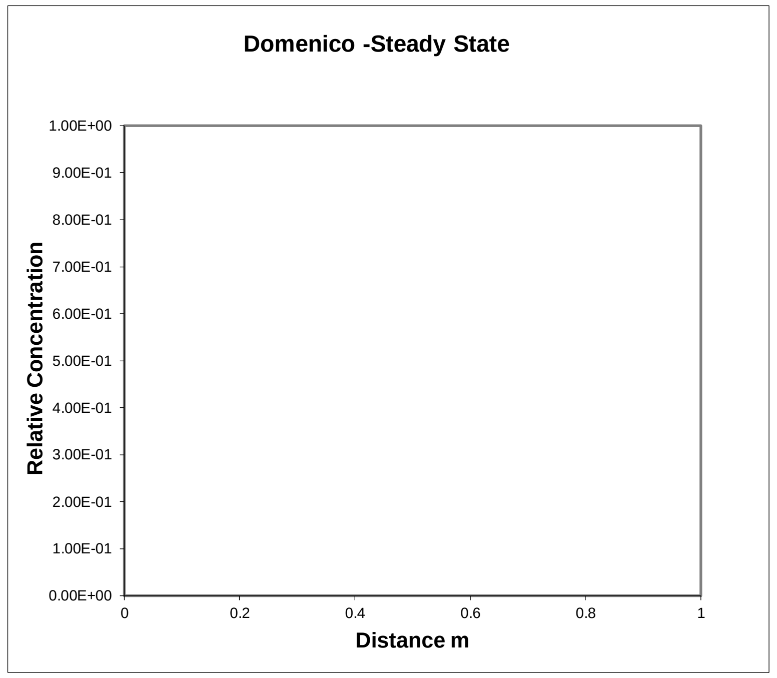


Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant zo(b)fluoranthene

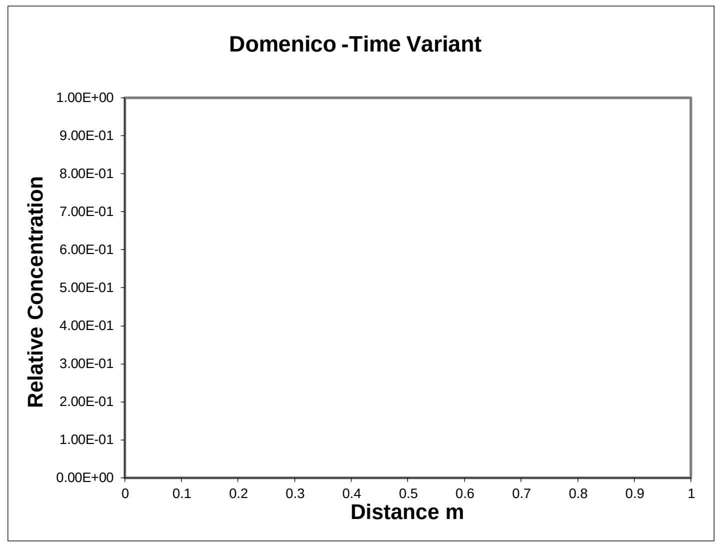
Input	**Value**	**Units**
C_T	0.00000017	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

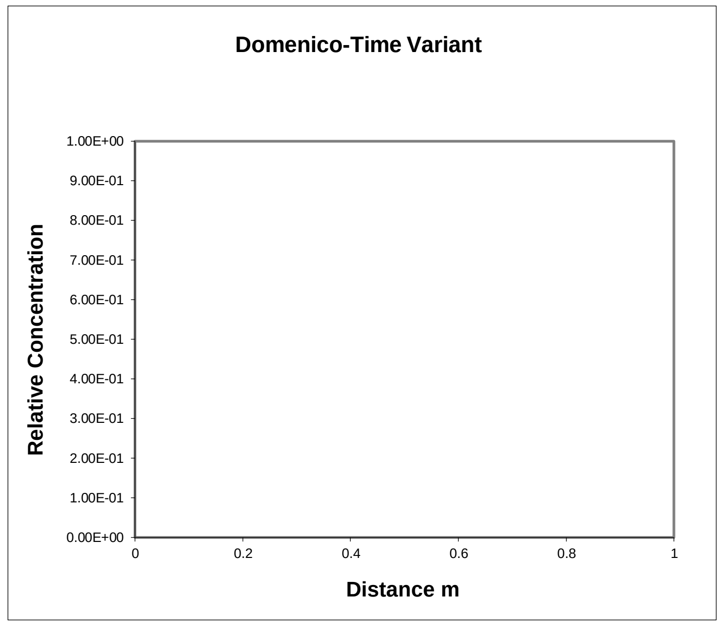
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Contaminant **nzo(b)fluoranthene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	7.67E-02	mg/l
λ	2.09E-11	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	5.34E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

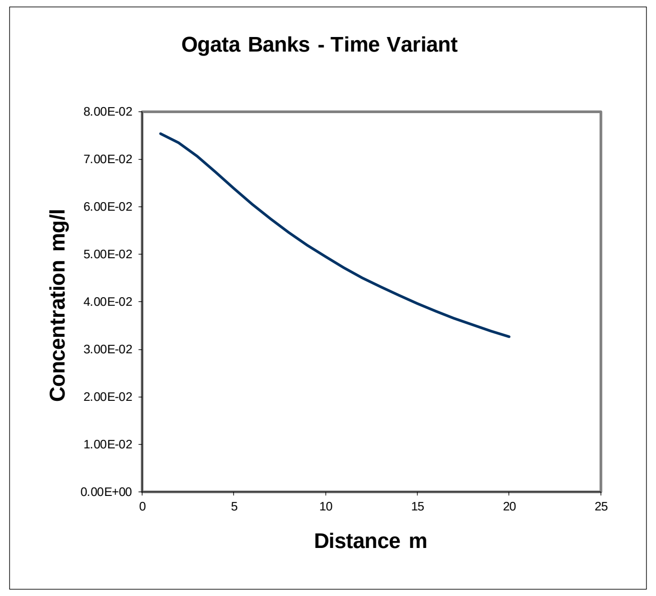
Calc	**Value**	
v	1.08E-03	m/d
Rc	9.09E+05	
u	1.19E-09	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

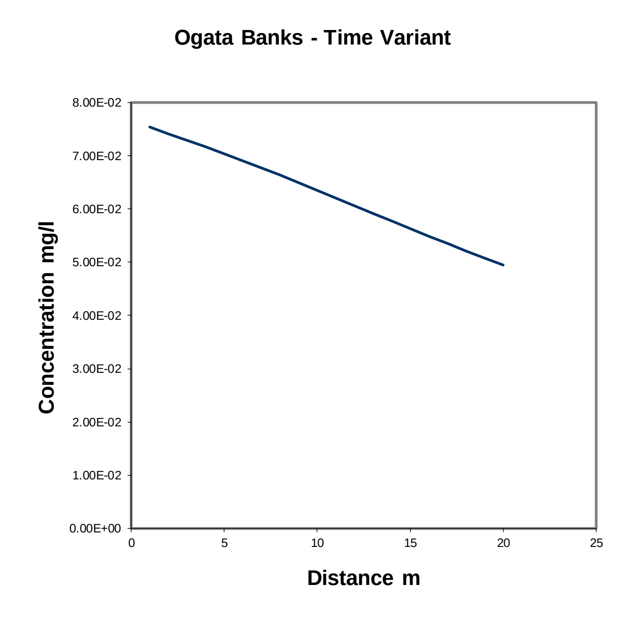
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	0.00959	-1.7E-02	9.8E-01	-1.3E+45	2.000	5.2E-01	1.7E+00	1.3E+45	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	7.54E-02
2	2	0.00959	-3.4E-02	9.7E-01	-1.3E+45	2.000	1.0E+00	2.8E+00	1.3E+45	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	7.35E-02
3	3	0.00959	-5.1E-02	9.5E-01	-1.3E+45	2.000	1.6E+00	4.7E+00	1.3E+45	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	7.07E-02
4	4	0.00959	-6.8E-02	9.3E-01	-1.3E+45	2.000	2.1E+00	7.9E+00	1.3E+45	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	6.73E-02
5	5	0.00959	-8.5E-02	9.2E-01	-1.3E+45	2.000	2.6E+00	1.3E+01	1.3E+45	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	6.39E-02
6	6	0.00959	-1.0E-01	9.0E-01	-1.3E+45	2.000	3.1E+00	2.2E+01	1.3E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	6.05E-02
7	7	0.00959	-1.2E-01	8.9E-01	-1.3E+45	2.000	3.6E+00	3.7E+01	1.3E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	5.74E-02
8	8	0.00959	-1.4E-01	8.7E-01	-1.3E+45	2.000	4.1E+00	6.3E+01	1.3E+45	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	5.46E-02
9	9	0.00959	-1.5E-01	8.6E-01	-1.3E+45	2.000	4.7E+00	1.0E+02	1.3E+45	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	5.19E-02
10	10	0.00959	-1.7E-01	8.4E-01	-1.3E+45	2.000	5.2E+00	1.8E+02	1.3E+45	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	4.95E-02
11	11	0.00959	-1.9E-01	8.3E-01	-1.3E+45	2.000	5.7E+00	3.0E+02	1.3E+45	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	4.72E-02
12	12	0.00959	-2.0E-01	8.2E-01	-1.3E+45	2.000	6.2E+00	4.9E+02	1.3E+45	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	4.51E-02
13	13	0.00959	-2.2E-01	8.0E-01	-1.3E+45	2.000	6.7E+00	8.3E+02	1.3E+45	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	4.31E-02
14	14	0.00959	-2.4E-01	7.9E-01	-1.3E+45	2.000	7.2E+00	1.4E+03	1.3E+45	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	4.13E-02
15	15	0.00959	-2.6E-01	7.7E-01	-1.3E+45	2.000	7.8E+00	2.3E+03	1.3E+45	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	3.96E-02
16	16	0.00959	-2.7E-01	7.6E-01	-1.3E+45	2.000	8.3E+00	3.9E+03	1.3E+45	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	3.81E-02
17	17	0.00959	-2.9E-01	7.5E-01	-1.3E+45	2.000	8.8E+00	6.6E+03	1.3E+45	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	3.66E-02
18	18	0.00959	-3.1E-01	7.4E-01	-1.3E+45	2.000	9.3E+00	1.1E+04	1.3E+45	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	3.52E-02
19	19	0.00959	-3.2E-01	7.2E-01	-1.3E+45	2.000	9.8E+00	1.8E+04	1.3E+45	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	3.39E-02
20	20	0.00959	-3.4E-01	7.1E-01	-1.3E+45	2.000	1.0E+01	3.1E+04	1.3E+45	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	3.27E-02



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	0.00959	-1.7E-02	9.8E-01	-1.3E+45	2.000	5.2E-01	1.7E+00	1.3E+45	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	7.54E-02
2	2	0.00959	-3.4E-02	9.7E-01	-1.3E+45	2.000	1.0E+00	2.8E+00	1.3E+45	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	7.41E-02
3	3	0.00959	-5.1E-02	9.5E-01	-1.3E+45	2.000	1.6E+00	4.7E+00	1.3E+45	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	7.29E-02
4	4	0.00959	-6.8E-02	9.3E-01	-1.3E+45	2.000	2.1E+00	7.9E+00	1.3E+45	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	7.16E-02
5	5	0.00959	-8.5E-02	9.2E-01	-1.3E+45	2.000	2.6E+00	1.3E+01	1.3E+45	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	7.04E-02
6	6	0.00959	-1.0E-01	9.0E-01	-1.3E+45	2.000	3.1E+00	2.2E+01	1.3E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	6.91E-02
7	7	0.00959	-1.2E-01	8.9E-01	-1.3E+45	2.000	3.6E+00	3.7E+01	1.3E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	6.78E-02
8	8	0.00959	-1.4E-01	8.7E-01	-1.3E+45	2.000	4.1E+00	6.3E+01	1.3E+45	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	6.64E-02
9	9	0.00959	-1.5E-01	8.6E-01	-1.3E+45	2.000	4.7E+00	1.0E+02	1.3E+45	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	6.50E-02
10	10	0.00959	-1.7E-01	8.4E-01	-1.3E+45	2.000	5.2E+00	1.8E+02	1.3E+45	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	6.36E-02
11	11	0.00959	-1.9E-01	8.3E-01	-1.3E+45	2.000	5.7E+00	3.0E+02	1.3E+45	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	6.21E-02
12	12	0.00959	-2.0E-01	8.2E-01	-1.3E+45	2.000	6.2E+00	4.9E+02	1.3E+45	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	6.06E-02
13	13	0.00959	-2.2E-01	8.0E-01	-1.3E+45	2.000	6.7E+00	8.3E+02	1.3E+45	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	5.92E-02
14	14	0.00959	-2.4E-01	7.9E-01	-1.3E+45	2.000	7.2E+00	1.4E+03	1.3E+45	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	5.77E-02
15	15	0.00959	-2.6E-01	7.7E-01	-1.3E+45	2.000	7.8E+00	2.3E+03	1.3E+45	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	5.63E-02
16	16	0.00959	-2.7E-01	7.6E-01	-1.3E+45	2.000	8.3E+00	3.9E+03	1.3E+45	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	5.49E-02
17	17	0.00959	-2.9E-01	7.5E-01	-1.3E+45	2.000	8.8E+00	6.6E+03	1.3E+45	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	5.35E-02
18	18	0.00959	-3.1E-01	7.4E-01	-1.3E+45	2.000	9.3E+00	1.1E+04	1.3E+45	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	5.21E-02
19	19	0.00959	-3.2E-01	7.2E-01	-1.3E+45	2.000	9.8E+00	1.8E+04	1.3E+45	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	5.08E-02
20	20	0.00959	-3.4E-01	7.1E-01	-1.3E+45	2.000	1.0E+01	3.1E+04	1.3E+45	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	4.95E-02



Contaminant **zo(b)fluoranthene**

Input	Value	Units
C_T	0.00000017	mg/l
Co	7.67E-02	mg/l
λ	2.09E-11	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	5.34E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

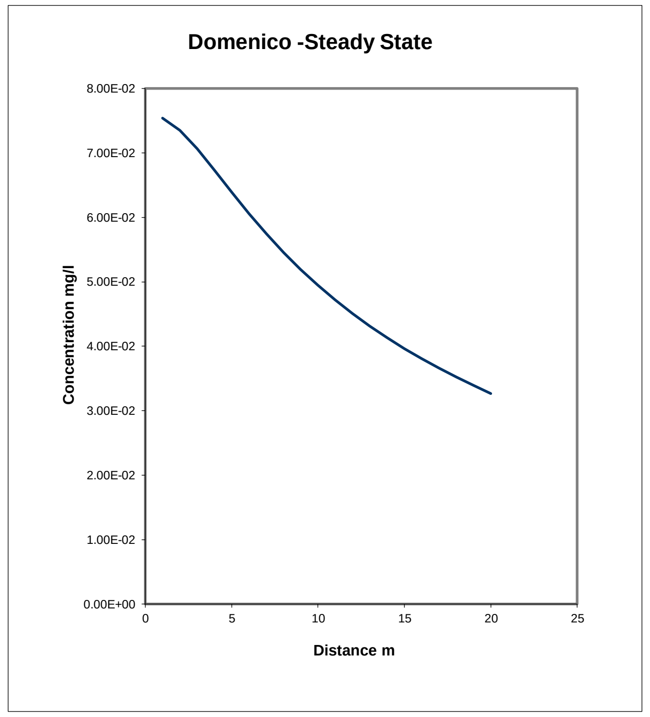
Calc	Value	
v	1.08E-03	m/d
Rc	9.09E+05	
u	1.19E-09	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

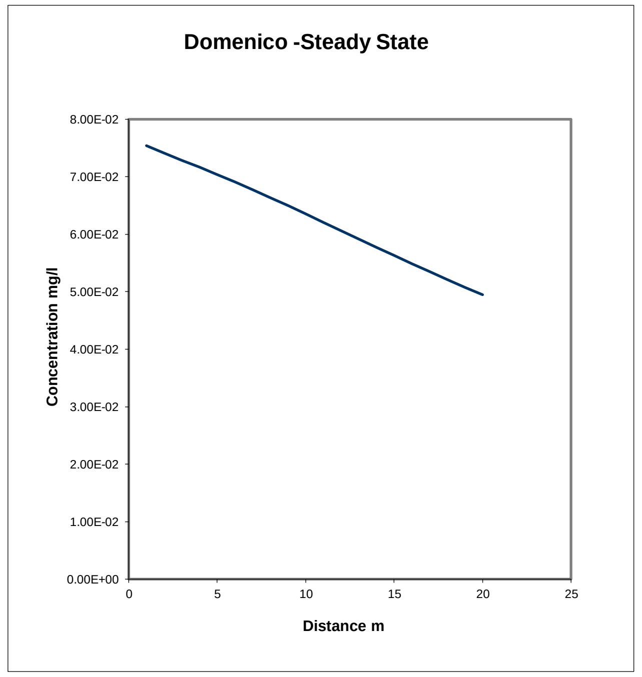
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	0.01918	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-0.9998	7.54E-02
2	2	0.01918	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	7.35E-02
3	3	0.01918	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.9696	7.07E-02
4	4	0.01918	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.9392	6.73E-02
5	5	0.01918	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.9065	6.39E-02
6	6	0.01918	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.8742	6.05E-02
7	7	0.01918	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.8436	5.74E-02
8	8	0.01918	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.8151	5.46E-02
9	9	0.01918	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.7887	5.19E-02
10	10	0.01918	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.7643	4.95E-02
11	11	0.01918	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.7418	4.72E-02
12	12	0.01918	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	4.51E-02
13	13	0.01918	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.7017	4.31E-02
14	14	0.01918	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.6838	4.13E-02
15	15	0.01918	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.6671	3.96E-02
16	16	0.01918	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.6515	3.81E-02
17	17	0.01918	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.6369	3.66E-02
18	18	0.01918	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.6232	3.52E-02
19	19	0.01918	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.6104	3.39E-02
20	20	0.01918	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.5983	3.27E-02



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	0.01918	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	7.54E-02
2	2	0.01918	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	7.41E-02
3	3	0.01918	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	7.29E-02
4	4	0.01918	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-0.9998	7.16E-02
5	5	0.01918	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.9992	7.04E-02
6	6	0.01918	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.9978	6.91E-02
7	7	0.01918	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.9954	6.78E-02
8	8	0.01918	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.64E-02
9	9	0.01918	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.9876	6.50E-02
10	10	0.01918	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.9823	6.36E-02
11	11	0.01918	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.9763	6.21E-02
12	12	0.01918	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.9696	6.06E-02
13	13	0.01918	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.9625	5.92E-02
14	14	0.01918	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	5.77E-02
15	15	0.01918	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.9472	5.63E-02
16	16	0.01918	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.9392	5.49E-02
17	17	0.01918	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.9311	5.35E-02
18	18	0.01918	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.9229	5.21E-02
19	19	0.01918	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.9147	5.08E-02
20	20	0.01918	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.9065	4.95E-02



DOMENICO (TIME VARIANT)

Contaminant **zo(b)fluoranthene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	7.67E-02	mg/l
λ	2.09E-11	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	5.34E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

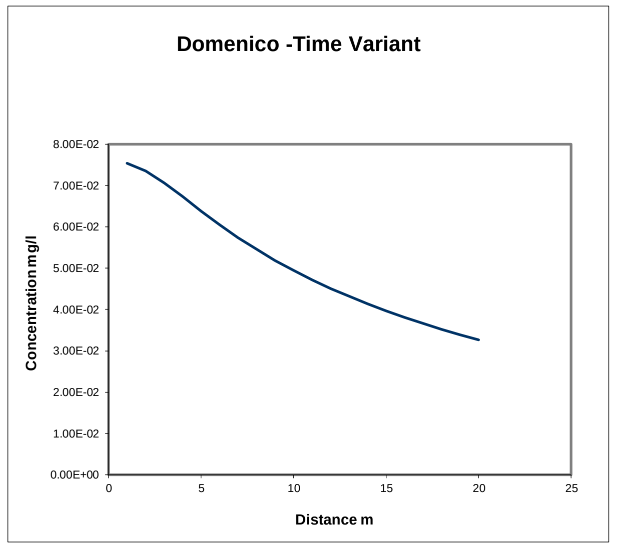
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	9.09E+05	
u	1.19E-09	m/d

Date:	24/02/2020
Version:	1

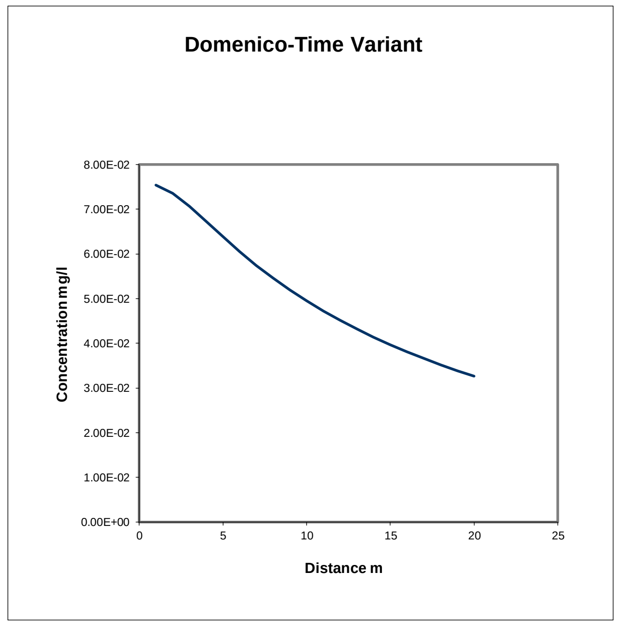
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	0.00959	-1.70E-02	9.83E-01	-1.30E+45	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	7.54E-02
2	2	0.00959	-3.40E-02	9.67E-01	-1.30E+45	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	7.35E-02
3	3	0.00959	-5.10E-02	9.50E-01	-1.30E+45	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	7.07E-02
4	4	0.00959	-6.80E-02	9.34E-01	-1.30E+45	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	6.73E-02
5	5	0.00959	-8.50E-02	9.18E-01	-1.30E+45	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	6.39E-02
6	6	0.00959	-1.02E-01	9.03E-01	-1.30E+45	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	6.05E-02
7	7	0.00959	-1.19E-01	8.88E-01	-1.30E+45	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	5.74E-02
8	8	0.00959	-1.36E-01	8.73E-01	-1.30E+45	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	5.46E-02
9	9	0.00959	-1.53E-01	8.58E-01	-1.30E+45	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	5.19E-02
10	10	0.00959	-1.70E-01	8.44E-01	-1.30E+45	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	4.95E-02
11	11	0.00959	-1.87E-01	8.29E-01	-1.30E+45	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	4.72E-02
12	12	0.00959	-2.04E-01	8.15E-01	-1.30E+45	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	4.51E-02
13	13	0.00959	-2.21E-01	8.02E-01	-1.30E+45	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	4.31E-02
14	14	0.00959	-2.38E-01	7.88E-01	-1.30E+45	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	4.13E-02
15	15	0.00959	-2.55E-01	7.75E-01	-1.30E+45	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	3.96E-02
16	16	0.00959	-2.72E-01	7.62E-01	-1.30E+45	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	3.81E-02
17	17	0.00959	-2.89E-01	7.49E-01	-1.30E+45	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	3.66E-02
18	18	0.00959	-3.06E-01	7.36E-01	-1.30E+45	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	3.52E-02
19	19	0.00959	-3.23E-01	7.24E-01	-1.30E+45	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	3.39E-02
20	20	0.00959	-3.40E-01	7.12E-01	-1.30E+45	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	3.27E-02



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	0.00959	-1.70E-02	9.83E-01	-1.30E+45	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	7.54E-02
2	2	0.00959	-3.40E-02	9.67E-01	-1.30E+45	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	7.41E-02
3	3	0.00959	-5.10E-02	9.50E-01	-1.30E+45	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	7.29E-02
4	4	0.00959	-6.80E-02	9.34E-01	-1.30E+45	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	7.16E-02
5	5	0.00959	-8.50E-02	9.18E-01	-1.30E+45	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	7.04E-02
6	6	0.00959	-1.02E-01	9.03E-01	-1.30E+45	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	6.91E-02
7	7	0.00959	-1.19E-01	8.88E-01	-1.30E+45	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	6.78E-02
8	8	0.00959	-1.36E-01	8.73E-01	-1.30E+45	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.64E-02
9	9	0.00959	-1.53E-01	8.58E-01	-1.30E+45	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	6.50E-02
10	10	0.00959	-1.70E-01	8.44E-01	-1.30E+45	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	6.36E-02
11	11	0.00959	-1.87E-01	8.29E-01	-1.30E+45	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	6.21E-02
12	12	0.00959	-2.04E-01	8.15E-01	-1.30E+45	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	6.06E-02
13	13	0.00959	-2.21E-01	8.02E-01	-1.30E+45	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	5.92E-02
14	14	0.00959	-2.38E-01	7.88E-01	-1.30E+45	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	5.77E-02
15	15	0.00959	-2.55E-01	7.75E-01	-1.30E+45	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	5.63E-02
16	16	0.00959	-2.72E-01	7.62E-01	-1.30E+45	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	5.49E-02
17	17	0.00959	-2.89E-01	7.49E-01	-1.30E+45	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	5.35E-02
18	18	0.00959	-3.06E-01	7.36E-01	-1.30E+45	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	5.21E-02
19	19	0.00959	-3.23E-01	7.24E-01	-1.30E+45	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	5.08E-02
20	20	0.00959	-3.40E-01	7.12E-01	-1.30E+45	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	4.95E-02



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Iron**			
Target Concentration (C_T)	**1**	**mg/l**	**Origin of C_T:**	**Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Iron**	
Target concentration	C_T	**1**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.35E+02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	1	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Iron**		from Level 1
Target concentration	**C_T**	**1**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Iron		from Level 1
Target Concentration	C_T	1	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		**Soil concentration as mg/kg**		
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**0**	**m**	
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

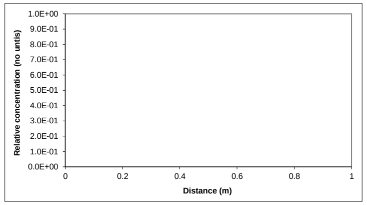
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg

Level 1 Parameters

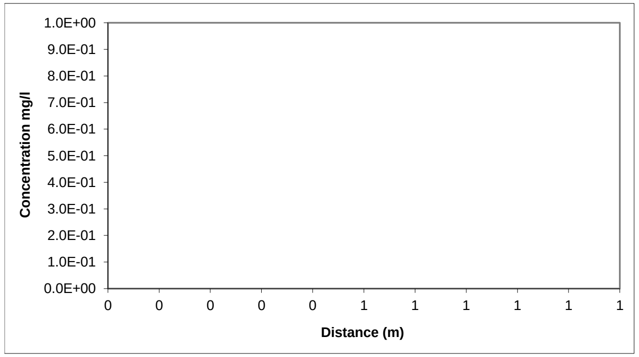
Water filled soil porosity	θ_W	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless

Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Iron**		from Level 1
Target Concentration	**C_T**	**1.00E+00**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.14E+02	mg/l	*Based on average soil conc of 92031mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	*100 day half life estimation*
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappir*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	8.10E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.38E+04	fraction
Decay rate used	λ	5.59E-105	d^{-1}
Rate of contaminant flow due to retardation	u	7.84E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.07E+02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.06E+00**	

Remedial Targets

Remedial Target		**1.06E+00**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.07E+02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	8.10E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	8.10E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

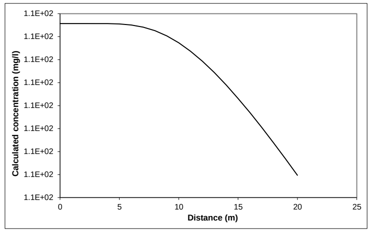
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.1E+02**
1.0	**1.14E+02**
2.0	**1.14E+02**
3.0	**1.14E+02**
4.0	**1.14E+02**
5.0	**1.14E+02**
6.0	**1.14E+02**
7.0	**1.13E+02**
8.0	**1.13E+02**
9.0	**1.13E+02**
10.0	**1.13E+02**
11.0	**1.12E+02**
12.0	**1.12E+02**
13.0	**1.11E+02**
14.0	**1.11E+02**
15.0	**1.10E+02**
16.0	**1.10E+02**
17.0	**1.09E+02**
18.0	**1.08E+02**
19.0	**1.08E+02**
20.0	**1.07E+02**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	m^3/year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Iron**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	1.00E+00	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

Selected option User specified value for partition coefficient

	calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical				

Partition coefficient used in Level 1 Assessment 1.34E+02 l/kg

Calculated Remedial Target	**1.35E+02**	**mg/kg**	**for**	**Iron**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **Iron**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	**Value**	**Units**
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	1.00E+00	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1.000E+00	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

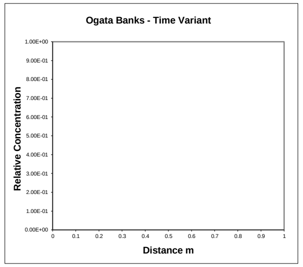
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

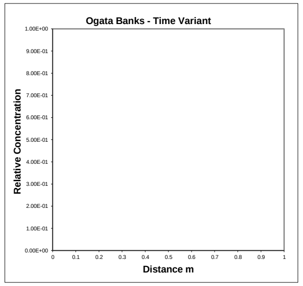
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

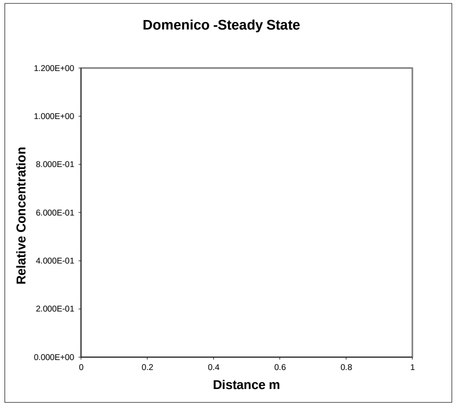


Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1.000E+00	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

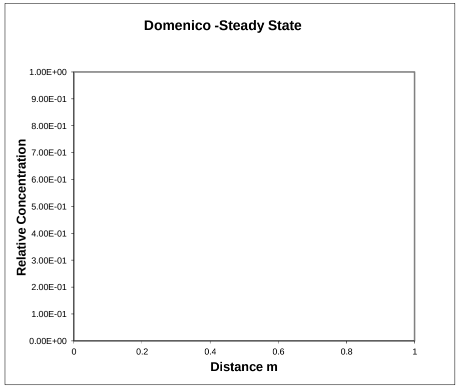


Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant **Iron**

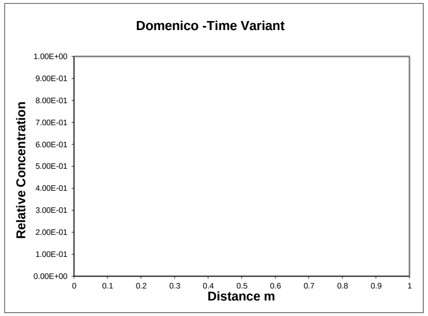
Input	Value	Units
C_T	1	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

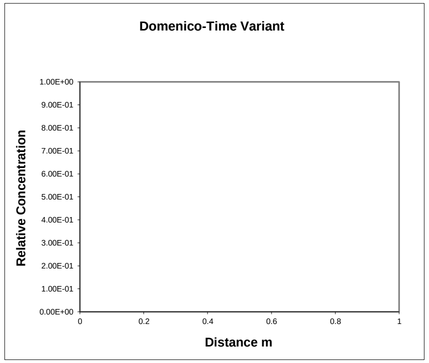
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Contaminant **Iron**

Input	Value	Units
C_T	1	mg/l
Co	1.14E+02	mg/l
λ	5.59E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	8.10E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

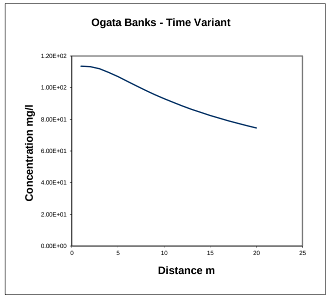
Calc	Value	
v	1.08E-03	m/d
Rc	1.38E+04	
u	7.84E-08	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

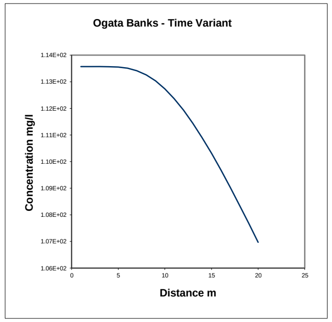
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.14E+02
2	2	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.13E+02
3	3	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.12E+02
4	4	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.10E+02
5	5	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.07E+02
6	6	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	1.04E+02
7	7	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	1.01E+02
8	8	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	9.83E+01
9	9	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	9.56E+01
10	10	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	9.31E+01
11	11	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	9.07E+01
12	12	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	8.84E+01
13	13	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	8.63E+01
14	14	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	8.43E+01
15	15	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	8.25E+01
16	16	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	8.07E+01
17	17	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	7.90E+01
18	18	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	7.75E+01
19	19	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	7.60E+01
20	20	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	7.46E+01



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	1.14E+02
2	2	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	1.14E+02
3	3	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	1.14E+02
4	4	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.14E+02
5	5	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	1.14E+02
6	6	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	1.14E+02
7	7	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	1.13E+02
8	8	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.13E+02
9	9	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	1.13E+02
10	10	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	1.13E+02
11	11	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	1.12E+02
12	12	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.12E+02
13	13	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	1.11E+02
14	14	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	1.11E+02
15	15	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	1.10E+02
16	16	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.10E+02
17	17	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	1.09E+02
18	18	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	1.08E+02
19	19	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	1.08E+02
20	20	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.07E+02



Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1	mg/l
Co	1.14E+02	mg/l
λ	5.59E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	8.10E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

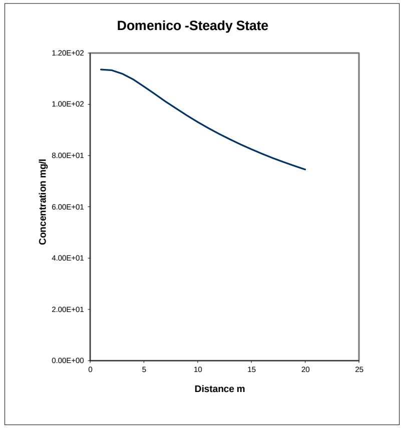
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.38E+04	
u	7.84E-08	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

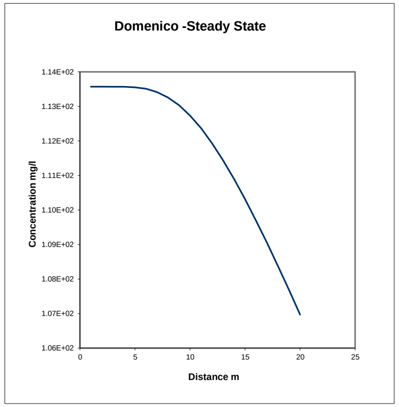
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	28.3925	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
2	2	28.3925	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.13E+02
3	3	28.3925	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.12E+02
4	4	28.3925	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.10E+02
5	5	28.3925	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.07E+02
6	6	28.3925	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	1.04E+02
7	7	28.3925	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	1.01E+02
8	8	28.3925	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	9.83E+01
9	9	28.3925	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	9.56E+01
10	10	28.3925	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	9.31E+01
11	11	28.3925	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	9.07E+01
12	12	28.3925	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	8.84E+01
13	13	28.3925	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	8.63E+01
14	14	28.3925	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	8.43E+01
15	15	28.3925	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.25E+01
16	16	28.3925	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	8.07E+01
17	17	28.3925	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	7.90E+01
18	18	28.3925	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	7.75E+01
19	19	28.3925	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	7.60E+01
20	20	28.3925	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	7.46E+01



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	28.3925	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.14E+02
2	2	28.3925	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.14E+02
3	3	28.3925	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.14E+02
4	4	28.3925	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
5	5	28.3925	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	1.14E+02
6	6	28.3925	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	1.14E+02
7	7	28.3925	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	1.13E+02
8	8	28.3925	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.13E+02
9	9	28.3925	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	1.13E+02
10	10	28.3925	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	1.13E+02
11	11	28.3925	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	1.12E+02
12	12	28.3925	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.12E+02
13	13	28.3925	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	1.11E+02
14	14	28.3925	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	1.11E+02
15	15	28.3925	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	1.10E+02
16	16	28.3925	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.10E+02
17	17	28.3925	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	1.09E+02
18	18	28.3925	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	1.08E+02
19	19	28.3925	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	1.08E+02
20	20	28.3925	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.07E+02



DOMENICO (TIME VARIANT)

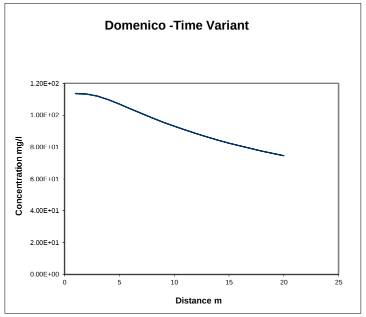
Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1	mg/l
Co	1.14E+02	mg/l
λ	5.59E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	8.10E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	1.38E+04	
u	7.84E-08	m/d

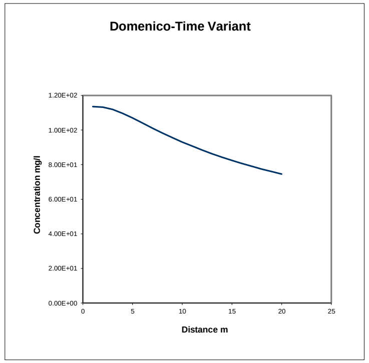
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
2	2	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.13E+02
3	3	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.12E+02
4	4	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.10E+02
5	5	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.07E+02
6	6	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	1.04E+02
7	7	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	1.01E+02
8	8	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	9.83E+01
9	9	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	9.56E+01
10	10	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	9.31E+01
11	11	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	9.07E+01
12	12	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	8.84E+01
13	13	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	8.63E+01
14	14	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	8.43E+01
15	15	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.25E+01
16	16	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	8.07E+01
17	17	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	7.90E+01
18	18	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	7.75E+01
19	19	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	7.60E+01
20	20	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	7.46E+01



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.14E+02
2	2	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.14E+02
3	3	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.14E+02
4	4	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
5	5	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	1.14E+02
6	6	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	1.14E+02
7	7	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	1.13E+02
8	8	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.13E+02
9	9	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	1.13E+02
10	10	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	1.13E+02
11	11	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	1.12E+02
12	12	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.12E+02
13	13	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	1.11E+02
14	14	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	1.11E+02
15	15	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	1.10E+02
16	16	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.10E+02
17	17	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	1.09E+02
18	18	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	1.08E+02
19	19	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	1.08E+02
20	20	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.07E+02



Date:	24/02/2020
Version:	1

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Manganese**			
Target Concentration (C_T)	**0.123**	**mg/l**	**Origin of C_T:**	**Water Framework Directive (EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		Manganese	
Target concentration	C_T	**0.123**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.66E+01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.123	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Manganese**		from Level 1
Target concentration	**C_T**	**0.123**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters

Input Parameters	Variable	Value	Unit	Source
Contaminant		Manganese		from Level 1
Target Concentration	C_T	0.123	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		0	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**0**	**m**	
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

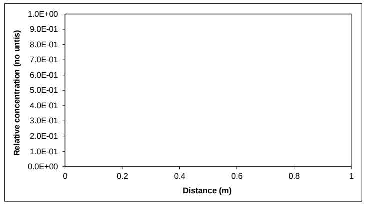
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg

Level 1 Parameters

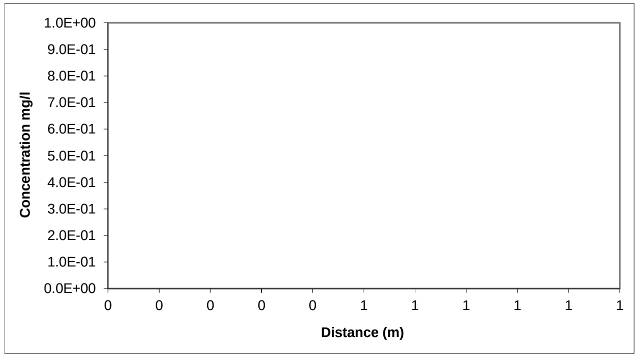
Water filled soil porosity	θ_W	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless

Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Manganese**		from Level 1
Target Concentration	C_T	**1.23E-01**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.20E+01	mg/l	*Based on average soil conc of 8645mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	*Estimation*
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappir*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.20E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.22E+04	fraction
Decay rate used	λ	6.29E-105	d^{-1}
Rate of contaminant flow due to retardation	u	8.82E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.13E+01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.06E+00**	

Remedial Targets

Remedial Target		**1.31E-01**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.13E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	7.20E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	7.20E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

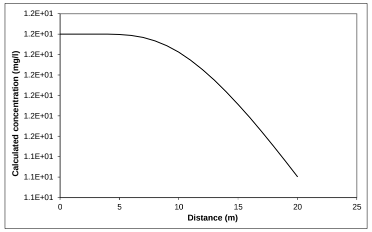
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.2E+01**
1.0	**1.20E+01**
2.0	**1.20E+01**
3.0	**1.20E+01**
4.0	**1.20E+01**
5.0	**1.20E+01**
6.0	**1.20E+01**
7.0	**1.20E+01**
8.0	**1.20E+01**
9.0	**1.19E+01**
10.0	**1.19E+01**
11.0	**1.19E+01**
12.0	**1.18E+01**
13.0	**1.18E+01**
14.0	**1.17E+01**
15.0	**1.17E+01**
16.0	**1.16E+01**
17.0	**1.15E+01**
18.0	**1.15E+01**
19.0	**1.14E+01**
20.0	**1.13E+01**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	

Calculated Parameters

Voids Ratio	#DIV/0!	fraction
Initial Saturation	#DIV/0!	%

Total porosity	**1.000**	**fraction**
Air Filled Porosity	**#DIV/0!**	**fraction**
Water Filled Porosity	**#DIV/0!**	**fraction**

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	

Calculated Parameters

Voids Ratio	#DIV/0!	fraction
dry bulk density	0.00	tonnes/m^3
Initial Saturation	#DIV/0!	%

Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	**symbol**		**unit**	**justification**
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	m^3/year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Manganese**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	1.23E-01	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option	User specified value for partition coefficient			
		calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical					
Partition coefficient used in Level 1 Assessment				1.34E+02	l/kg

Calculated Remedial Target	**1.66E+01**	**mg/kg**	**for**	**Manganese**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **Manganese**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	**Value**	**Units**
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	1.23E-01	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Manganese**	
Input	**Value**	**Units**
C_T	1.230E-01	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

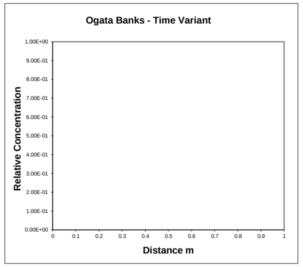
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

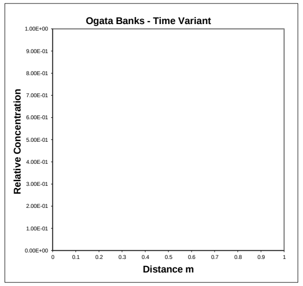
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



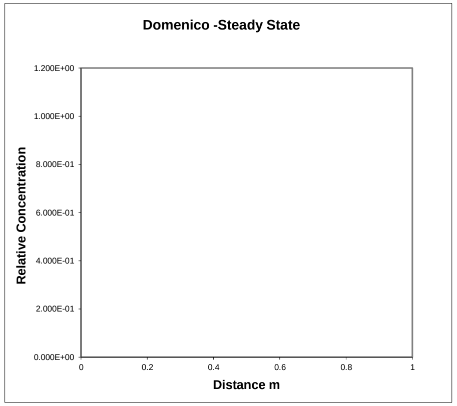
Contaminant **Manganese**

Input	Value	Units
C_T	1.230E-01	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

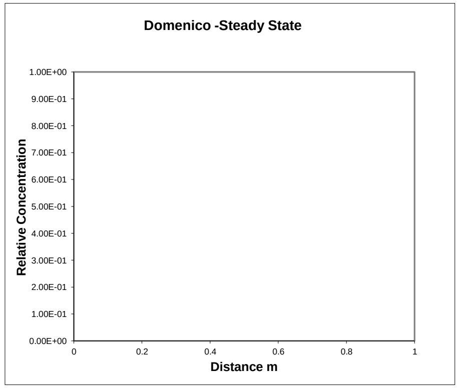


Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



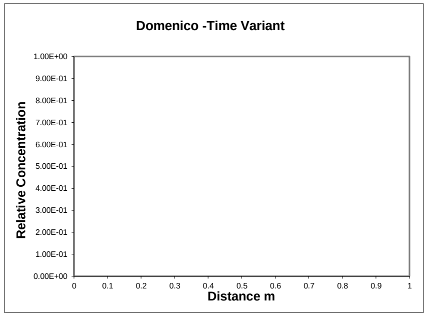
Date:	24/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant	**Manganese**	
Input	**Value**	**Units**
C_T	0.123	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

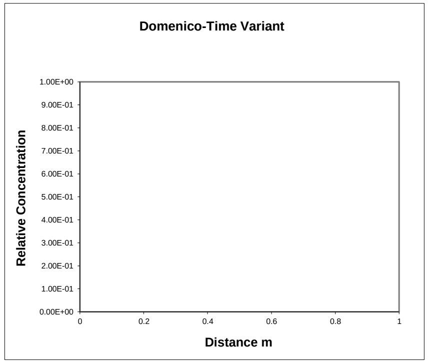
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

Contaminant	**Manganese**	
Input	**Value**	**Units**
C_T	0.123	mg/l
Co	1.20E+01	mg/l
λ	6.29E-105	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	7.20E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

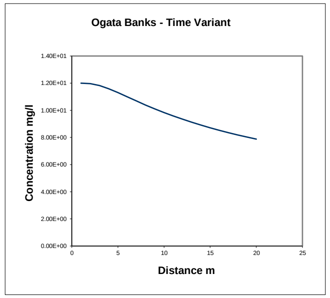
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.22E+04	
u	8.82E-08	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

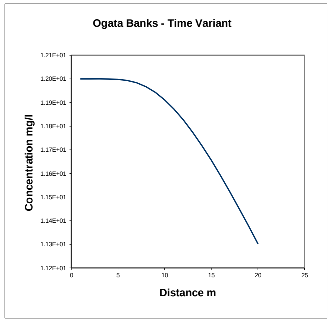
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E-01	1.9E+00	1.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.20E+01
2	2	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+00	3.6E+00	1.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.20E+01
3	3	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.9E+00	6.8E+00	1.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.18E+01
4	4	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	2.6E+00	1.3E+01	1.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.16E+01
5	5	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.2E+00	2.4E+01	1.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.13E+01
6	6	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.8E+00	4.6E+01	1.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	1.10E+01
7	7	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	4.5E+00	8.7E+01	1.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	1.07E+01
8	8	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.1E+00	1.7E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	1.04E+01
9	9	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.7E+00	3.1E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	1.01E+01
10	10	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E+00	5.9E+02	1.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	9.84E+00
11	11	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.0E+00	1.1E+03	1.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	9.58E+00
12	12	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.7E+00	2.1E+03	1.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	9.34E+00
13	13	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.3E+00	4.0E+03	1.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	9.12E+00
14	14	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.9E+00	7.6E+03	1.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	8.91E+00
15	15	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	9.6E+00	1.4E+04	1.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	8.71E+00
16	16	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.0E+01	2.7E+04	1.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	8.53E+00
17	17	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	5.2E+04	1.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	8.35E+00
18	18	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	9.8E+04	1.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	8.18E+00
19	19	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.2E+01	1.8E+05	1.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	8.03E+00
20	20	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+01	3.5E+05	1.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	7.88E+00



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E-01	1.9E+00	1.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	1.20E+01
2	2	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+00	3.6E+00	1.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	1.20E+01
3	3	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.9E+00	6.8E+00	1.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	1.20E+01
4	4	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	2.6E+00	1.3E+01	1.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.20E+01
5	5	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.2E+00	2.4E+01	1.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	1.20E+01
6	6	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.8E+00	4.6E+01	1.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	1.20E+01
7	7	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	4.5E+00	8.7E+01	1.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	1.20E+01
8	8	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.1E+00	1.7E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.20E+01
9	9	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.7E+00	3.1E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	1.19E+01
10	10	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E+00	5.9E+02	1.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	1.19E+01
11	11	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.0E+00	1.1E+03	1.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	1.19E+01
12	12	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.7E+00	2.1E+03	1.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.18E+01
13	13	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.3E+00	4.0E+03	1.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	1.18E+01
14	14	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.9E+00	7.6E+03	1.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	1.17E+01
15	15	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	9.6E+00	1.4E+04	1.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	1.17E+01
16	16	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.0E+01	2.7E+04	1.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.16E+01
17	17	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	5.2E+04	1.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	1.15E+01
18	18	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	9.8E+04	1.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	1.15E+01
19	19	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.2E+01	1.8E+05	1.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	1.14E+01
20	20	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+01	3.5E+05	1.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.13E+01



Contaminant	**Manganese**	
Input	**Value**	**Units**
C_T	0.123	mg/l
Co	1.20E+01	mg/l
λ	6.29E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	7.20E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

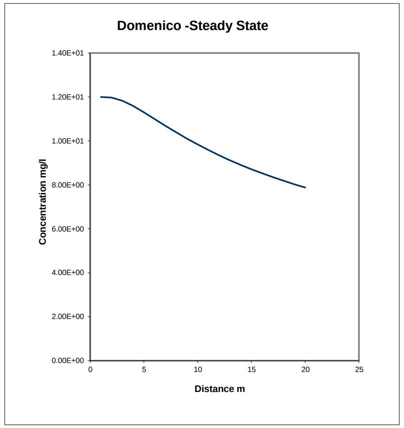
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.22E+04	
u	8.82E-08	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

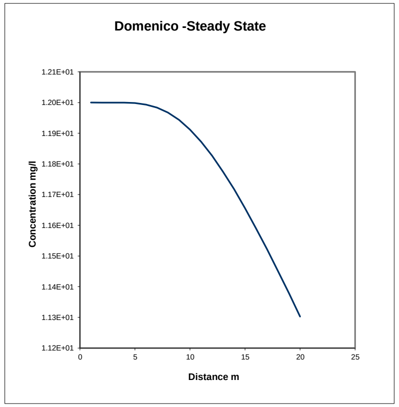
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	3	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01
2	2	3	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.20E+01
3	3	3	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.18E+01
4	4	3	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.16E+01
5	5	3	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.13E+01
6	6	3	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	1.10E+01
7	7	3	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	1.07E+01
8	8	3	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	1.04E+01
9	9	3	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	1.01E+01
10	10	3	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	9.84E+00
11	11	3	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	9.58E+00
12	12	3	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	9.34E+00
13	13	3	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	9.12E+00
14	14	3	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	8.91E+00
15	15	3	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.71E+00
16	16	3	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	8.53E+00
17	17	3	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	8.35E+00
18	18	3	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	8.18E+00
19	19	3	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	8.03E+00
20	20	3	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	7.88E+00



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	3	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.20E+01
2	2	3	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.20E+01
3	3	3	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.20E+01
4	4	3	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01
5	5	3	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	1.20E+01
6	6	3	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	1.20E+01
7	7	3	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	1.20E+01
8	8	3	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.20E+01
9	9	3	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	1.19E+01
10	10	3	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	1.19E+01
11	11	3	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	1.19E+01
12	12	3	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.18E+01
13	13	3	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	1.18E+01
14	14	3	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	1.17E+01
15	15	3	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	1.17E+01
16	16	3	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.16E+01
17	17	3	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	1.15E+01
18	18	3	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	1.15E+01
19	19	3	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	1.14E+01
20	20	3	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.13E+01



DOMENICO (TIME VARIANT)

Contaminant **Manganese**

Input	**Value**	**Units**
C_T	0.123	mg/l
Co	1.20E+01	mg/l
λ	6.29E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	7.20E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

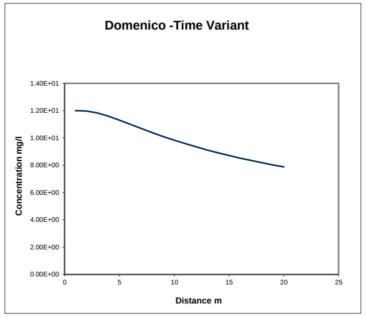
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	1.22E+04	
u	8.82E-08	m/d

Date:	24/02/2020
Version:	1

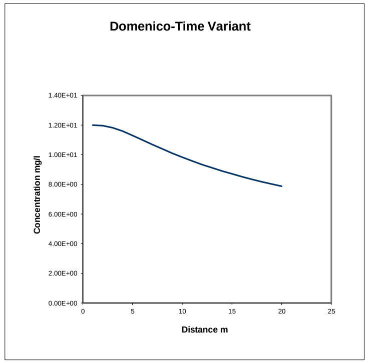
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	1.5	0.00E+00	1.00E+00	-1.19E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01
2	2	1.5	0.00E+00	1.00E+00	-1.19E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.20E+01
3	3	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.18E+01
4	4	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.16E+01
5	5	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.13E+01
6	6	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	1.10E+01
7	7	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	1.07E+01
8	8	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	1.04E+01
9	9	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	1.01E+01
10	10	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	9.84E+00
11	11	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	9.58E+00
12	12	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	9.34E+00
13	13	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	9.12E+00
14	14	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	8.91E+00
15	15	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.71E+00
16	16	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	8.53E+00
17	17	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	8.35E+00
18	18	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	8.18E+00
19	19	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	8.03E+00
20	20	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	7.88E+00



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	1.5	0.00E+00	1.00E+00	-1.19E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.20E+01
2	2	1.5	0.00E+00	1.00E+00	-1.19E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.20E+01
3	3	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.20E+01
4	4	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01
5	5	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	1.20E+01
6	6	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	1.20E+01
7	7	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	1.20E+01
8	8	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.20E+01
9	9	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	1.19E+01
10	10	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	1.19E+01
11	11	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	1.19E+01
12	12	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.18E+01
13	13	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	1.18E+01
14	14	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	1.17E+01
15	15	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	1.17E+01
16	16	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.16E+01
17	17	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	1.15E+01
18	18	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	1.15E+01
19	19	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	1.14E+01
20	20	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.13E+01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Naphthalene**			
Target Concentration (C_T)	**0.002**	**mg/l**	**Origin of C_T:**	**Proposed Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Naphthalene**	
Target concentration	C_T	**0.002**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.69E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.002	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		Naphthalene		from Level 1
Target concentration	**C_T**	**0.002**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C_T	**0.002**	mg/l	from Level 1
Dilution Factor	DF	**#DIV/0!**		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**0**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

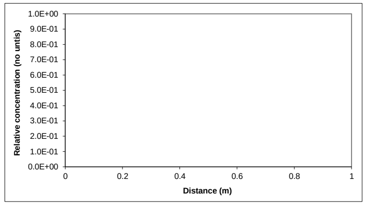
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: #######
Version: 1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

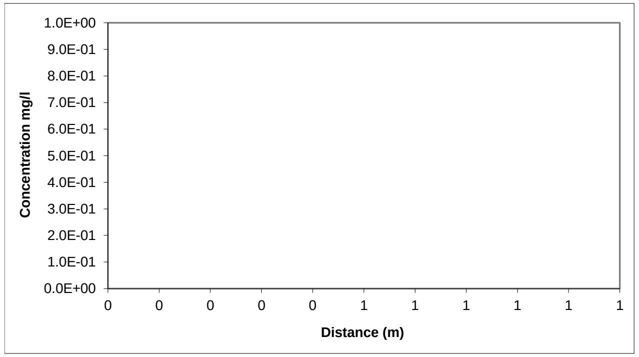
Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg
Level 1 Parameters			
Water filled soil porosity	θ_W	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless
Level 2 Parameters **Dilution Factor**	DF	#DIV/0!	
Level 3 Parameters **Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!	

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Naphthalene**		from Level 1
Target Concentration	C_T	**2.00E-03**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	2.31E-01	mg/l	*Based on average soil conc of 8.4mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+02	days	*100 day half life estimation*
Calculated decay rate	λ	6.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappi*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.60E+01	l/kg	*see options*
Longitudinal dispersivity	ax	2.00E+00	m	*see options*
Transverse dispersivity	az	2.00E-01	m	*see options*
Vertical dispersivity	ay	2.00E-02	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	6.13E+02	fraction
Decay rate used	λ	1.13E-05	d^{-1}
Rate of contaminant flow due to retardation	u	1.76E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.05E-15	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.82E+13**	

Remedial Targets

Remedial Target		**7.64E+10**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**6.05E-15**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.60E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.60E+01	l/kg

Define dispersivity (click brown cell and use pull down list)

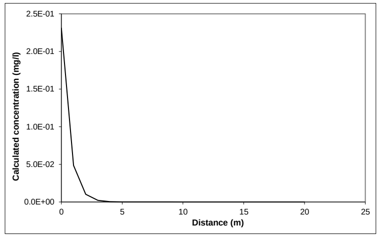
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.3E-01**
1.0	**4.86E-02**
2.0	**1.02E-02**
3.0	**2.15E-03**
4.0	**4.53E-04**
5.0	**9.52E-05**
6.0	**2.00E-05**
7.0	**4.20E-06**
8.0	**8.80E-07**
9.0	**1.84E-07**
10.0	**3.86E-08**
11.0	**8.06E-09**
12.0	**1.69E-09**
13.0	**3.52E-10**
14.0	**7.35E-11**
15.0	**1.53E-11**
16.0	**3.20E-12**
17.0	**6.67E-13**
18.0	**1.39E-13**
19.0	**2.90E-14**
20.0	**6.05E-15**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	**Value**	**Unit**	**justification**
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	**Value**	**Unit**	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	m^3/year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Naphthalene**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	2.00E-03	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option	User specified value for partition coefficient			
	calc	calc	Calc Kd	l/kg	
Calculation of partition coefficient for ionic organic chemical					
Partition coefficient used in Level 1 Assessment			1.34E+02	l/kg	
Calculated Remedial Target	**2.69E-01**	**mg/kg**		**for**	**Naphthalene**
Factor (partitioning between soil and water)			1.35E+02		

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **Naphthalene**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	Value	Units
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	2.00E-03	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

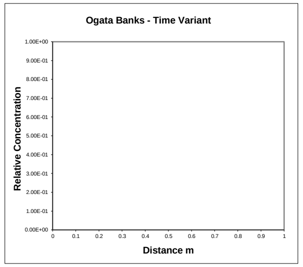
	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	2.000E-03	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

OGATA BANKS SOLUTION

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

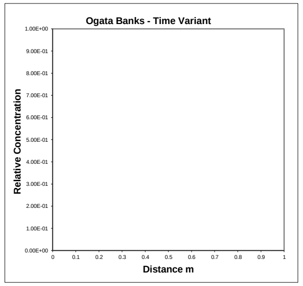
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



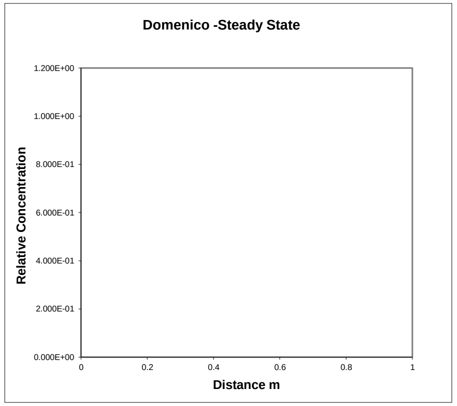
Date:	24/02/2020
Version:	1

Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	2.000E-03	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

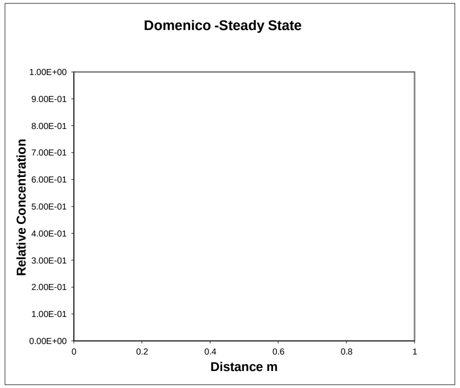


Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant **Naphthalene**

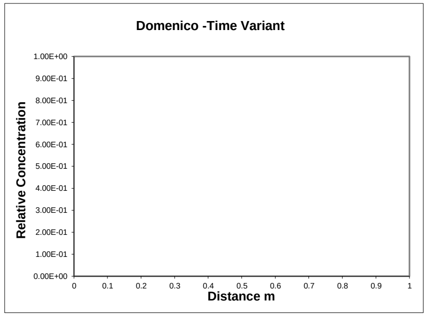
Input	Value	Units
C_T	0.002	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

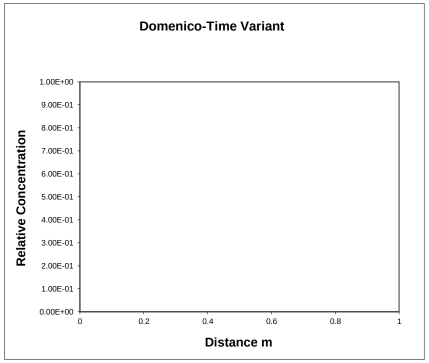
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	0.002	mg/l
Co	2.31E-01	mg/l
λ	1.13E-05	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	3.60E+01	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

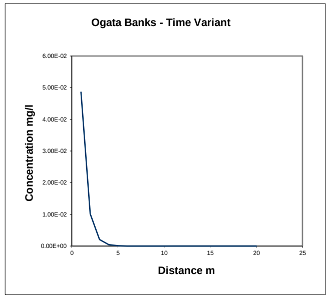
Calc	**Value**	
v	1.08E-03	m/d
Rc	6.13E+02	
u	1.76E-06	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

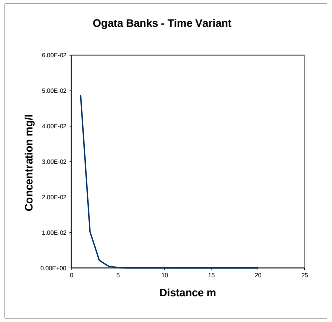
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	0.02888	-1.6E+00	2.1E-01	-3.4E+47	2.000	2.1E+00	7.8E+00	3.4E+47	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	4.86E-02
2	2	0.02888	-3.1E+00	4.4E-02	-3.4E+47	2.000	4.1E+00	6.1E+01	3.4E+47	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	1.01E-02
3	3	0.02888	-4.7E+00	9.3E-03	-3.4E+47	2.000	6.2E+00	4.8E+02	3.4E+47	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	2.09E-03
4	4	0.02888	-6.2E+00	2.0E-03	-3.4E+47	2.000	8.2E+00	3.8E+03	3.4E+47	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	4.25E-04
5	5	0.02888	-7.8E+00	4.1E-04	-3.4E+47	2.000	1.0E+01	3.0E+04	3.4E+47	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	8.63E-05
6	6	0.02888	-9.4E+00	8.7E-05	-3.4E+47	2.000	1.2E+01	2.3E+05	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	1.75E-05
7	7	0.02888	-1.1E+01	1.8E-05	-3.4E+47	2.000	1.4E+01	1.8E+06	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	3.56E-06
8	8	0.02888	-1.2E+01	3.8E-06	-3.4E+47	2.000	1.6E+01	1.4E+07	3.4E+47	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	7.23E-07
9	9	0.02888	-1.4E+01	8.1E-07	-3.4E+47	2.000	1.9E+01	1.1E+08	3.4E+47	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	1.47E-07
10	10	0.02888	-1.6E+01	1.7E-07	-3.4E+47	2.000	2.1E+01	8.7E+08	3.4E+47	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	3.00E-08
11	11	0.02888	-1.7E+01	3.6E-08	-3.4E+47	2.000	2.3E+01	6.8E+09	3.4E+47	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	6.13E-09
12	12	0.02888	-1.9E+01	7.5E-09	-3.4E+47	2.000	2.5E+01	5.4E+10	3.4E+47	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	1.25E-09
13	13	0.02888	-2.0E+01	1.6E-09	-3.4E+47	2.000	2.7E+01	4.2E+11	3.4E+47	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	2.57E-10
14	14	0.02888	-2.2E+01	3.3E-10	-3.4E+47	2.000	2.9E+01	3.3E+12	3.4E+47	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	5.26E-11
15	15	0.02888	-2.3E+01	7.0E-11	-3.4E+47	2.000	3.1E+01	2.6E+13	3.4E+47	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	1.08E-11
16	16	0.02888	-2.5E+01	1.5E-11	-3.4E+47	2.000	3.3E+01	2.0E+14	3.4E+47	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	2.22E-12
17	17	0.02888	-2.6E+01	3.1E-12	-3.4E+47	2.000	3.5E+01	1.6E+15	3.4E+47	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	4.56E-13
18	18	0.02888	-2.8E+01	6.5E-13	-3.4E+47	2.000	3.7E+01	1.2E+16	3.4E+47	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	9.40E-14
19	19	0.02888	-3.0E+01	1.4E-13	-3.4E+47	2.000	3.9E+01	9.7E+16	3.4E+47	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	1.94E-14
20	20	0.02888	-3.1E+01	2.9E-14	-3.4E+47	2.000	4.1E+01	7.6E+17	3.4E+47	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	3.99E-15



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	0.02888	-1.6E+00	2.1E-01	-3.4E+47	2.000	2.1E+00	7.8E+00	3.4E+47	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	4.86E-02
2	2	0.02888	-3.1E+00	4.4E-02	-3.4E+47	2.000	4.1E+00	6.1E+01	3.4E+47	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	1.02E-02
3	3	0.02888	-4.7E+00	9.3E-03	-3.4E+47	2.000	6.2E+00	4.8E+02	3.4E+47	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	2.15E-03
4	4	0.02888	-6.2E+00	2.0E-03	-3.4E+47	2.000	8.2E+00	3.8E+03	3.4E+47	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	4.53E-04
5	5	0.02888	-7.8E+00	4.1E-04	-3.4E+47	2.000	1.0E+01	3.0E+04	3.4E+47	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	9.52E-05
6	6	0.02888	-9.4E+00	8.7E-05	-3.4E+47	2.000	1.2E+01	2.3E+05	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	2.00E-05
7	7	0.02888	-1.1E+01	1.8E-05	-3.4E+47	2.000	1.4E+01	1.8E+06	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	4.20E-06
8	8	0.02888	-1.2E+01	3.8E-06	-3.4E+47	2.000	1.6E+01	1.4E+07	3.4E+47	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	8.80E-07
9	9	0.02888	-1.4E+01	8.1E-07	-3.4E+47	2.000	1.9E+01	1.1E+08	3.4E+47	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.84E-07
10	10	0.02888	-1.6E+01	1.7E-07	-3.4E+47	2.000	2.1E+01	8.7E+08	3.4E+47	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	3.86E-08
11	11	0.02888	-1.7E+01	3.6E-08	-3.4E+47	2.000	2.3E+01	6.8E+09	3.4E+47	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	8.06E-09
12	12	0.02888	-1.9E+01	7.5E-09	-3.4E+47	2.000	2.5E+01	5.4E+10	3.4E+47	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	1.69E-09
13	13	0.02888	-2.0E+01	1.6E-09	-3.4E+47	2.000	2.7E+01	4.2E+11	3.4E+47	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	3.52E-10
14	14	0.02888	-2.2E+01	3.3E-10	-3.4E+47	2.000	2.9E+01	3.3E+12	3.4E+47	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	7.35E-11
15	15	0.02888	-2.3E+01	7.0E-11	-3.4E+47	2.000	3.1E+01	2.6E+13	3.4E+47	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	1.53E-11
16	16	0.02888	-2.5E+01	1.5E-11	-3.4E+47	2.000	3.3E+01	2.0E+14	3.4E+47	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	3.20E-12
17	17	0.02888	-2.6E+01	3.1E-12	-3.4E+47	2.000	3.5E+01	1.6E+15	3.4E+47	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	6.67E-13
18	18	0.02888	-2.8E+01	6.5E-13	-3.4E+47	2.000	3.7E+01	1.2E+16	3.4E+47	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	1.39E-13
19	19	0.02888	-3.0E+01	1.4E-13	-3.4E+47	2.000	3.9E+01	9.7E+16	3.4E+47	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	2.90E-14
20	20	0.02888	-3.1E+01	2.9E-14	-3.4E+47	2.000	4.1E+01	7.6E+17	3.4E+47	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	6.05E-15



Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	0.002	mg/l
Co	2.31E-01	mg/l
λ	1.13E-05	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	3.60E+01	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

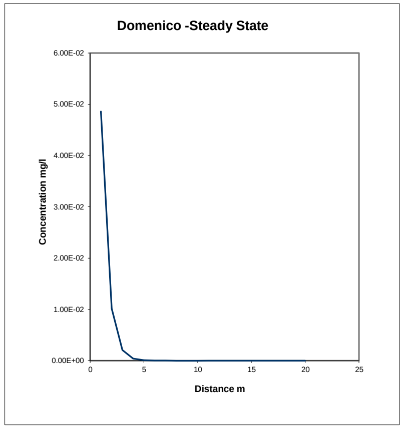
Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	6.13E+02	
u	1.76E-06	m/d

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

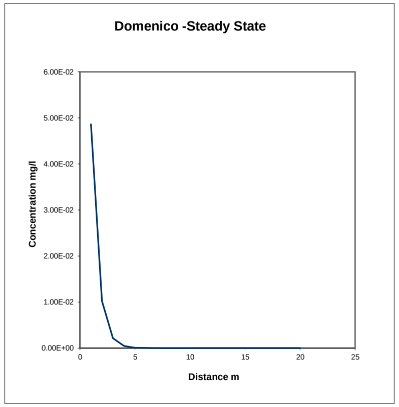
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	0.05775	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	4.86E-02
2	2	0.05775	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	1.01E-02
3	3	0.05775	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.97	-1.53E+00	-0.9696	2.09E-03
4	4	0.05775	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.939	-1.33E+00	-0.9392	4.25E-04
5	5	0.05775	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.906	-1.19E+00	-0.9065	8.63E-05
6	6	0.05775	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.874	-1.08E+00	-0.8742	1.75E-05
7	7	0.05775	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.844	-1.00E+00	-0.8436	3.56E-06
8	8	0.05775	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.815	-9.38E-01	-0.8151	7.23E-07
9	9	0.05775	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.789	-8.84E-01	-0.7887	1.47E-07
10	10	0.05775	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.764	-8.39E-01	-0.7643	3.00E-08
11	11	0.05775	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.742	-8.00E-01	-0.7418	6.13E-09
12	12	0.05775	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	1.25E-09
13	13	0.05775	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.702	-7.35E-01	-0.7017	2.57E-10
14	14	0.05775	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.684	-7.09E-01	-0.6838	5.26E-11
15	15	0.05775	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.667	-6.85E-01	-0.6671	1.08E-11
16	16	0.05775	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.651	-6.63E-01	-0.6515	2.22E-12
17	17	0.05775	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.637	-6.43E-01	-0.6369	4.56E-13
18	18	0.05775	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.623	-6.25E-01	-0.6232	9.40E-14
19	19	0.05775	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.61	-6.08E-01	-0.6104	1.94E-14
20	20	0.05775	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.598	-5.93E-01	-0.5983	3.99E-15



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	0.05775	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	4.86E-02
2	2	0.05775	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	1.02E-02
3	3	0.05775	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	2.15E-03
4	4	0.05775	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	4.53E-04
5	5	0.05775	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.999	-2.37E+00	-0.9992	9.52E-05
6	6	0.05775	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.998	-2.17E+00	-0.9978	2.00E-05
7	7	0.05775	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9954	4.20E-06
8	8	0.05775	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	8.80E-07
9	9	0.05775	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.84E-07
10	10	0.05775	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.982	-1.68E+00	-0.9823	3.86E-08
11	11	0.05775	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9763	8.06E-09
12	12	0.05775	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.97	-1.53E+00	-0.9696	1.69E-09
13	13	0.05775	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.962	-1.47E+00	-0.9625	3.52E-10
14	14	0.05775	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	7.35E-11
15	15	0.05775	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.947	-1.37E+00	-0.9472	1.53E-11
16	16	0.05775	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.939	-1.33E+00	-0.9392	3.20E-12
17	17	0.05775	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.931	-1.29E+00	-0.9311	6.67E-13
18	18	0.05775	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.923	-1.25E+00	-0.9229	1.39E-13
19	19	0.05775	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.915	-1.22E+00	-0.9147	2.90E-14
20	20	0.05775	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.906	-1.19E+00	-0.9065	6.05E-15



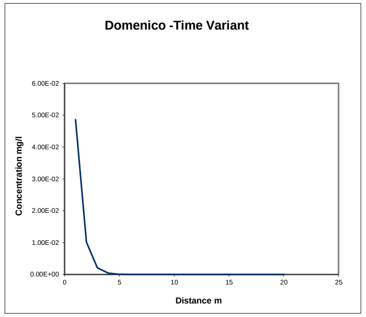
Date:	24/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	0.002	mg/l
Co	2.31E-01	mg/l
λ	1.13E-05	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	3.60E+01	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	0.02888	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	4.86E-02
2	2	0.02888	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	1.01E-02
3	3	0.02888	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	2.09E-03
4	4	0.02888	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	4.25E-04
5	5	0.02888	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	8.63E-05
6	6	0.02888	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	1.75E-05
7	7	0.02888	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	3.56E-06
8	8	0.02888	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	7.23E-07
9	9	0.02888	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	1.47E-07
10	10	0.02888	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	3.00E-08
11	11	0.02888	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	6.13E-09
12	12	0.02888	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	1.25E-09
13	13	0.02888	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	2.57E-10
14	14	0.02888	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	5.26E-11
15	15	0.02888	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	1.08E-11
16	16	0.02888	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	2.22E-12
17	17	0.02888	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	4.56E-13
18	18	0.02888	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	9.40E-14
19	19	0.02888	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	1.94E-14
20	20	0.02888	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	3.99E-15

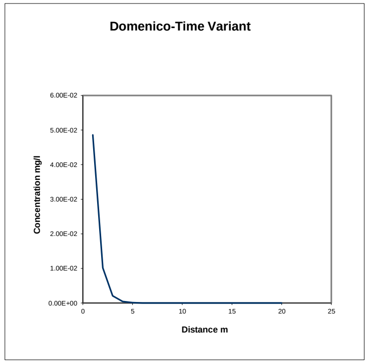


Vertical dispersion option   Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	6.13E+02	
u	1.76E-06	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	0.02888	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	4.86E-02
2	2	0.02888	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	1.02E-02
3	3	0.02888	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	2.15E-03
4	4	0.02888	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	4.53E-04
5	5	0.02888	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	9.52E-05
6	6	0.02888	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	2.00E-05
7	7	0.02888	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	4.20E-06
8	8	0.02888	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	8.80E-07
9	9	0.02888	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.84E-07
10	10	0.02888	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	3.86E-08
11	11	0.02888	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	8.06E-09
12	12	0.02888	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	1.69E-09
13	13	0.02888	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	3.52E-10
14	14	0.02888	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	7.35E-11
15	15	0.02888	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	1.53E-11
16	16	0.02888	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	3.20E-12
17	17	0.02888	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	6.67E-13
18	18	0.02888	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	1.39E-13
19	19	0.02888	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	2.90E-14
20	20	0.02888	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	6.05E-15



Date:	24/02/2020
Version:	1

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Vanadium**		from Level 1
Target Concentration	**C_T**	**2.00E-02**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.70E-01	mg/l	*Based on average soil conc of 206.93mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	*Estimation*
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappi*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.13E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	3.62E+03	fraction
Decay rate used	λ	2.13E-104	d^{-1}
Rate of contaminant flow due to retardation	u	2.98E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.14E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.06E+00**	

Remedial Targets

Remedial Target		**2.12E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**9.14E-01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.13E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.13E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

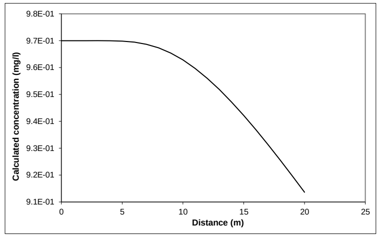
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**9.7E-01**
1.0	**9.70E-01**
2.0	**9.70E-01**
3.0	**9.70E-01**
4.0	**9.70E-01**
5.0	**9.70E-01**
6.0	**9.69E-01**
7.0	**9.69E-01**
8.0	**9.67E-01**
9.0	**9.65E-01**
10.0	**9.63E-01**
11.0	**9.60E-01**
12.0	**9.56E-01**
13.0	**9.52E-01**
14.0	**9.47E-01**
15.0	**9.42E-01**
16.0	**9.37E-01**
17.0	**9.31E-01**
18.0	**9.26E-01**
19.0	**9.20E-01**
20.0	**9.14E-01**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**0.00000017**	**mg/l**	**Origin of C_T:**	**Proposed Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Benzo(a)pyrene**	
Target concentration	C_T	**0.00000017**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.29E-05**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.00000017	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Benzo(a)pyrene**		from Level 1
Target concentration	C_T	**0.00000017**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C_T	**0.00000017**	mg/l	from Level 1
Dilution Factor	**DF**	**#DIV/0!**		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**0**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

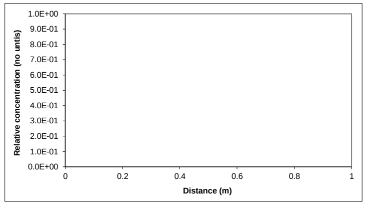
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!
0.0	#DIV/0!	#DIV/0!

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg

Level 1 Parameters

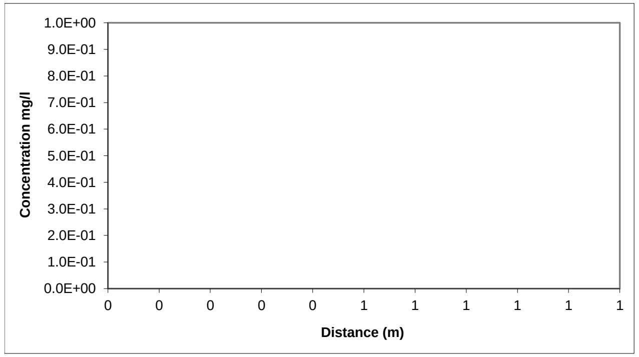
Water filled soil porosity	θ_W	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless

Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		**Benzo(a)pyrene**		from Level 1
Target Concentration	C_T	**1.70E-07**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

Parameter	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	7.00E-02	mg/l	*Based on max soil conc of 714mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+04	days	*10 year half life estimation*
Calculated decay rate	λ	1.90E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappi*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	*Estimate*
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.02E+04	l/kg	*see options*
Longitudinal dispersivity	ax	2.00E+00	m	*see options*
Transverse dispersivity	az	2.00E-01	m	*see options*
Vertical dispersivity	ay	2.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.73E+05	fraction
Decay rate used	λ	1.10E-10	d^{-1}
Rate of contaminant flow due to retardation	u	6.24E-09	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.52E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.55E+00**	

Remedial Targets

Remedial Target	**2.64E-07**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	**20**	**m**	
Concentration of contaminant at compliance point C_{ED}/C_0	**4.52E-02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	1.02E+04	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.02E+04	l/kg

Define dispersivity (click brown cell and use pull down list)

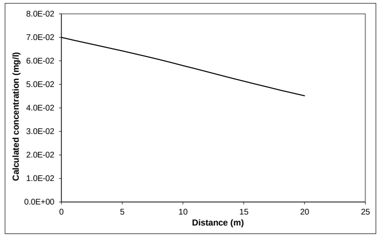
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value		Calc value Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: #######
Version: 1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**7.0E-02**
1.0	**6.88E-02**
2.0	**6.77E-02**
3.0	**6.65E-02**
4.0	**6.54E-02**
5.0	**6.42E-02**
6.0	**6.31E-02**
7.0	**6.19E-02**
8.0	**6.06E-02**
9.0	**5.93E-02**
10.0	**5.80E-02**
11.0	**5.67E-02**
12.0	**5.53E-02**
13.0	**5.40E-02**
14.0	**5.27E-02**
15.0	**5.14E-02**
16.0	**5.01E-02**
17.0	**4.88E-02**
18.0	**4.76E-02**
19.0	**4.63E-02**
20.0	**4.52E-02**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	m^3/year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Benzo(a)pyrene**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	1.70E-07	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option	User specified value for partition coefficient			
		calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical					
Partition coefficient used in Level 1 Assessment				1.34E+02	l/kg

Calculated Remedial Target	**2.29E-05**	**mg/kg**	**for**	**Benzo(a)pyrene**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **Benzo(a)pyrene**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	Value	Units
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	1.70E-07	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

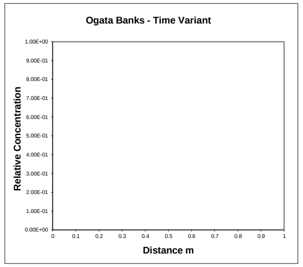
	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Benzo(a)pyrene**	
Input	**Value**	**Units**
C_T	1.700E-07	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

OGATA BANKS SOLUTION

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

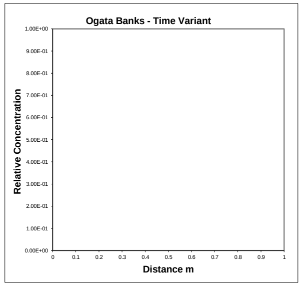
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

Contaminant **enzo(a)pyrene**

Input	Value	Units
C_T	1.700E-07	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

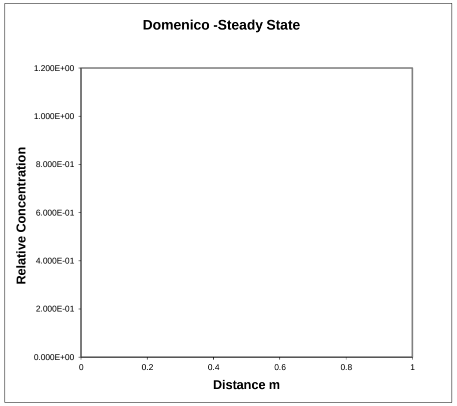
Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

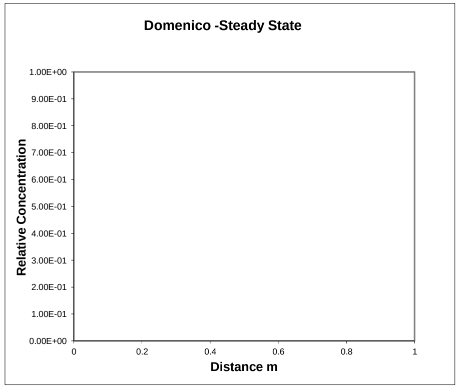
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



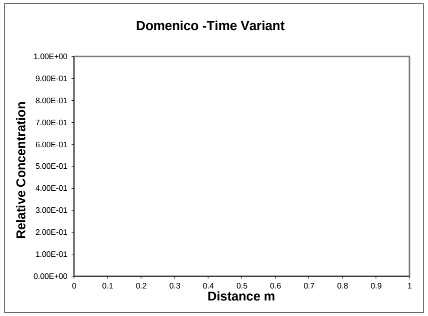
DOMENICO (TIME VARIANT)

Contaminant **Benzo(a)pyrene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

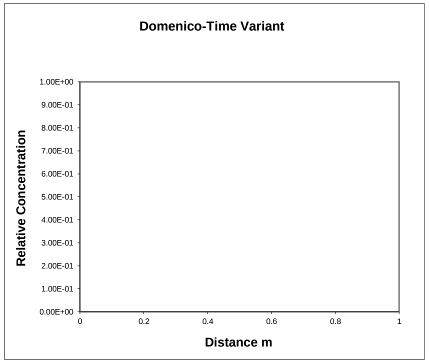
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

Contaminant **Benzo(a)pyrene**

Input	Value	Units
C_T	0.00000017	mg/l
Co	7.00E-02	mg/l
λ	1.10E-10	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	1.02E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

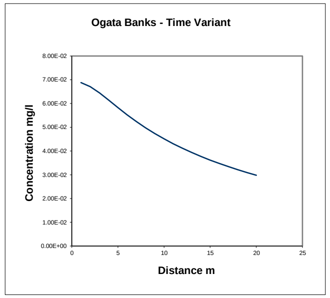
Calc	Value	
v	1.08E-03	m/d
Rc	1.73E+05	
u	6.24E-09	m/d

Date: 24/02/2020
Version: 1

OGATA BANKS SOLUTION

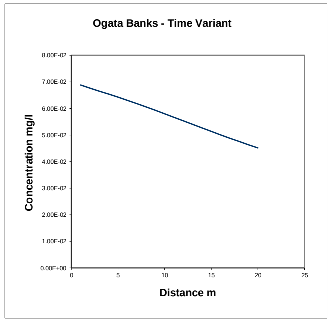
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	0.00875	-1.7E-02	9.8E-01	-3.0E+45	2.000	5.2E-01	1.7E+00	3.0E+45	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	6.88E-02
2	2	0.00875	-3.4E-02	9.7E-01	-3.0E+45	2.000	1.0E+00	2.8E+00	3.0E+45	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	6.71E-02
3	3	0.00875	-5.1E-02	9.5E-01	-3.0E+45	2.000	1.6E+00	4.7E+00	3.0E+45	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	6.45E-02
4	4	0.00875	-6.8E-02	9.3E-01	-3.0E+45	2.000	2.1E+00	7.9E+00	3.0E+45	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	6.14E-02
5	5	0.00875	-8.5E-02	9.2E-01	-3.0E+45	2.000	2.6E+00	1.3E+01	3.0E+45	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	5.83E-02
6	6	0.00875	-1.0E-01	9.0E-01	-3.0E+45	2.000	3.1E+00	2.2E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	5.53E-02
7	7	0.00875	-1.2E-01	8.9E-01	-3.0E+45	2.000	3.6E+00	3.7E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	5.24E-02
8	8	0.00875	-1.4E-01	8.7E-01	-3.0E+45	2.000	4.1E+00	6.3E+01	3.0E+45	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	4.98E-02
9	9	0.00875	-1.5E-01	8.6E-01	-3.0E+45	2.000	4.7E+00	1.0E+02	3.0E+45	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	4.74E-02
10	10	0.00875	-1.7E-01	8.4E-01	-3.0E+45	2.000	5.2E+00	1.8E+02	3.0E+45	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	4.51E-02
11	11	0.00875	-1.9E-01	8.3E-01	-3.0E+45	2.000	5.7E+00	3.0E+02	3.0E+45	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	4.31E-02
12	12	0.00875	-2.0E-01	8.2E-01	-3.0E+45	2.000	6.2E+00	4.9E+02	3.0E+45	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	4.12E-02
13	13	0.00875	-2.2E-01	8.0E-01	-3.0E+45	2.000	6.7E+00	8.3E+02	3.0E+45	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	3.94E-02
14	14	0.00875	-2.4E-01	7.9E-01	-3.0E+45	2.000	7.2E+00	1.4E+03	3.0E+45	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	3.77E-02
15	15	0.00875	-2.6E-01	7.7E-01	-3.0E+45	2.000	7.8E+00	2.3E+03	3.0E+45	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	3.62E-02
16	16	0.00875	-2.7E-01	7.6E-01	-3.0E+45	2.000	8.3E+00	3.9E+03	3.0E+45	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	3.47E-02
17	17	0.00875	-2.9E-01	7.5E-01	-3.0E+45	2.000	8.8E+00	6.6E+03	3.0E+45	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	3.34E-02
18	18	0.00875	-3.1E-01	7.4E-01	-3.0E+45	2.000	9.3E+00	1.1E+04	3.0E+45	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	3.21E-02
19	19	0.00875	-3.2E-01	7.2E-01	-3.0E+45	2.000	9.8E+00	1.8E+04	3.0E+45	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	3.09E-02
20	20	0.00875	-3.4E-01	7.1E-01	-3.0E+45	2.000	1.0E+01	3.1E+04	3.0E+45	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	2.98E-02



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	0.00875	-1.7E-02	9.8E-01	-3.0E+45	2.000	5.2E-01	1.7E+00	3.0E+45	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	6.88E-02
2	2	0.00875	-3.4E-02	9.7E-01	-3.0E+45	2.000	1.0E+00	2.8E+00	3.0E+45	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	6.77E-02
3	3	0.00875	-5.1E-02	9.5E-01	-3.0E+45	2.000	1.6E+00	4.7E+00	3.0E+45	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	6.65E-02
4	4	0.00875	-6.8E-02	9.3E-01	-3.0E+45	2.000	2.1E+00	7.9E+00	3.0E+45	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	6.54E-02
5	5	0.00875	-8.5E-02	9.2E-01	-3.0E+45	2.000	2.6E+00	1.3E+01	3.0E+45	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	6.42E-02
6	6	0.00875	-1.0E-01	9.0E-01	-3.0E+45	2.000	3.1E+00	2.2E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	6.31E-02
7	7	0.00875	-1.2E-01	8.9E-01	-3.0E+45	2.000	3.6E+00	3.7E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	6.19E-02
8	8	0.00875	-1.4E-01	8.7E-01	-3.0E+45	2.000	4.1E+00	6.3E+01	3.0E+45	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	6.06E-02
9	9	0.00875	-1.5E-01	8.6E-01	-3.0E+45	2.000	4.7E+00	1.0E+02	3.0E+45	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	5.93E-02
10	10	0.00875	-1.7E-01	8.4E-01	-3.0E+45	2.000	5.2E+00	1.8E+02	3.0E+45	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	5.80E-02
11	11	0.00875	-1.9E-01	8.3E-01	-3.0E+45	2.000	5.7E+00	3.0E+02	3.0E+45	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	5.67E-02
12	12	0.00875	-2.0E-01	8.2E-01	-3.0E+45	2.000	6.2E+00	4.9E+02	3.0E+45	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	5.53E-02
13	13	0.00875	-2.2E-01	8.0E-01	-3.0E+45	2.000	6.7E+00	8.3E+02	3.0E+45	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	5.40E-02
14	14	0.00875	-2.4E-01	7.9E-01	-3.0E+45	2.000	7.2E+00	1.4E+03	3.0E+45	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	5.27E-02
15	15	0.00875	-2.6E-01	7.7E-01	-3.0E+45	2.000	7.8E+00	2.3E+03	3.0E+45	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	5.14E-02
16	16	0.00875	-2.7E-01	7.6E-01	-3.0E+45	2.000	8.3E+00	3.9E+03	3.0E+45	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	5.01E-02
17	17	0.00875	-2.9E-01	7.5E-01	-3.0E+45	2.000	8.8E+00	6.6E+03	3.0E+45	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	4.88E-02
18	18	0.00875	-3.1E-01	7.4E-01	-3.0E+45	2.000	9.3E+00	1.1E+04	3.0E+45	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	4.76E-02
19	19	0.00875	-3.2E-01	7.2E-01	-3.0E+45	2.000	9.8E+00	1.8E+04	3.0E+45	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	4.63E-02
20	20	0.00875	-3.4E-01	7.1E-01	-3.0E+45	2.000	1.0E+01	3.1E+04	3.0E+45	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	4.52E-02



Contaminant **enzo(a)pyrene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	7.00E-02	mg/l
λ	1.10E-10	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	1.02E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

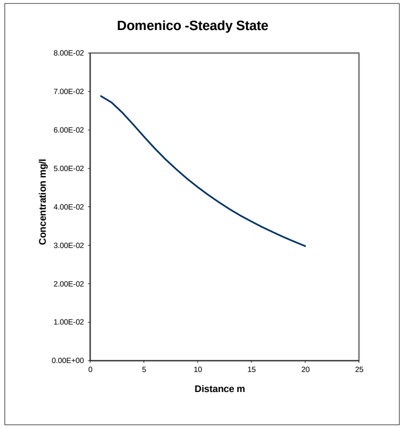
Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	1.73E+05	
u	6.24E-09	m/d

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

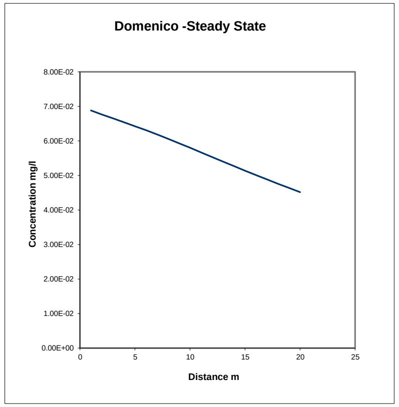
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	0.0175	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	6.88E-02
2	2	0.0175	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.71E-02
3	3	0.0175	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.97	-1.53E+00	-0.9696	6.45E-02
4	4	0.0175	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.939	-1.33E+00	-0.9392	6.14E-02
5	5	0.0175	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.906	-1.19E+00	-0.9065	5.83E-02
6	6	0.0175	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.874	-1.08E+00	-0.8742	5.53E-02
7	7	0.0175	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.844	-1.00E+00	-0.8436	5.24E-02
8	8	0.0175	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.815	-9.38E-01	-0.8151	4.98E-02
9	9	0.0175	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.789	-8.84E-01	-0.7887	4.74E-02
10	10	0.0175	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.764	-8.39E-01	-0.7643	4.51E-02
11	11	0.0175	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.742	-8.00E-01	-0.7418	4.31E-02
12	12	0.0175	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	4.12E-02
13	13	0.0175	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.702	-7.35E-01	-0.7017	3.94E-02
14	14	0.0175	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.684	-7.09E-01	-0.6838	3.77E-02
15	15	0.0175	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.667	-6.85E-01	-0.6671	3.62E-02
16	16	0.0175	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.651	-6.63E-01	-0.6515	3.47E-02
17	17	0.0175	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.637	-6.43E-01	-0.6369	3.34E-02
18	18	0.0175	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.623	-6.25E-01	-0.6232	3.21E-02
19	19	0.0175	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.61	-6.08E-01	-0.6104	3.09E-02
20	20	0.0175	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.598	-5.93E-01	-0.5983	2.98E-02



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	0.0175	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	6.88E-02
2	2	0.0175	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	6.77E-02
3	3	0.0175	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	6.65E-02
4	4	0.0175	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	6.54E-02
5	5	0.0175	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.999	-2.37E+00	-0.9992	6.42E-02
6	6	0.0175	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.998	-2.17E+00	-0.9978	6.31E-02
7	7	0.0175	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9954	6.19E-02
8	8	0.0175	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.06E-02
9	9	0.0175	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.988	-1.77E+00	-0.9876	5.93E-02
10	10	0.0175	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.982	-1.68E+00	-0.9823	5.80E-02
11	11	0.0175	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9763	5.67E-02
12	12	0.0175	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.97	-1.53E+00	-0.9696	5.53E-02
13	13	0.0175	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.962	-1.47E+00	-0.9625	5.40E-02
14	14	0.0175	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	5.27E-02
15	15	0.0175	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.947	-1.37E+00	-0.9472	5.14E-02
16	16	0.0175	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.939	-1.33E+00	-0.9392	5.01E-02
17	17	0.0175	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.931	-1.29E+00	-0.9311	4.88E-02
18	18	0.0175	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.923	-1.25E+00	-0.9229	4.76E-02
19	19	0.0175	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.915	-1.22E+00	-0.9147	4.63E-02
20	20	0.0175	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.906	-1.19E+00	-0.9065	4.52E-02



Date:	24/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant **Benzo(a)pyrene**

Input	**Value**	**Units**
C_T	0.00000017	mg/l
Co	7.00E-02	mg/l
λ	1.10E-10	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	1.02E+04	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

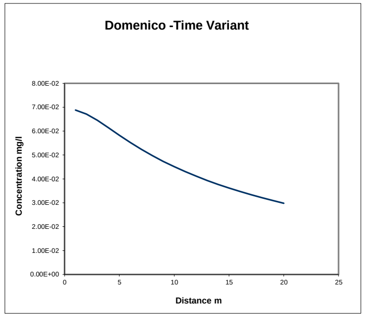
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	1.73E+05	
u	6.24E-09	m/d

Date:	24/02/2020
Version:	1

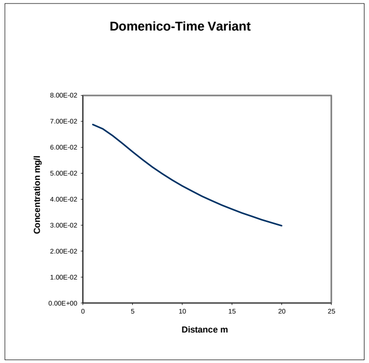
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	0.00875	-1.70E-02	9.83E-01	-2.98E+45	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	6.88E-02
2	2	0.00875	-3.40E-02	9.67E-01	-2.98E+45	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.71E-02
3	3	0.00875	-5.10E-02	9.50E-01	-2.98E+45	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	6.45E-02
4	4	0.00875	-6.80E-02	9.34E-01	-2.98E+45	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	6.14E-02
5	5	0.00875	-8.50E-02	9.18E-01	-2.98E+45	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	5.83E-02
6	6	0.00875	-1.02E-01	9.03E-01	-2.98E+45	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	5.53E-02
7	7	0.00875	-1.19E-01	8.88E-01	-2.98E+45	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	5.24E-02
8	8	0.00875	-1.36E-01	8.73E-01	-2.98E+45	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	4.98E-02
9	9	0.00875	-1.53E-01	8.58E-01	-2.98E+45	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	4.74E-02
10	10	0.00875	-1.70E-01	8.44E-01	-2.98E+45	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	4.51E-02
11	11	0.00875	-1.87E-01	8.29E-01	-2.98E+45	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	4.31E-02
12	12	0.00875	-2.04E-01	8.15E-01	-2.98E+45	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	4.12E-02
13	13	0.00875	-2.21E-01	8.02E-01	-2.98E+45	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	3.94E-02
14	14	0.00875	-2.38E-01	7.88E-01	-2.98E+45	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	3.77E-02
15	15	0.00875	-2.55E-01	7.75E-01	-2.98E+45	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	3.62E-02
16	16	0.00875	-2.72E-01	7.62E-01	-2.98E+45	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	3.47E-02
17	17	0.00875	-2.89E-01	7.49E-01	-2.98E+45	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	3.34E-02
18	18	0.00875	-3.06E-01	7.36E-01	-2.98E+45	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	3.21E-02
19	19	0.00875	-3.23E-01	7.24E-01	-2.98E+45	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	3.09E-02
20	20	0.00875	-3.40E-01	7.12E-01	-2.98E+45	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	2.98E-02



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	0.00875	-1.70E-02	9.83E-01	-2.98E+45	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	6.88E-02
2	2	0.00875	-3.40E-02	9.67E-01	-2.98E+45	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	6.77E-02
3	3	0.00875	-5.10E-02	9.50E-01	-2.98E+45	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	6.65E-02
4	4	0.00875	-6.80E-02	9.34E-01	-2.98E+45	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	6.54E-02
5	5	0.00875	-8.50E-02	9.18E-01	-2.98E+45	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	6.42E-02
6	6	0.00875	-1.02E-01	9.03E-01	-2.98E+45	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	6.31E-02
7	7	0.00875	-1.19E-01	8.88E-01	-2.98E+45	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	6.19E-02
8	8	0.00875	-1.36E-01	8.73E-01	-2.98E+45	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.06E-02
9	9	0.00875	-1.53E-01	8.58E-01	-2.98E+45	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	5.93E-02
10	10	0.00875	-1.70E-01	8.44E-01	-2.98E+45	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	5.80E-02
11	11	0.00875	-1.87E-01	8.29E-01	-2.98E+45	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	5.67E-02
12	12	0.00875	-2.04E-01	8.15E-01	-2.98E+45	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	5.53E-02
13	13	0.00875	-2.21E-01	8.02E-01	-2.98E+45	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	5.40E-02
14	14	0.00875	-2.38E-01	7.88E-01	-2.98E+45	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	5.27E-02
15	15	0.00875	-2.55E-01	7.75E-01	-2.98E+45	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	5.14E-02
16	16	0.00875	-2.72E-01	7.62E-01	-2.98E+45	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	5.01E-02
17	17	0.00875	-2.89E-01	7.49E-01	-2.98E+45	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	4.88E-02
18	18	0.00875	-3.06E-01	7.36E-01	-2.98E+45	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	4.76E-02
19	19	0.00875	-3.23E-01	7.24E-01	-2.98E+45	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	4.63E-02
20	20	0.00875	-3.40E-01	7.12E-01	-2.98E+45	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	4.52E-02



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**0.00000017**	**mg/l**	**Origin of C_T:**	**Proposed Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**20-Feb-20**		**Version:**	**1**
Contaminant	**Iron**			
Target Concentration (C_T)	**1**	**mg/l**	**Origin of C_T:**	**Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
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It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Iron**	
Target concentration	C_T	**1**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.35E+02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	1	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	20-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Iron**		from Level 1
Target concentration	C_T	**1**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	20-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		**Iron**		from Level 1
Target Concentration	**C_T**	**1**	mg/l	from Level 1
Dilution Factor	**DF**	**#DIV/0!**		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**0**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

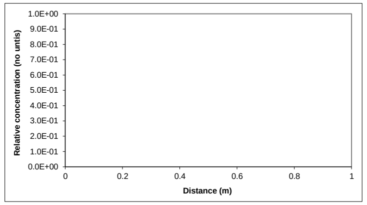
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: #######
Version: 1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Relative concentration (No units)**	**Concentration mg/l**
0	**1.0E+00**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg

Level 1 Parameters

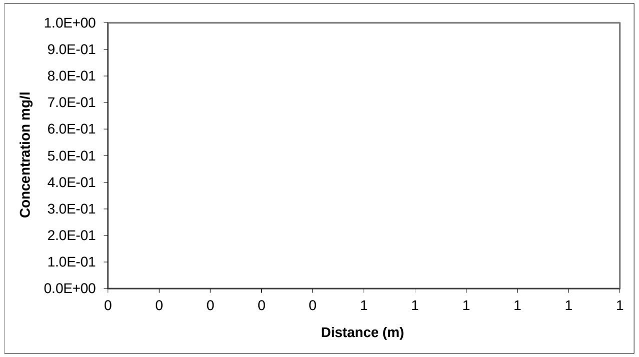
Water filled soil porosity	θ_W	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless

Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Iron**		from Level 1
Target Concentration	**C_T**	**1.00E+00**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.95E+03	mg/l	*Based on maximum soil conc of 2390000mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	*Estimation*
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappi*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	8.10E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.38E+04	fraction
Decay rate used	λ	5.59E-105	d^{-1}
Rate of contaminant flow due to retardation	u	7.84E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.78E+03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.06E+00**	

Remedial Targets

Remedial Target		**1.06E+00**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**2.78E+03**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	8.10E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	8.10E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

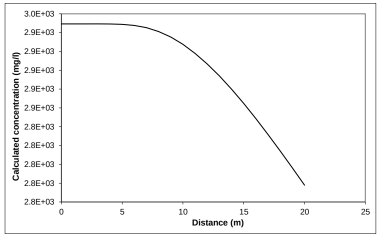
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.9E+03**
1.0	**2.95E+03**
2.0	**2.95E+03**
3.0	**2.95E+03**
4.0	**2.95E+03**
5.0	**2.95E+03**
6.0	**2.95E+03**
7.0	**2.95E+03**
8.0	**2.94E+03**
9.0	**2.94E+03**
10.0	**2.93E+03**
11.0	**2.92E+03**
12.0	**2.91E+03**
13.0	**2.89E+03**
14.0	**2.88E+03**
15.0	**2.86E+03**
16.0	**2.85E+03**
17.0	**2.83E+03**
18.0	**2.81E+03**
19.0	**2.80E+03**
20.0	**2.78E+03**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	m^3/year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Iron**

Parameter (carried over from input sheet)	**Value**	**Units**
$\mathbf{C_T}$	1.00E+00	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option	User specified value for partition coefficient			
		calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical					
Partition coefficient used in Level 1 Assessment				1.34E+02	l/kg

Calculated Remedial Target	**1.35E+02**	**mg/kg**	**for**	**Iron**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	20/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant **Iron**

Site assessed:	Glan Llyn
Date:	20/02/2020
Version:	1

Parameter (carried over from input sheet)	**Value**	**Units**
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	1.00E+00	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1.000E+00	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

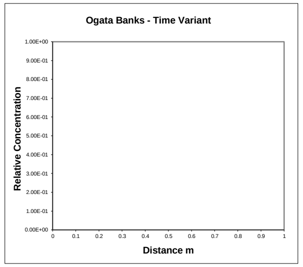
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date: 20/02/2020
Version: 1

OGATA BANKS SOLUTION

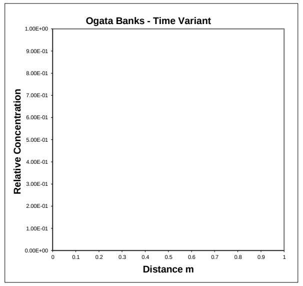
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



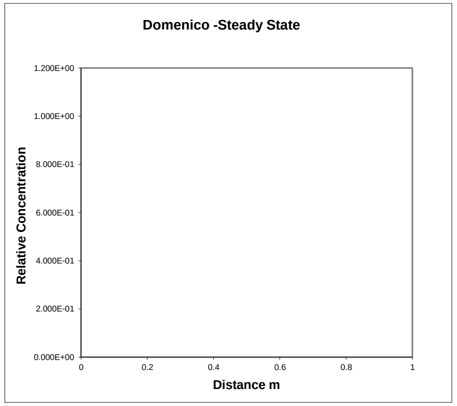
Contaminant **Iron**

Input	Value	Units
C_T	1.000E+00	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

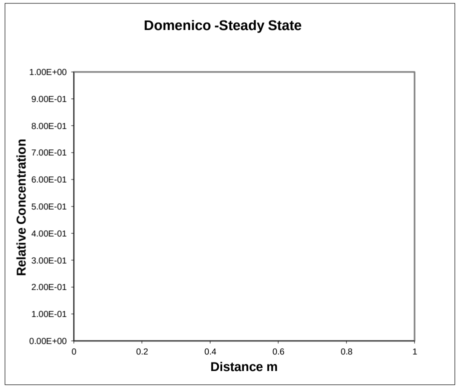


Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



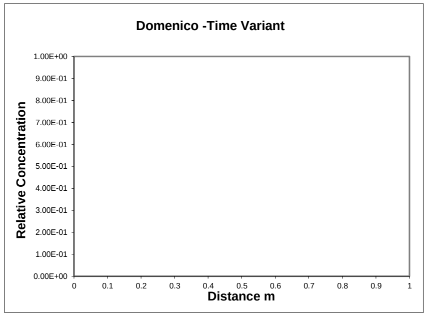
Date:	20/02/2020
Version:	1

DOMENICO (TIME VARIANT)

Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

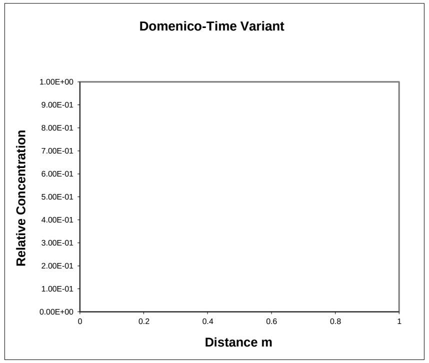
	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	20/02/2020
Version:	1

Contaminant **Iron**

Input	**Value**	**Units**
C_T	1	mg/l
Co	2.95E+03	mg/l
λ	5.59E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	8.10E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

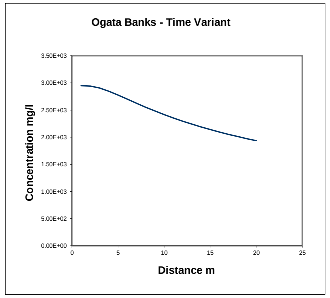
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.38E+04	
u	7.84E-08	m/d

Date: 20/02/2020
Version: 1

OGATA BANKS SOLUTION

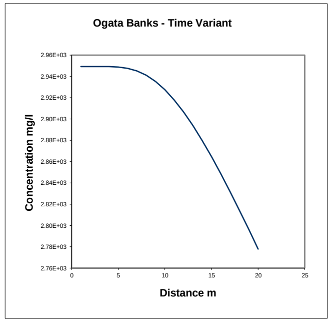
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	2.95E+03
2	2	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	2.94E+03
3	3	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	2.91E+03
4	4	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	2.85E+03
5	5	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	2.78E+03
6	6	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	2.70E+03
7	7	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	2.63E+03
8	8	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	2.55E+03
9	9	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	2.48E+03
10	10	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	2.42E+03
11	11	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	2.36E+03
12	12	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	2.30E+03
13	13	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	2.24E+03
14	14	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	2.19E+03
15	15	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	2.14E+03
16	16	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	2.10E+03
17	17	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	2.05E+03
18	18	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	2.01E+03
19	19	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	1.97E+03
20	20	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	1.94E+03



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	2.95E+03
2	2	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	2.95E+03
3	3	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	2.95E+03
4	4	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	2.95E+03
5	5	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	2.95E+03
6	6	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	2.95E+03
7	7	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	2.95E+03
8	8	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	2.94E+03
9	9	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	2.94E+03
10	10	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	2.93E+03
11	11	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	2.92E+03
12	12	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	2.91E+03
13	13	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	2.89E+03
14	14	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	2.88E+03
15	15	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	2.86E+03
16	16	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	2.85E+03
17	17	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	2.83E+03
18	18	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	2.81E+03
19	19	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	2.80E+03
20	20	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	2.78E+03



Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1	mg/l
Co	2.95E+03	mg/l
λ	5.59E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	8.10E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

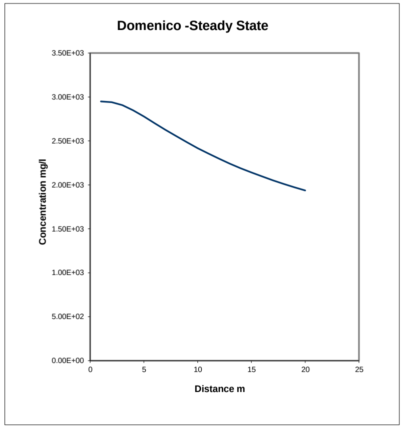
Calc	**Value**	
v	1.08E-03	m/d
Rc	1.38E+04	
u	7.84E-08	m/d

Date:	20/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

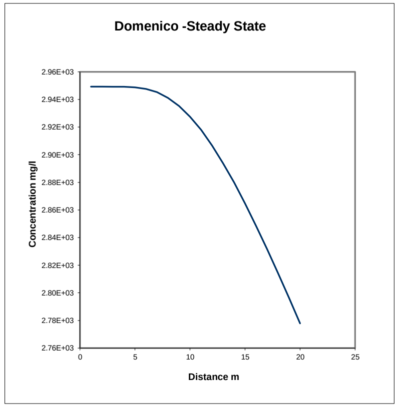
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	737.318	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
2	2	737.318	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	2.94E+03
3	3	737.318	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	2.91E+03
4	4	737.318	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	2.85E+03
5	5	737.318	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	2.78E+03
6	6	737.318	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	2.70E+03
7	7	737.318	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	2.63E+03
8	8	737.318	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	2.55E+03
9	9	737.318	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	2.48E+03
10	10	737.318	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	2.42E+03
11	11	737.318	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	2.36E+03
12	12	737.318	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	2.30E+03
13	13	737.318	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	2.24E+03
14	14	737.318	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	2.19E+03
15	15	737.318	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	2.14E+03
16	16	737.318	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	2.10E+03
17	17	737.318	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	2.05E+03
18	18	737.318	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	2.01E+03
19	19	737.318	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	1.97E+03
20	20	737.318	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	1.94E+03



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	737.318	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	2.95E+03
2	2	737.318	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	2.95E+03
3	3	737.318	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	2.95E+03
4	4	737.318	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
5	5	737.318	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	2.95E+03
6	6	737.318	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	2.95E+03
7	7	737.318	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	2.95E+03
8	8	737.318	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	2.94E+03
9	9	737.318	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	2.94E+03
10	10	737.318	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	2.93E+03
11	11	737.318	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	2.92E+03
12	12	737.318	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	2.91E+03
13	13	737.318	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	2.89E+03
14	14	737.318	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	2.88E+03
15	15	737.318	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	2.86E+03
16	16	737.318	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	2.85E+03
17	17	737.318	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	2.83E+03
18	18	737.318	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	2.81E+03
19	19	737.318	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	2.80E+03
20	20	737.318	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	2.78E+03



DOMENICO (TIME VARIANT)

Contaminant	**Iron**	
Input	**Value**	**Units**
C_T	1	mg/l
Co	2.95E+03	mg/l
λ	5.59E-105	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	8.10E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

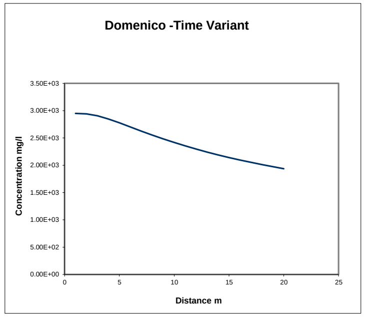
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	1.38E+04	
u	7.84E-08	m/d

Date:	20/02/2020
Version:	1

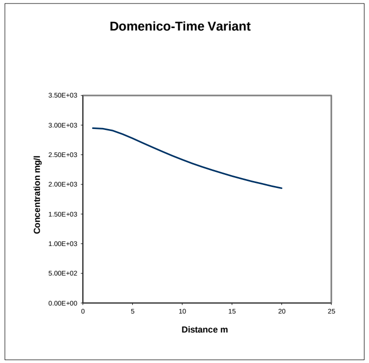
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	368.659	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
2	2	368.659	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	2.94E+03
3	3	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	2.91E+03
4	4	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	2.85E+03
5	5	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	2.78E+03
6	6	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	2.70E+03
7	7	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	2.63E+03
8	8	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	2.55E+03
9	9	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	2.48E+03
10	10	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	2.42E+03
11	11	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	2.36E+03
12	12	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	2.30E+03
13	13	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	2.24E+03
14	14	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	2.19E+03
15	15	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	2.14E+03
16	16	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	2.10E+03
17	17	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	2.05E+03
18	18	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	2.01E+03
19	19	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	1.97E+03
20	20	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	1.94E+03



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
	m														
1	1	368.659	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	2.95E+03
2	2	368.659	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	2.95E+03
3	3	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	2.95E+03
4	4	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
5	5	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	2.95E+03
6	6	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	2.95E+03
7	7	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	2.95E+03
8	8	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	2.94E+03
9	9	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	2.94E+03
10	10	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	2.93E+03
11	11	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	2.92E+03
12	12	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	2.91E+03
13	13	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	2.89E+03
14	14	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	2.88E+03
15	15	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	2.86E+03
16	16	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	2.85E+03
17	17	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	2.83E+03
18	18	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	2.81E+03
19	19	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	2.80E+03
20	20	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	2.78E+03



R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Manganese**		from Level 1
Target Concentration	C_T	**1.23E-01**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	8.99E-01	mg/l	*Based on maximum soil conc of 408000mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	*Estimation*
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappi*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.20E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	7.20E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	7.20E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

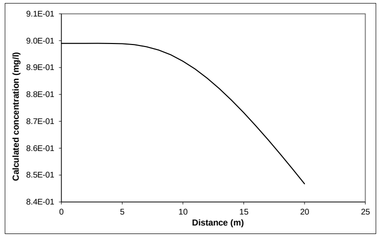
Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.22E+04	fraction
Decay rate used	λ	6.29E-105	d^{-1}
Rate of contaminant flow due to retardation	u	8.82E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.47E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.06E+00**	

Remedial Targets

Remedial Target		**1.31E-01**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**8.47E-01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**9.0E-01**
1.0	**8.99E-01**
2.0	**8.99E-01**
3.0	**8.99E-01**
4.0	**8.99E-01**
5.0	**8.99E-01**
6.0	**8.99E-01**
7.0	**8.98E-01**
8.0	**8.97E-01**
9.0	**8.95E-01**
10.0	**8.92E-01**
11.0	**8.89E-01**
12.0	**8.86E-01**
13.0	**8.82E-01**
14.0	**8.78E-01**
15.0	**8.73E-01**
16.0	**8.68E-01**
17.0	**8.63E-01**
18.0	**8.58E-01**
19.0	**8.52E-01**
20.0	**8.47E-01**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**3**
Contaminant	**Naphthalene**			
Target Concentration (C_T)	**0.002**	**mg/l**	**Origin of C_T:**	**Proposed Water Framework Directive EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		Naphthalene	
Target concentration	C_T	0.002	mg/l

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.69E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.002	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	3

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**Naphthalene**		from Level 1
Target concentration	C_T	**0.002**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	3

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		**Naphthalene**		from Level 1
Target Concentration	**C_T**	**0.002**	mg/l	from Level 1
Dilution Factor	**DF**	**#DIV/0!**		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**0**	**m**	
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

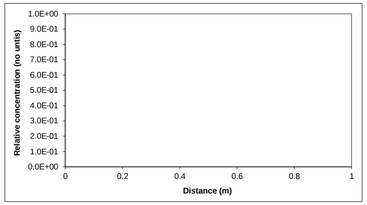
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	3

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	**1.0E+00**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

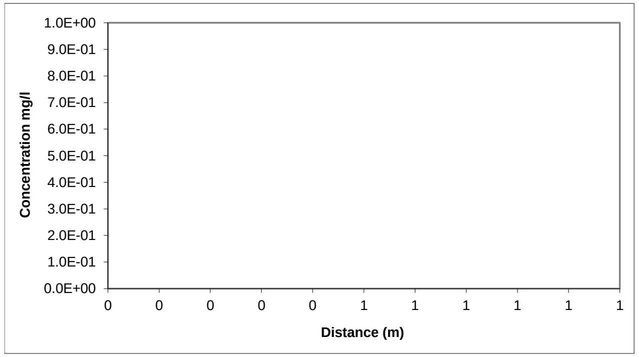
Only input required is Soil Contaminant Concentration

	Input Parameters			
	Soil contaminant concentration	C_0	0.00E+00	mg/kg
Level 1 Parameters				
	Water filled soil porosity	θ_w	5.00E-01	fraction
	Air filled soil porosity	θa	3.70E-01	fraction
	Bulk density	ρ	1.36E+00	g/cm^3
	Henry's Law constant	H	1.00E+00	dimensionless
	Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
	Factor (partitioning between soil and water)		1.35E+02	dimensionless
Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!	
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!	

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Naphthalene**		from Level 1
Target Concentration	**C_T**	**2.00E-03**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.29E+02	mg/l	*Based on maximum soil conc of 4680mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+02	days	*100 day half life estimation*
Calculated decay rate	λ	6.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappir*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.60E+01	l/kg	*see options*
Longitudinal dispersivity	ax	2.00E+00	m	*see options*
Transverse dispersivity	az	2.00E-01	m	*see options*
Vertical dispersivity	ay	2.00E-02	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	6.13E+02	fraction
Decay rate used	λ	1.13E-05	d^{-1}
Rate of contaminant flow due to retardation	u	1.76E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.37E-12	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.82E+13**	

Remedial Targets

Remedial Target		**7.64E+10**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.37E-12**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.60E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.60E+01	l/kg

Define dispersivity (click brown cell and use pull down list)

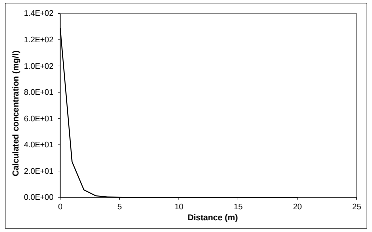
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	########
Version:	3

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.3E+02**
1.0	**2.71E+01**
2.0	**5.70E+00**
3.0	**1.20E+00**
4.0	**2.52E-01**
5.0	**5.30E-02**
6.0	**1.11E-02**
7.0	**2.34E-03**
8.0	**4.90E-04**
9.0	**1.03E-04**
10.0	**2.15E-05**
11.0	**4.49E-06**
12.0	**9.39E-07**
13.0	**1.96E-07**
14.0	**4.09E-08**
15.0	**8.54E-09**
16.0	**1.78E-09**
17.0	**3.72E-10**
18.0	**7.75E-11**
19.0	**1.62E-11**
20.0	**3.37E-12**

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit		
Moisture Content	0.00	% wt		
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)	
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3		
Calculated Parameters				
Voids Ratio	#DIV/0!	fraction		
dry bulk density	0.00	tonnes/m^3		
Initial Saturation	#DIV/0!	%		
Total porosity	**1.000**	**fraction**		**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**		
Water Filled Porosity	**#DIV/0!**	**fraction**		

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	m^3/year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Naphthalene**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	2.00E-03	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

	Selected option	User specified value for partition coefficient			
		calc	calc	Calc Kd	l/kg
Calculation of partition coefficient for ionic organic chemical					
Partition coefficient used in Level 1 Assessment				1.34E+02	l/kg

Calculated Remedial Target	**2.69E-01**	**mg/kg**	**for**	**Naphthalene**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	3

Level 2 Calculation Sheet

Contaminant **Naphthalene**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	3

Parameter (carried over from input sheet)	Value	Units
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	2.00E-03	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	2.000E-03	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

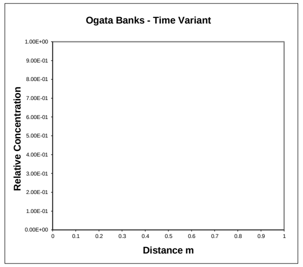
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	3

OGATA BANKS SOLUTION

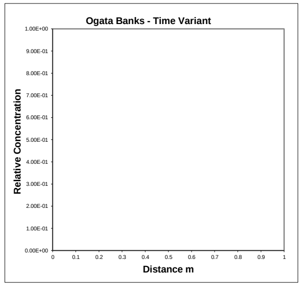
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



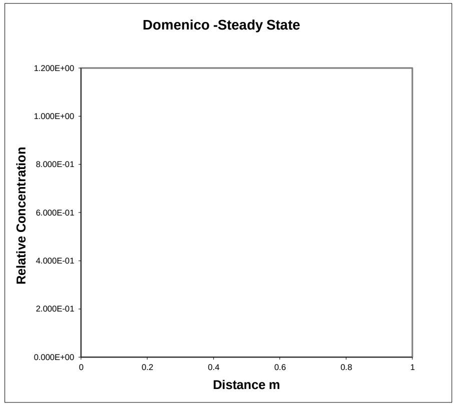
Contaminant **Naphthalene**

Input	Value	Units
C_T	2.000E-03	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!

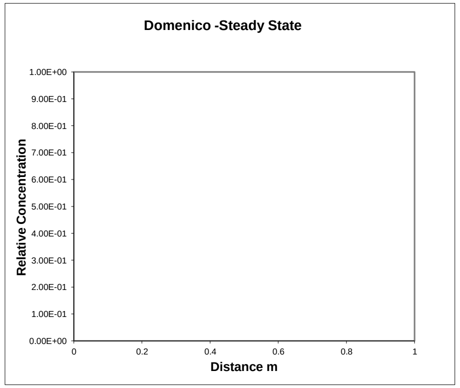


Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	3

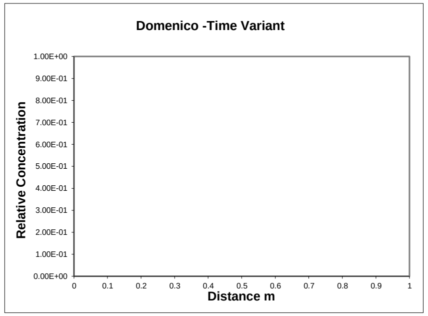
DOMENICO (TIME VARIANT)

Contaminant **Naphthalene**

Input	**Value**	**Units**
C_T	0.002	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

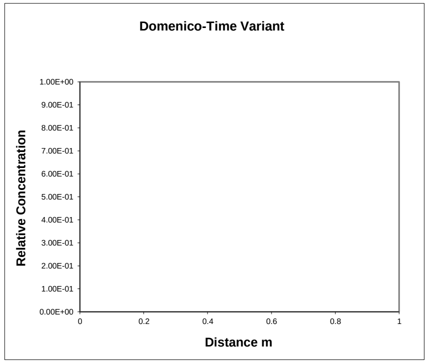
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	3

Contaminant **Naphthalene**

Input	**Value**	**Units**
C_T	0.002	mg/l
Co	1.29E+02	mg/l
λ	1.13E-05	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	3.60E+01	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

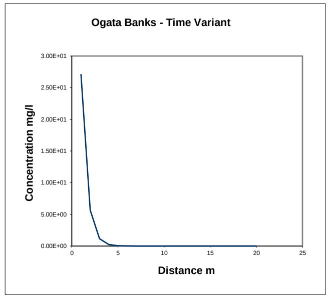
Calc	**Value**	
v	1.08E-03	m/d
Rc	6.13E+02	
u	1.76E-06	m/d

Date:	24/02/2020
Version:	3

OGATA BANKS SOLUTION

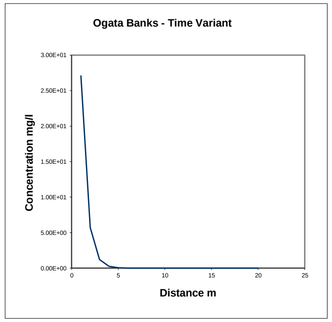
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	16.085	-1.6E+00	2.1E-01	-3.4E+47	2.000	2.1E+00	7.8E+00	3.4E+47	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	2.71E+01
2	2	16.085	-3.1E+00	4.4E-02	-3.4E+47	2.000	4.1E+00	6.1E+01	3.4E+47	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	5.65E+00
3	3	16.085	-4.7E+00	9.3E-03	-3.4E+47	2.000	6.2E+00	4.8E+02	3.4E+47	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	1.16E+00
4	4	16.085	-6.2E+00	2.0E-03	-3.4E+47	2.000	8.2E+00	3.8E+03	3.4E+47	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	2.37E-01
5	5	16.085	-7.8E+00	4.1E-04	-3.4E+47	2.000	1.0E+01	3.0E+04	3.4E+47	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	4.81E-02
6	6	16.085	-9.4E+00	8.7E-05	-3.4E+47	2.000	1.2E+01	2.3E+05	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	9.76E-03
7	7	16.085	-1.1E+01	1.8E-05	-3.4E+47	2.000	1.4E+01	1.8E+06	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	1.98E-03
8	8	16.085	-1.2E+01	3.8E-06	-3.4E+47	2.000	1.6E+01	1.4E+07	3.4E+47	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	4.03E-04
9	9	16.085	-1.4E+01	8.1E-07	-3.4E+47	2.000	1.9E+01	1.1E+08	3.4E+47	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	8.20E-05
10	10	16.085	-1.6E+01	1.7E-07	-3.4E+47	2.000	2.1E+01	8.7E+08	3.4E+47	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	1.67E-05
11	11	16.085	-1.7E+01	3.6E-08	-3.4E+47	2.000	2.3E+01	6.8E+09	3.4E+47	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	3.41E-06
12	12	16.085	-1.9E+01	7.5E-09	-3.4E+47	2.000	2.5E+01	5.4E+10	3.4E+47	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	6.98E-07
13	13	16.085	-2.0E+01	1.6E-09	-3.4E+47	2.000	2.7E+01	4.2E+11	3.4E+47	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	1.43E-07
14	14	16.085	-2.2E+01	3.3E-10	-3.4E+47	2.000	2.9E+01	3.3E+12	3.4E+47	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	2.93E-08
15	15	16.085	-2.3E+01	7.0E-11	-3.4E+47	2.000	3.1E+01	2.6E+13	3.4E+47	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	6.01E-09
16	16	16.085	-2.5E+01	1.5E-11	-3.4E+47	2.000	3.3E+01	2.0E+14	3.4E+47	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	1.24E-09
17	17	16.085	-2.6E+01	3.1E-12	-3.4E+47	2.000	3.5E+01	1.6E+15	3.4E+47	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	2.54E-10
18	18	16.085	-2.8E+01	6.5E-13	-3.4E+47	2.000	3.7E+01	1.2E+16	3.4E+47	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	5.23E-11
19	19	16.085	-3.0E+01	1.4E-13	-3.4E+47	2.000	3.9E+01	9.7E+16	3.4E+47	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	1.08E-11
20	20	16.085	-3.1E+01	2.9E-14	-3.4E+47	2.000	4.1E+01	7.6E+17	3.4E+47	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	2.22E-12



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	16.085	-1.6E+00	2.1E-01	-3.4E+47	2.000	2.1E+00	7.8E+00	3.4E+47	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	2.71E+01
2	2	16.085	-3.1E+00	4.4E-02	-3.4E+47	2.000	4.1E+00	6.1E+01	3.4E+47	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	5.70E+00
3	3	16.085	-4.7E+00	9.3E-03	-3.4E+47	2.000	6.2E+00	4.8E+02	3.4E+47	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	1.20E+00
4	4	16.085	-6.2E+00	2.0E-03	-3.4E+47	2.000	8.2E+00	3.8E+03	3.4E+47	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	2.52E-01
5	5	16.085	-7.8E+00	4.1E-04	-3.4E+47	2.000	1.0E+01	3.0E+04	3.4E+47	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	5.30E-02
6	6	16.085	-9.4E+00	8.7E-05	-3.4E+47	2.000	1.2E+01	2.3E+05	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	1.11E-02
7	7	16.085	-1.1E+01	1.8E-05	-3.4E+47	2.000	1.4E+01	1.8E+06	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	2.34E-03
8	8	16.085	-1.2E+01	3.8E-06	-3.4E+47	2.000	1.6E+01	1.4E+07	3.4E+47	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	4.90E-04
9	9	16.085	-1.4E+01	8.1E-07	-3.4E+47	2.000	1.9E+01	1.1E+08	3.4E+47	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.03E-04
10	10	16.085	-1.6E+01	1.7E-07	-3.4E+47	2.000	2.1E+01	8.7E+08	3.4E+47	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	2.15E-05
11	11	16.085	-1.7E+01	3.6E-08	-3.4E+47	2.000	2.3E+01	6.8E+09	3.4E+47	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	4.49E-06
12	12	16.085	-1.9E+01	7.5E-09	-3.4E+47	2.000	2.5E+01	5.4E+10	3.4E+47	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	9.39E-07
13	13	16.085	-2.0E+01	1.6E-09	-3.4E+47	2.000	2.7E+01	4.2E+11	3.4E+47	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	1.96E-07
14	14	16.085	-2.2E+01	3.3E-10	-3.4E+47	2.000	2.9E+01	3.3E+12	3.4E+47	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	4.09E-08
15	15	16.085	-2.3E+01	7.0E-11	-3.4E+47	2.000	3.1E+01	2.6E+13	3.4E+47	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	8.54E-09
16	16	16.085	-2.5E+01	1.5E-11	-3.4E+47	2.000	3.3E+01	2.0E+14	3.4E+47	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	1.78E-09
17	17	16.085	-2.6E+01	3.1E-12	-3.4E+47	2.000	3.5E+01	1.6E+15	3.4E+47	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	3.72E-10
18	18	16.085	-2.8E+01	6.5E-13	-3.4E+47	2.000	3.7E+01	1.2E+16	3.4E+47	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	7.75E-11
19	19	16.085	-3.0E+01	1.4E-13	-3.4E+47	2.000	3.9E+01	9.7E+16	3.4E+47	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	1.62E-11
20	20	16.085	-3.1E+01	2.9E-14	-3.4E+47	2.000	4.1E+01	7.6E+17	3.4E+47	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	3.37E-12



Contaminant	**Naphthalene**	
Input	**Value**	**Units**
C_T	0.002	mg/l
Co	1.29E+02	mg/l
λ	1.13E-05	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	3.60E+01	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

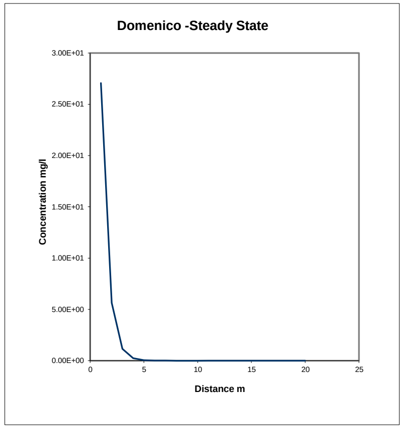
Calc	**Value**	
v	1.08E-03	m/d
Rc	6.13E+02	
u	1.76E-06	m/d

Date:	24/02/2020
Version:	3

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

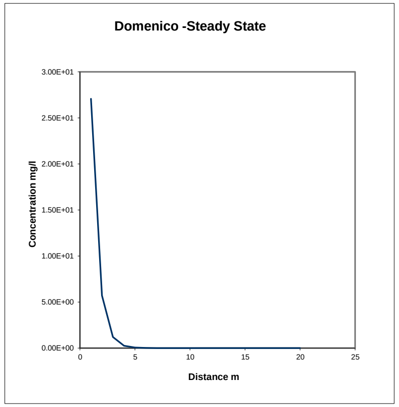
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	32.17	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	2.71E+01
2	2	32.17	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	5.65E+00
3	3	32.17	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.97	-1.53E+00	-0.9696	1.16E+00
4	4	32.17	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.939	-1.33E+00	-0.9392	2.37E-01
5	5	32.17	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.906	-1.19E+00	-0.9065	4.81E-02
6	6	32.17	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.874	-1.08E+00	-0.8742	9.76E-03
7	7	32.17	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.844	-1.00E+00	-0.8436	1.98E-03
8	8	32.17	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.815	-9.38E-01	-0.8151	4.03E-04
9	9	32.17	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.789	-8.84E-01	-0.7887	8.20E-05
10	10	32.17	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.764	-8.39E-01	-0.7643	1.67E-05
11	11	32.17	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.742	-8.00E-01	-0.7418	3.41E-06
12	12	32.17	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	6.98E-07
13	13	32.17	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.702	-7.35E-01	-0.7017	1.43E-07
14	14	32.17	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.684	-7.09E-01	-0.6838	2.93E-08
15	15	32.17	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.667	-6.85E-01	-0.6671	6.01E-09
16	16	32.17	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.651	-6.63E-01	-0.6515	1.24E-09
17	17	32.17	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.637	-6.43E-01	-0.6369	2.54E-10
18	18	32.17	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.623	-6.25E-01	-0.6232	5.23E-11
19	19	32.17	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.61	-6.08E-01	-0.6104	1.08E-11
20	20	32.17	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.598	-5.93E-01	-0.5983	2.22E-12



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	32.17	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	2.71E+01
2	2	32.17	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	5.70E+00
3	3	32.17	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	1.20E+00
4	4	32.17	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	2.52E-01
5	5	32.17	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.999	-2.37E+00	-0.9992	5.30E-02
6	6	32.17	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.998	-2.17E+00	-0.9978	1.11E-02
7	7	32.17	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9954	2.34E-03
8	8	32.17	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	4.90E-04
9	9	32.17	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.03E-04
10	10	32.17	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.982	-1.68E+00	-0.9823	2.15E-05
11	11	32.17	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9763	4.49E-06
12	12	32.17	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.97	-1.53E+00	-0.9696	9.39E-07
13	13	32.17	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.962	-1.47E+00	-0.9625	1.96E-07
14	14	32.17	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	4.09E-08
15	15	32.17	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.947	-1.37E+00	-0.9472	8.54E-09
16	16	32.17	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.939	-1.33E+00	-0.9392	1.78E-09
17	17	32.17	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.931	-1.29E+00	-0.9311	3.72E-10
18	18	32.17	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.923	-1.25E+00	-0.9229	7.75E-11
19	19	32.17	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.915	-1.22E+00	-0.9147	1.62E-11
20	20	32.17	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.906	-1.19E+00	-0.9065	3.37E-12



DOMENICO (TIME VARIANT)

Contaminant **Naphthalene**

Input	Value	Units
C_T	0.002	mg/l
Co	1.29E+02	mg/l
λ	1.13E-05	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	3.60E+01	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	2.00E+00	m
az	2.00E-01	m
ay	2.00E-02	m

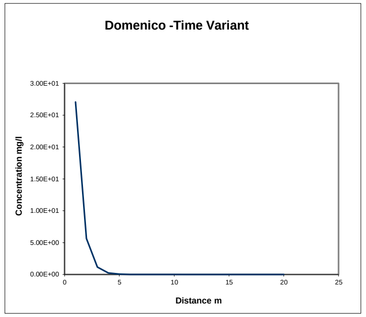
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	Value	
v	1.08E-03	m/d
Rc	6.13E+02	
u	1.76E-06	m/d

Date:	24/02/2020
Version:	3

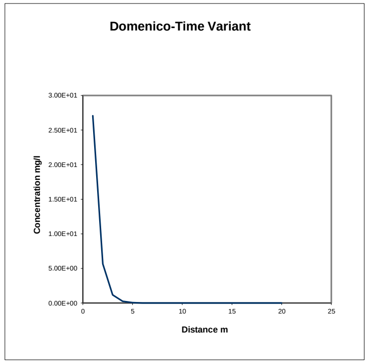
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	16.085	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	2.71E+01
2	2	16.085	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	5.65E+00
3	3	16.085	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	1.16E+00
4	4	16.085	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	2.37E-01
5	5	16.085	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	4.81E-02
6	6	16.085	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	9.76E-03
7	7	16.085	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	1.98E-03
8	8	16.085	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	4.03E-04
9	9	16.085	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	8.20E-05
10	10	16.085	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	1.67E-05
11	11	16.085	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	3.41E-06
12	12	16.085	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	6.98E-07
13	13	16.085	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	1.43E-07
14	14	16.085	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	2.93E-08
15	15	16.085	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	6.01E-09
16	16	16.085	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	1.24E-09
17	17	16.085	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	2.54E-10
18	18	16.085	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	5.23E-11
19	19	16.085	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	1.08E-11
20	20	16.085	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	2.22E-12



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	16.085	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	2.71E+01
2	2	16.085	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	5.70E+00
3	3	16.085	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	1.20E+00
4	4	16.085	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	2.52E-01
5	5	16.085	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	5.30E-02
6	6	16.085	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	1.11E-02
7	7	16.085	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	2.34E-03
8	8	16.085	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	4.90E-04
9	9	16.085	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.03E-04
10	10	16.085	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	2.15E-05
11	11	16.085	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	4.49E-06
12	12	16.085	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	9.39E-07
13	13	16.085	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	1.96E-07
14	14	16.085	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	4.09E-08
15	15	16.085	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	8.54E-09
16	16	16.085	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	1.78E-09
17	17	16.085	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	3.72E-10
18	18	16.085	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	7.75E-11
19	19	16.085	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	1.62E-11
20	20	16.085	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	3.37E-12



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment

Site Name:	**Glan Llyn**			
Site Address:	**Llanwern**			
Completed by:	**Ross Cameron**			
Date:	**24-Feb-20**		**Version:**	**1**
Contaminant	**Vanadium**			
Target Concentration (C_T)	**0.02**	**mg/l**	**Origin of C_T:**	**UK Standard (Statutory): Protection of Aquatic Life (Co**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 1 - Soil

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

User specified value for partition coefficient

Contaminant		**Vanadium**	
Target concentration	C_T	**0.02**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	5.00E-01	fraction	0.5
Air filled soil porosity	θa	3.70E-01	fraction	0.0037
Bulk density of soil zone material	ρ	1.36E+00	g/cm^3	1.36
Henry's Law constant	H	1.00E+00	dimensionless	*1*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.34E+02	l/kg	*1.34E+02*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.34E+02**	**l/kg**	*Specified value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.69E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.02	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Environment Agency

Contaminant		**Vanadium**		from Level 1
Target concentration	C_T	**0.02**	**mg/l**	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	0.00E+00	m/d		
Area of contaminant source	A	0.00E+00	m^2		Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m		
Saturated aquifer thickness	da	0.00E+00	m		
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d		
Hydraulic gradient of water table	i	0.00E+00	fraction		
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m		Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Specify**			
Enter mixing zone thickness	Mz	0.00E+00	m		
Calculated mixing zone thickness	Mz		m		

Calculated Parameters

Dilution Factor	**DF**	**#DIV/0!**		
Level 2 Remedial Target		**#DIV/0!**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		#DIV/0!	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Vanadium		from Level 1
Target Concentration	C_T	**0.02**	mg/l	from Level 1
Dilution Factor	DF	**#DIV/0!**		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value, la**

	Variable	Value	Unit	Source of parameter value
Enter source concentration	**Soil concentration as mg/kg**			
Enter soil concentration		**0**	mg/kg	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	
Calculated decay rate	λ	6.93E-101	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	Sy	0.00E+00	m	from Level 2
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Effective porosity of aquifer	n	0.00E+00	fraction	
Hydraulic gradient	i	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	0.00E+00	m/d	from Level 2
Distance to compliance point	x	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	0.000	m	*see options*
Transverse dispersivity	az	0.000	m	*see options*
Vertical dispersivity	ay	0.000	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	#DIV/0!	fraction
Attenuation factor (C_O/C_{ED})	**AF**	**#DIV/0!**	**fraction**
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target		**#DIV/0!**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
		#DIV/0!	**mg/kg**	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**0**	**m**	
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**#DIV/0!**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

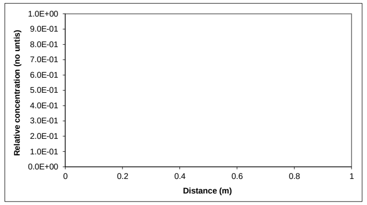
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	**az**	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	**ay**	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Relative concentration (No units)**	**Concentration mg/l**
0	**1.0E+00**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**
0.0	**#DIV/0!**	**#DIV/0!**

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters			
Soil contaminant concentration	C_0	0.00E+00	mg/kg

Level 1 Parameters

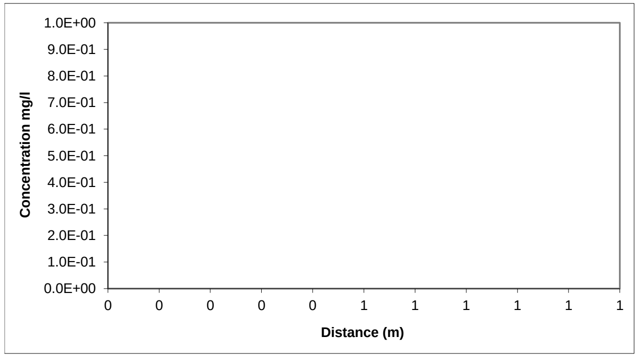
Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θa	3.70E-01	fraction
Bulk density	ρ	1.36E+00	g/cm^3
Henry's Law constant	H	1.00E+00	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.34E+02	l/kg
Factor (partitioning between soil and water)		1.35E+02	dimensionless

Level 2 Parameters	**Dilution Factor**	DF	#DIV/0!
Level 3 Parameters	**Attenuation factor (C_O/C_{ED})**	AF	#DIV/0!

Predicted concentrations at compliance point

Level 1	C	0.00E+00	mg/l	No dilution or attenuation
Level 2	C	#DIV/0!	mg/l	Dilution taken into account
Level 3	C	#DIV/0!	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!
0.00	#DIV/0!

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Vanadium**		from Level 1
Target Concentration	C_T	**2.00E-02**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.35E+01	mg/l	*Based on maximum soil conc of 2880mg/kg*
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	*Estimation*
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	*Site data*
Plume thickness at source	Sy	1.50E+00	m	*Thickness of re-engineered MG*
Saturated aquifer thickness	da	2.00E+00	m	*Based upon proposed total MG and cappi*
Bulk density of aquifer materials	ρ	1.36E+00	g/cm^3	*Site data*
Effective porosity of aquifer	n	8.00E-02	fraction	*Estimate*
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	*Proposed best achievable*
Distance to compliance point	x	2.00E+01	m	*Site data*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.13E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	3.62E+03	fraction
Decay rate used	λ	2.13E-104	d^{-1}
Rate of contaminant flow due to retardation	u	2.98E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.27E+01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.06E+00**	

Remedial Targets

Remedial Target		**2.12E-02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**20**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.27E+01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

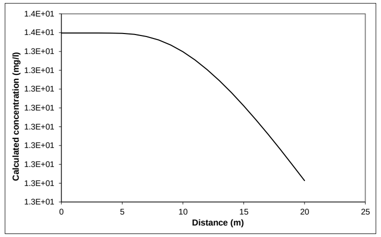
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.13E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.13E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E+00	1.57E+00	m
Transverse dispersivity	**az**	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-02	1.57E-02	

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#######
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	1.3E+01
1.0	1.35E+01
2.0	1.35E+01
3.0	1.35E+01
4.0	1.35E+01
5.0	1.35E+01
6.0	1.35E+01
7.0	1.35E+01
8.0	1.35E+01
9.0	1.34E+01
10.0	1.34E+01
11.0	1.34E+01
12.0	1.33E+01
13.0	1.32E+01
14.0	1.32E+01
15.0	1.31E+01
16.0	1.30E+01
17.0	1.30E+01
18.0	1.29E+01
19.0	1.28E+01
20.0	1.27E+01

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Dry Bulk Density	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

WET BULK DENSITY DATA

Variable	Value	Unit	
Moisture Content	0.00	% wt	
Particle Density	2.78	tonnes/m^3	(Change this number only if you have specific information)
Actual (wet) Bulk Density (i.e. at natural MC)	0.00	tonnes/m^3	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
dry bulk density	0.00	tonnes/m^3	
Initial Saturation	#DIV/0!	%	
Total porosity	**1.000**	**fraction**	**#DIV/0!**
Air Filled Porosity	**#DIV/0!**	**fraction**	
Water Filled Porosity	**#DIV/0!**	**fraction**	

Analytical solutions provided by David Hall, Golder Associates (UK) Ltd

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	0.00E+00	m/d	
Hydraulic gradient	i	0.00E+00	unitless	
Effective porosity of aquifer	n	0.00E+00	fraction	
Thickness of saturated aquifer	b	0.00E+00	m	
Width of aquifer perpendicular to flow	w	0.00E+00	m	
Distance to receptor	x	0.00E+00	m	
Bulk density of aquifer materials	ρ	0.00E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	#DIV/0!		

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m^3/s	0.00E+00	m^3/day	0.00E+00	$m^3/year$

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant **Vanadium**

Parameter (carried over from input sheet)	**Value**	**Units**
C_T	2.00E-02	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_W	5.00E-01	fraction
θa	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer toTable 4.3, R&D Publication 20)

Selected option User specified value for partition coefficient

calc calc Calc Kd l/kg

Calculation of partition coefficient for ionic organic chemical

Partition coefficient used in Level 1 Assessment 1.34E+02 l/kg

Calculated Remedial Target **2.69E+00** **mg/kg** **for** **Vanadium**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 24/02/2020
Version: 1

Level 2 Calculation Sheet

Contaminant **Vanadium**

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter (carried over from input sheet)	**Value**	**Units**
Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	
		m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C_T	2.00E-02	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

	Calculated Dilution Factor
Calculation based on target concentration	#DIV/0!
Calculation based on observed contaminant concentration	#DIV/0!

Contaminant	Vanadium	
Input	**Value**	**Units**
C_T	2.000E-02	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

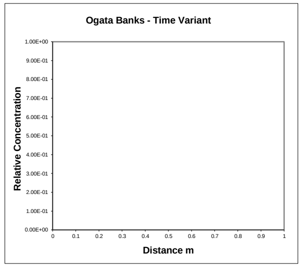
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date: 24/02/2020
Version: 1

OGATA BANKS SOLUTION

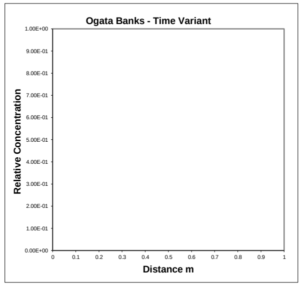
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) -USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
1	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.13	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Contaminant	**Vanadium**	
Input	**Value**	**Units**
C_T	2.000E-02	mg/l
DF	#DIV/0!	
λ	6.931E-101	days^{-1}
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

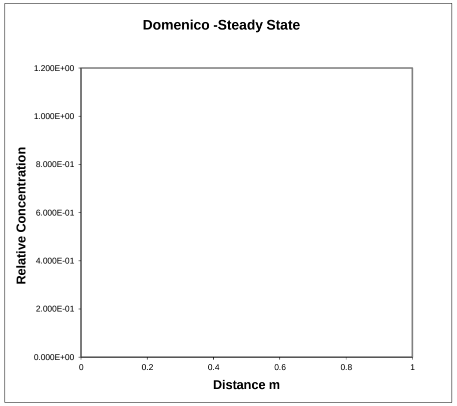
Calc	**Value**	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

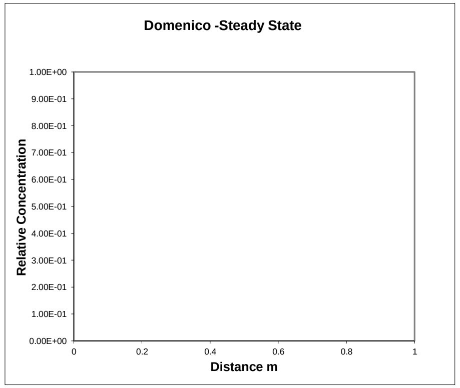
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	######	#DIV/0!	#DIV/0!	#DIV/0!



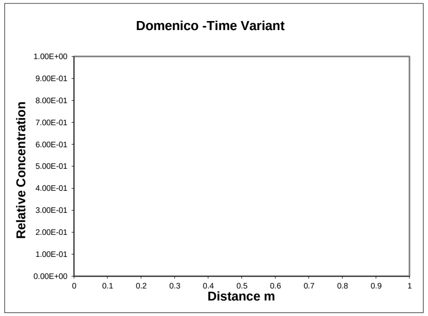
DOMENICO (TIME VARIANT)

Contaminant **Vanadium**

Input	Value	Units
C_T	0.02	mg/l
DF	#DIV/0!	
λ	6.931E-101	$days^{-1}$
Sz	0.000E+00	m
Sy	0.000E+00	m
Kd	0.000E+00	l/kg
ρ	0.000E+00	g/cm3
n	0.000E+00	
i	#DIV/0!	
K	0.000E+00	m/d
x	0.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	0.000E+00	m
az	0.000E+00	m
ay	0.000E+00	m

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

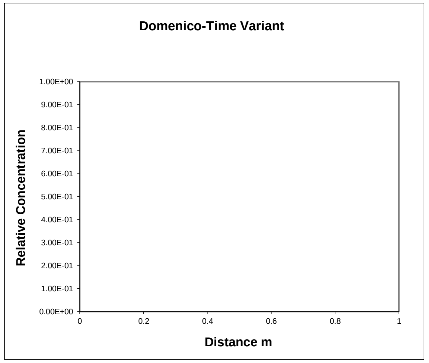
	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	Value	
v	#DIV/0!	m/d
Rc	#DIV/0!	
u	#DIV/0!	m/d

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
	m														
1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date:	24/02/2020
Version:	1

Contaminant **Vanadium**

Input	**Value**	**Units**
C_T	0.02	mg/l
Co	1.35E+01	mg/l
λ	2.13E-104	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	2.13E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion option Simulate vertical dispersion in 1 direction

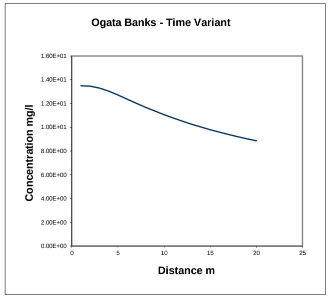
Calc	**Value**	
v	1.08E-03	m/d
Rc	3.62E+03	
u	2.98E-07	m/d

Date:	24/02/2020
Version:	1

OGATA BANKS SOLUTION

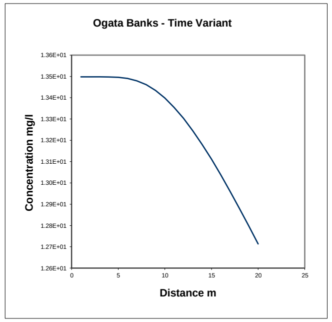
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E-01	1.9E+00	2.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.35E+01
2	2	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+00	3.6E+00	2.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.35E+01
3	3	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.9E+00	6.8E+00	2.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.33E+01
4	4	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	2.6E+00	1.3E+01	2.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.30E+01
5	5	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.2E+00	2.4E+01	2.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.27E+01
6	6	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.8E+00	4.6E+01	2.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	1.24E+01
7	7	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	4.5E+00	8.7E+01	2.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	1.20E+01
8	8	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.1E+00	1.7E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	1.17E+01
9	9	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.7E+00	3.1E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	1.14E+01
10	10	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E+00	5.9E+02	2.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	1.11E+01
11	11	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.0E+00	1.1E+03	2.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	1.08E+01
12	12	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.7E+00	2.1E+03	2.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	1.05E+01
13	13	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.3E+00	4.0E+03	2.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	1.03E+01
14	14	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.9E+00	7.6E+03	2.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	1.00E+01
15	15	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	9.6E+00	1.4E+04	2.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	9.80E+00
16	16	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.0E+01	2.7E+04	2.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	9.59E+00
17	17	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	5.2E+04	2.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	9.39E+00
18	18	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	9.8E+04	2.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	9.21E+00
19	19	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.2E+01	1.8E+05	2.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	9.03E+00
20	20	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+01	3.5E+05	2.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	8.86E+00



Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
1	1	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E-01	1.9E+00	2.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	1.35E+01
2	2	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+00	3.6E+00	2.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	1.35E+01
3	3	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.9E+00	6.8E+00	2.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	1.35E+01
4	4	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	2.6E+00	1.3E+01	2.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.35E+01
5	5	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.2E+00	2.4E+01	2.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	1.35E+01
6	6	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.8E+00	4.6E+01	2.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	1.35E+01
7	7	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	4.5E+00	8.7E+01	2.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	1.35E+01
8	8	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.1E+00	1.7E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.35E+01
9	9	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.7E+00	3.1E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	1.34E+01
10	10	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E+00	5.9E+02	2.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	1.34E+01
11	11	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.0E+00	1.1E+03	2.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	1.34E+01
12	12	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.7E+00	2.1E+03	2.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.33E+01
13	13	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.3E+00	4.0E+03	2.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	1.32E+01
14	14	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.9E+00	7.6E+03	2.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	1.32E+01
15	15	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	9.6E+00	1.4E+04	2.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	1.31E+01
16	16	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.0E+01	2.7E+04	2.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.30E+01
17	17	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	5.2E+04	2.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	1.30E+01
18	18	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	9.8E+04	2.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	1.29E+01
19	19	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.2E+01	1.8E+05	2.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	1.28E+01
20	20	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+01	3.5E+05	2.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.27E+01



Contaminant **Vanadium**

Input	**Value**	**Units**
C_T	0.02	mg/l
Co	1.35E+01	mg/l
λ	2.13E-104	days^{-1}
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	2.13E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

Vertical dispersion optio Simulate vertical dispersion in 1 direction

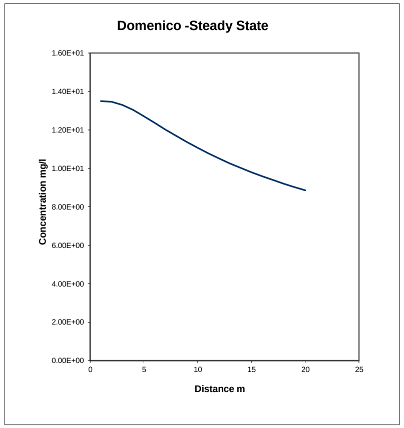
Calc	**Value**	
v	1.08E-03	m/d
Rc	3.62E+03	
u	2.98E-07	m/d

Date:	24/02/2020
Version:	1

DOMENICO (STEADY STATE)

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

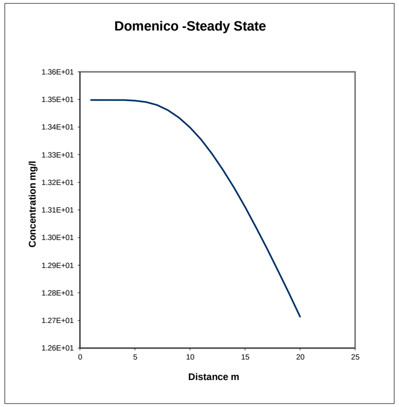
	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	3.3745	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
2	2	3.3745	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.35E+01
3	3	3.3745	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.33E+01
4	4	3.3745	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.30E+01
5	5	3.3745	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.27E+01
6	6	3.3745	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	1.24E+01
7	7	3.3745	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	1.20E+01
8	8	3.3745	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	1.17E+01
9	9	3.3745	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	1.14E+01
10	10	3.3745	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	1.11E+01
11	11	3.3745	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	1.08E+01
12	12	3.3745	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	1.05E+01
13	13	3.3745	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	1.03E+01
14	14	3.3745	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	1.00E+01
15	15	3.3745	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	9.80E+00
16	16	3.3745	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	9.59E+00
17	17	3.3745	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	9.39E+00
18	18	3.3745	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	9.21E+00
19	19	3.3745	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	9.03E+00
20	20	3.3745	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	8.86E+00



DOMENICO (STEADY STATE)

Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
1	1	3.3745	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.35E+01
2	2	3.3745	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.35E+01
3	3	3.3745	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.35E+01
4	4	3.3745	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
5	5	3.3745	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	1.35E+01
6	6	3.3745	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	1.35E+01
7	7	3.3745	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	1.35E+01
8	8	3.3745	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.35E+01
9	9	3.3745	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	1.34E+01
10	10	3.3745	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	1.34E+01
11	11	3.3745	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	1.34E+01
12	12	3.3745	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.33E+01
13	13	3.3745	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	1.32E+01
14	14	3.3745	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	1.32E+01
15	15	3.3745	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	1.31E+01
16	16	3.3745	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.30E+01
17	17	3.3745	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	1.30E+01
18	18	3.3745	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	1.29E+01
19	19	3.3745	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	1.28E+01
20	20	3.3745	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.27E+01



DOMENICO (TIME VARIANT)

Contaminant	**Vanadium**	
Input	**Value**	**Units**
C_T	0.02	mg/l
Co	1.35E+01	mg/l
λ	2.13E-104	$days^{-1}$
Sz	5.00E+02	m
Sy	1.50E+00	m
Kd	2.13E+02	l/kg
ρ	1.36E+00	g/cm3
n	8.00E-02	
i	1.00E-02	
K	8.64E-03	m/d
x	2.00E+01	m
z	0.00E+00	m
y	0.00E+00	m
t	1.00E+100	days
ax	1.57E+00	m
az	1.57E-01	m
ay	1.57E-02	m

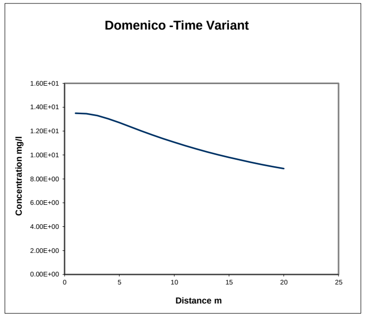
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	**Value**	
v	1.08E-03	m/d
Rc	3.62E+03	
u	2.98E-07	m/d

Date:	24/02/2020
Version:	1

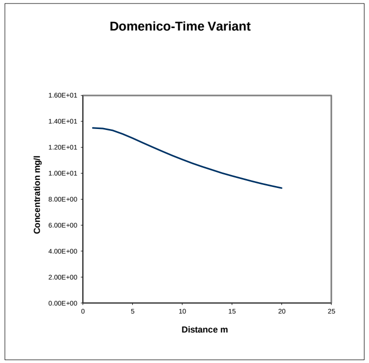
Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
2	2	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.35E+01
3	3	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.33E+01
4	4	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.30E+01
5	5	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.27E+01
6	6	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	1.24E+01
7	7	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	1.20E+01
8	8	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	1.17E+01
9	9	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	1.14E+01
10	10	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	1.11E+01
11	11	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	1.08E+01
12	12	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	1.05E+01
13	13	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	1.03E+01
14	14	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	1.00E+01
15	15	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	9.80E+00
16	16	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	9.59E+00
17	17	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	9.39E+00
18	18	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	9.21E+00
19	19	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	9.03E+00
20	20	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	8.86E+00



Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

	X m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
1	1	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.35E+01
2	2	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.35E+01
3	3	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.35E+01
4	4	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
5	5	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	1.35E+01
6	6	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	1.35E+01
7	7	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	1.35E+01
8	8	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.35E+01
9	9	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	1.34E+01
10	10	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	1.34E+01
11	11	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	1.34E+01
12	12	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.33E+01
13	13	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	1.32E+01
14	14	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	1.32E+01
15	15	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	1.31E+01
16	16	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.30E+01
17	17	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	1.30E+01
18	18	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	1.29E+01
19	19	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	1.28E+01
20	20	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.27E+01



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Appendix D – Phase 4B & 5D CWDQRA

Technical Note

Project:	P18-669 Llanwern – Phase 4B & 5D		
Subject:	Phase 4B & 5D Controlled Waters Detailed Quantitative Risk Assessment Addendum		
Prepared by:	Aimee Meredith-Smith – Geo-Environmental Consultant	**Date:**	20/06/2025
Authorised by:	Chris Wilson – Principal Geo-Environmental Consultant	**Status:**	S2 - Information
Document Ref:	18669-RLL-24-XX-RP-O-0591	**Revision:**	P02

1 Introduction

1.1 General

Rodgers Leask Ltd (RLL) has been commissioned by Revantage Real Estate Ltd (Revantage) to develop a phase specific addendum Controlled Waters Detailed Quantitative Risk Assessment (CWDQRA) to assess the potential risk to Controlled Waters for Phase 4B & 5D of the Glan Llyn development at Llanwern, Newport (herein referred to as the Site).

In July 2024 the Client, St Modwen Developments were rebranded to be called Revantage Real Estate. Any reference to the previous company name in this report should be referred to accordingly.

1.2 Purpose

This report has been prepared to support the discharge of Planning Condition 27 of the Outline Planning Permission Reference 06/0471 for the proposed development of residential development Phase 4B & 5D as part of a wider mixed-use development at Llanwern, Newport.

Planning Condition 27 states the following.

"(27) Prior to the commencement of each phase of development as defined by Condition 03 (or at such other date or stage in development or for such specified activities or works as may be agreed in writing with the Local Planning Authority), the following components of a scheme to deal with the risks associated with contamination relating to that phase or activity shall each be submitted to and approved, in writing, by the Local Planning Authority:

(1) A preliminary risk assessment which has identified:
  (a) all previous uses;
  (b) potential contaminants associated with those uses;
  (c) a conceptual model of the site indicating sources, pathways and receptors;
  (d) potentially unacceptable risks arising from contamination at the site.
(2) A site investigation scheme, based on (1) to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site.
(3) The site investigation results and the detailed risk assessment (2) and, based on these, an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.
(4) A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in (3) are complete and identifying any requirements for longer term monitoring of pollutant linkages, maintenance and arrangements for contingency action. Any changes to these components require the express consent of the Local Planning Authority.

Reason: To ensure that the proposed development will not cause pollution of the environment or harm to human health."

1.3 Objectives and Scope

The objectives and scope of this report are to assess the soil chemical testing results obtained during previous ground investigations, within the Site, against the soil re-use criteria presented in H F Consulting's Soils Validation Strategy and to discuss the suitability of the soils for retention as part of the proposed remedial works.

1.4 Sources of Information

The following documents have been reviewed in preparation of this technical note, and should be read in conjunction with it:

- RLL, Updated Controlled Waters Detailed Quantitative Risk Assessment, Glan Llyn, ref. 18669-RLE-19-RP-O-0006, dated June 2022
- RLL, Phase 4B & 5D Desk Study & Phase 2 Geo-Environmental Report, ref. 18669-RLL-22-XX-RP-O-0328 _P03, dated June 2025.
- H F Consulting, Glan Llyn: Soils validation strategy for protection of controlled waters (30937 R2), dated December 2024.

2 Site Information

2.1 Site Setting

The Site is located within the Glan Llyn development at the former Llanwern Steelworks, approximately 4km to the east of Newport City Centre at approximate National Grid Reference 335990E, 186950N. The wider Glan Llyn development covers approximately 250 hectares and is proposed to be redeveloped for residential, commercial and open space use.

The eastern part of Phase 4B & 5D formed part of a separate contract managed by Vertase FLI and approved under planning application references 23/1127 (PC27) and 24/0468 (PC28). This area is not included in this study area.

The Site covers an area of approximately 3.10ha and is located in the approximate centre of the wider Glan Llyn development. The Site historically housed a bag filter plant, conveyors, hoppers and a travelling boom. The Site was partially demolished by 2004 and fully demolished by 2021.

The Site boundary is shown on drawing 18669-RLL-22-X-DR-O-0323-P02, the site masterplan is presented on Drawing ref. 8111-08-A012, both presented in **Appendix A**.

2.2 Geology

Information pertaining to the underlying ground conditions at the Site has been obtained via the BGS Onshore Geoindex[1]. The published geological information shows the Site to be void of Made Ground. However, due to the Site's history, Made Ground is likely to be present associated with the previous development and subsequent demolition.

Superficial deposits are shown to comprise Tidal Flat Deposits.

Tidal Flat Deposits are described by the BGS as *'unconsolidated sediment, mainly mud and/ or sand. They may form the top surface of a deltaic deposit. Normally a consolidated soft silty clay, with layers of sand, gravel and peat.'*

The underlying bedrock is shown to be the Mercia Mudstone Group.

The Mercia Mudstone Group is described by the BGS as comprising '*predominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite bearing units in some basinal areas. Thin beds of gypsum/anhydrite are widespread; sandstones are also present*'.

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[1] http://mapapps2.bgs.ac.uk/geoindex/home.html

There is an inferred fault approximately 500m north-east of the Site which trends roughly north to south and extends northwards away from Site.

2.3 Encountered Ground Conditions

One ground investigation has been undertaken by RLL in 2021 which covered the wider Glan Llyn development and included the current Site boundary. As part of this ground investigation 35 trial pits were excavated within the Site area. Detailed information is available in the RLL Phase 4B & 5D Desk Study and Ground Investigation Report (**Appendix C**).

The following table provides a summary of the exploratory holes that were situated within the Site boundary.

Table 2.1: Summary of Historical Exploratory Holes within the Site Boundary

Report	Exploratory Holes
RLL (2021)	35 Trial Pits (U14, U12, T14, S15, S14, R18, R15, R14, Q17, Q14, P16, P15, P14, V21, V20, V19, V18, V17, V16, V14, V13, V12, V11, V10, U19, U16, U15, U11, U10, T18, T15, T13, T12, T10 and S16)

The RLL ground investigation found the Site to be underlain by Made Ground overlying Tidal Flat Deposits, encountered from 1.20m to 2.30m depth.

The Made Ground comprised sandy gravelly clay to sandy gravel of slag with occasional to frequent cobbles. Gravel and cobble constituents typically comprised sandstone, mudstone, shale, concrete, brick, and slag, as well as occasional fragments of plastic, timber, iron ore and metal.

Tidal Flat Deposits were generally described as very soft to firm, bluish grey to grey, occasionally mottled black and occasionally peaty clay.

The Mercia Mudstone Group bedrock was not encountered during the intrusive investigation.

2.4 Post-construction ground conditions

The following table provides an anticipated post-construction ground model.

Post-Development Ground Conditions

Unit	Approximate Thickness	Description
Impermeable Construction Materials/ Housing Sub-base/Permeable Topsoil	0.6m	Imported clean topsoil/ construction materials
Piling Mat*	0.5m	Imported 6F2 (*may be included

		within 600mm of construction materials)
Made Ground	1.5 – 2.0m	Excavated and re-compacted Made Ground
Tidal Flat Deposits	7.0 – 10.0m	No change from current conditions
Bedrock (Mercia Mudstone Group)	>1,350m	No change from current conditions

In accordance with the assumptions of the 2019 RLL CWDQRA, further mitigation to promote lateral flow is the provision of a drainage blanket to cap the reengineered material (including piling mat) which will increase the fall from the centre of a plot to periphery.

2.5 Historical Groundwater Monitoring and Wider Site Hydrogeology

A summary of pre-reclamation groundwater levels is presented in the Phase 4B & 5D Desk Study & Phase 2 Geo-Environmental Report. Groundwater levels recorded during the pre-reclamation ground investigations across the development suggest that the groundwater is present beneath the wider Glan Llyn development as follows:

- Shallow/ perched groundwater within the Made Ground (shallow boreholes); and
- Groundwater within the Tidal Flat Deposits (confined to the basal sand layers) and Mercia Mudstone (deep boreholes).

The shallow perched groundwater described above was recorded during pre-reclamation conditions. The earthworks on the phase include the reengineering of the Made Ground, this shallow perched groundwater shall no longer be present.

Groundwater monitoring within the deep boreholes was considered to be primarily derived from the bedrock geology, and hydraulic continuity between the upper perched shallow groundwater and 'regional' groundwater was considered likely to be limited. Post-development, the excavation and re-compaction of the Made Ground was recognised as likely to reduce its permeability, lowering still further, the hydraulic continuity.

3 Controlled Waters Detailed Quantitative Risk Assessment

3.1 Introduction

In 2019 RLL were commissioned by St Modwen to prepare a Controlled Waters Detailed Quantitative Risk Assessment (CWDQRA) for the wider Glan Llyn development, report reference 18669-RLE-19-RP-O-0006, dated June 2022. This assessment was considered to be an update to and further development of Atkins Limited (Atkins), CWDQRA, Document Reference: 5111373-LLA-OUT-0257, Version: 3, dated February 2017.

The principal objectives of the 2019 RLL CWDQRA, as practicably as possible, was to provide compliant future surface water flow contributions from private drainage system on the wider Glan Llyn development (following the redevelopment for mixed residential and commercial end use) upon entry into the Monks' Ditch. It was also to improve sustainability and further limit the amount of material which requires off-site removal by virtue of its contaminative potential towards local Controlled Waters.

With the aim generating a streamlined and consistent process for the Phase-by-Phase reporting process, in 2024 H Fraser Consulting Ltd. were commissioned to build on the findings of the CWDQRA and produce a Soils Validation Strategy for the Protection of Controlled Waters (30937 R2).

A summary of the reporting relating to controlled waters on the development are presented in the following sections.

The area of the development this assessment covers, which includes the Site, are presented on RLL drawing reference 18669-RLE-19-XX-DR-O-0004 in **Appendix A**.

3.2 RLL CWDQRA Summary

In 2019 RLL prepared a Controlled Waters Detailed Quantitative Risk Assessment (CWDQRA) for the wider Glan Llyn development site. This assessment incorporated a comprehensive dataset of concentrations of contamination recorded in soils across the development, included data taken from the 2018 investigations within the Site. Screening analysis of soil, soil leachate, groundwater and surface water data revealed potential moderate to low levels of inorganic and organic contamination present onsite in line with contaminants associated with former steelworks sites. Made Ground comprising clayey sandy gravels with local slag, burnt shale, tarmac, concrete, brick and mudstone was found to be a potential source of contamination. Calculation of representative re-use criteria for a commercial end use was undertaken using a dilution assessment methodology based on the site-wide water balance, incorporating site specific permeability and infiltration parameters. No allowance was made for dilution of discharged waters within Monks' Ditch itself as part of this calculation as, this being the receptor, it is proposed that the water quality in this Controlled Water be maintained (as far as possible) at EQS values.

Comparison of re-use criteria against available soil chemical testing established that the much of the Made Ground was likely to be suitable for re-use onsite, however, localised source materials existed containing higher concentrations of contamination (particularly elevated concentrations of iron, manganese and vanadium), and ammoniacal and cyanide components, may require remediation, or offsite disposal.

Further modelling of these contaminants was undertaken using Remedial Target Methodology (RTM) to assess the potential extent of attenuation of these specific determinands within the ground where these soils may be placed, with the receiving surface waters being assumed to be existing blueways (reens), which were considered as the Compliance Points. The compliance point for the Business Park is at the pumping station and will require an enacted permit for discharge to occur.

Initial modelling was carried out by Atkins (Glan Llyn, Llanwern Controlled Waters Detailed Quantitative Risk Assessment dated February 2017), with this approach being adopted within later revisions of this Report in the Rodgers Leask, Controlled Waters Detailed Quantitative Risk Assessment, Glan Llyn (sitewide) Update (2019), using the Equation presented in the EA Table 5.2 – soil-water partitioning of the EA Remedial Targets Methodology Guidance (2006) where a pore-water concentration (Cp) was determined from soil concentration analyses to derive soil reuse criteria at the site as a whole. Subsequently, and purely to gauge the potential distance that re-engineered Made Ground could be placed from the respective Compliance Point(s), further modelling was carried out for specific determinands using the EA RT Excel Worksheets, based on maximum and average soils concentrations determined within samples of re-engineered Made Ground and available site derived data.

Further modelling was carried out for specific determinands (including specific PAHs) using the EA Remedial Target Excel Worksheets, based on maximum and average soils concentrations did indicate that there was little attenuation of the initial porewater PAH concentrations on migration within the re-engineered Made Ground toward the nearest reen Receptors. However, the presence of elevated porewater PAH concentrations were only theoretical and based on calculated values derived using the Equation presented in the EA Table 5.2 – soil-water partitioning of the EA Remedial Targets Methodology Guidance (2006). Actual PAH concentrations determined more recently in groundwater samples recovered (where sufficient groundwater was available for sampling purposes), were generally lower, and potentially significantly lower, than the calculated values which were derived using soils analyses data. Additionally, as previously mentioned, there was little evidence obtained of hydraulicly continuous groundwater horizon(s) within the re-engineered Made Ground beneath areas proposed for residential and commercial development. Therefore, there have been no proven PAH (or other contaminant) migration pathways towards the reens.

As the data used within the CWDQRA has utilised ground investigation data taken from within the Site, it is therefore considered that the findings of this assessment are representative of the Site and therefore adoption of the calculated re-use criteria and recommendations presented within the CWQRA are appropriate.

3.3 HFCL Glan Llyn: Soils Validation Strategy for Protection of Controlled Waters

Following queries from Natural Resources Wales (NRW), H Fraser Consulting Limited (HFCL) were commissioned by RLL to assist with NRW liaison and reporting pursuant to the discharge of PC28. Following discussion with NRW, RLL and the developer, HFCL prepared a revised methodology for the validation of soils in relation to the protection of controlled waters.

The assessment does not rely on groundwater analysis, being dependent rather on soil re-use values. It included distance specific remedial targets that model the attenuation of contaminants in the saturated zone allowing for advection, dispersion, retardation and decay during transport. In addition to the inclusion of distance specific remedial targets, further statistical and spatial analysis was carried out on contaminants of concern.

More detail is provided in the HFC Glan Llyn: Soils Validation Strategy for the Protection of Controlled Waters (30937 R2).

4 Comparison of Phase 4B & 5D and CWDQRA Dataset

The dataset utilised in the RLL CWDQRA was taken from soil samples from the wider Glan Llyn development site which did not include the Site area. Therefore, a comparison of the residential CWDQRA dataset with the soil samples taken from within the Site has been undertaken.

The purpose of this comparison is to establish if the residential dataset used in the CWDQRA is representative of concentrations of contamination present within Site and therefore whether the derived re-use criteria and recommendations of this assessment are applicable to the Site or whether further assessment is required.

4.1 Phase 4B & 5D Sampling

60 soil samples were collected from the Site during the 2021 RLL ground investigation for contamination testing, all of which were taken from the Made Ground. The works comprised trial pitting to collect soil samples for chemical and geotechnical testing.

The samples were tested for heavy metals, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbon (TPH), gasoline range organics (GROs), BTEX, pH, soil organic matter (SOM), cyanide, phenols, ammoniacal nitrogen and select samples were also tested for asbestos.

4.2 Comparison of Results

Determinand	**Samples from Phase 4B & 5D – Residential Area**			**Samples from CWDQRA - Residential Area**			**Considered Representative of CWDQRA data (Yes/No)**
	Maximum Soil Sample Value* (mg/kg)	**Average Soil Sample Value* (mg/kg)**	**95th Percentile Soil Sample Value* (mg/kg)**	**Maximum Soil Sample Value (mg/kg)**	**Average Soil Sample Value* (mg/kg)**	**95th Percentile Soil Sample Value* (mg/kg)**	
Inorganic Metals and Metalloids							
Arsenic	78.60	7.75	13.46	397.00	12.18	21.89	Y
Cadmium	2.19	0.54	1.71	31.30	0.65	2.37	Y
Chromium	783.00	130.81	523.20	3090.00	138.89	590.80	Y
Copper	71.70	19.73	44.31	1790.00	25.19	52.07	Y
Iron	232000	61542	154400	2390000	103039	277000	Y
Lead	408.00	44.67	143.15	4220.00	91.58	231.85	Y
Manganese	93900	10324	28785	408000	9574	33520	Y
Mercury	2.13	0.94	1.40	6.24	0.68	1.40	Y
Nickel	50.80	12.47	30.01	313.00	25.73	44.90	Y
Selenium	71.30	10.23	15.20	51.70	6.09	16.67	N
Vanadium	680.00	154.81	473.10	2880.00	206.93	693.10	Y

Determinand	Samples from Phase 4B & 5D – Residential Area			Samples from CWDQRA - Residential Area			Considered Representative of CWDQRA data (Yes/No)
	Maximum Soil Sample Value* (mg/kg)	Average Soil Sample Value* (mg/kg)	95th Percentile Soil Sample Value* (mg/kg)	Maximum Soil Sample Value (mg/kg)	Average Soil Sample Value* (mg/kg)	95th Percentile Soil Sample Value* (mg/kg)	
Zinc	482.00	100.19	292.60	13300.00	291.45	784.75	Y
Other Inorganics							
Ammoniacal Nitrogen	30.60	12.37	12.00	1590.00	60.97	263.00	Y
Cyanide	20.90	1.69	4.44	272.00	2.32	4.05	Y
Organics							
Benzene	1.8	0.37	1.8	0.12	0.04	0.04	N
Toluene	2.41	0.31	1.40	0.07	0.01	0.02	N
Ethylbenzene	0.80	0.16	0.80	0.02	0.01	0.01	N
Xylene	2.00	0.41	2.00	0.11	0.01	0.01	N
Phenol	1.00	0.24	1.00	1.21	0.02	0.03	N
TPH Criteria Working Group							
Aliphatics >C5-C6	0.07	0.01	0.03	0.92	0.03	0.04	Y
Aliphatics >C6-C8	0.36	0.04	0.15	3.32	0.04	0.09	Y
Aliphatics >C8-C10	0.30	0.04	0.16	74.20	0.20	0.12	Y
Aliphatics >C10-C12	52.30	2.58	5.83	987.00	2.55	0.35	Y
Aliphatics >C12-C16	186.00	9.81	26.21	514.00	5.26	16.47	Y
Aliphatics >C16-C21	811.00	28.78	65.05	3530.00	26.92	83.07	Y
Aliphatics >C21-C35	778.00	49.43	126.10	2980.00	64.53	174.70	Y
Aliphatics >C35-C44	188.00	14.88	45.37	913.00	20.37	68.99	Y
Aromatics >EC5-EC7	0.09	0.01	0.02	5.26	0.03	0.04	Y
Aromatics >EC7-EC8	0.12	0.01	0.03	20.30	0.05	0.04	Y
Aromatics >EC8-EC10	0.20	0.03	0.11	49.50	0.14	0.10	Y
Aromatics >EC10-EC12	26.80	2.14	4.74	658.00	1.71	0.24	N
Aromatics >EC12-EC16	151.00	7.42	21.08	5280.00	13.62	24.72	Y
Aromatics >EC16-EC21	265.00	19.45	77.24	9800.00	56.85	165.55	Y
Aromatics >EC21-EC35	317.00	43.19	137.25	9010.00	122.76	440.85	Y
Aromatics >EC35-EC44	52.90	5.81	39.05	1580.00	40.69	150.00	Y
Polyaromatic Hydrocarbons							
Acenaphthylene	14.10	0.64	1.84	2100.00	3.08	3.18	Y
Acenaphthene	0.88	0.10	0.67	193.00	0.47	0.41	Y
Anthracene	20.90	1.07	2.83	1860.00	3.608	5.48	Y
Benz(a)anthracene	20.30	1.82	6.40	1150.00	4.64	1.61	Y
Benzo(a)pyrene	15.30	1.42	5.18	714.00	3.73	10.58	Y
Benzo(b)fluoranthene	20.80	2.25	9.05	1110.00	5.28	15.87	Y
Benzo(k)fluoranthene	7.62	0.76	7.62	373.00	2.08	5.96	Y
Benzo(g,h,i)perylene	10.00	1.02	3.60	333.00	2.51	7.27	Y
Chrysene	16.90	1.65	5.68	1090.00	4.22	11.47	Y
Dibenzo(a,h)anthracene	2.12	0.26	1.02	177.00	0.74	1.86	Y
Indeno(1,2,3-cd)pyrene	12.20	1.20	4.25	374.00	2.61	7.46	Y
Fluoranthene	58.30	4.54	13.35	2940.00	11.59	29.56	Y
Fluorene	16.50	0.67	1.91	1890.00	2.81	2.72	Y
Naphthalene	24.10	1.59	7.17	4680.00	10.98	5.66	Y
Phenanthrene	60.80	3.87	12.27	3810.00	9.79	18.03	Y
Pyrene	39.10	3.21	9.68	1.95	0.01	0.03	N

A review of the datasets has shown that the contaminants largely show similar or lower concentration ranges for the Site and for the wider Glan Llyn development site; with the exception of selenium, benzene, toluene, ethylbenzene, xylene, phenol, aromatics >EC10-EC12 and pyrene.

Selenium shows higher maximum and average concentrations when compared to the CWDQRA dataset, but has a lower 95th percentile concentration and therefore can be considered comparable to the CWDQRA data. Similarly, aromatic >EC10-EC12 TPH shows a higher 95th percentile concentration but lower maximum and average concentrations when compared to the wider site CWDQRA dataset and can be considered comparable. Laboratory concentrations of selenium and aromatic >EC10-EC12 TPH were all below the residential soil re-use criteria for controlled waters.

Benzene, toluene, ethylbenzene, xylene, phenol and pyrene from within the Site present higher maximum, average and 95th percentile concentrations when compared to the wider site CWDQRA dataset. However, the detection limits for these contaminants within the sample pool on the Site have concentrations that are greater than the respective concentrations presented within the wider CWDQRA and this causes a significant skew in the results. The true concentrations for these contaminants are likely to be significantly lower than their respective values. Laboratory concentrations of benzene, toluene, ethylbenzene, xylene, phenol and pyrene were all below the residential soil re-use criteria for controlled waters.

Given the values were lower than the relevant reuse criteria this shouldn't have a detrimental impact on the conclusions of the CWDQRA.

4.3 Comparison to H Fraser Consulting re-use criteria

The samples collected for the Site, as part of the RLL ground investigation, have subsequently been assessed against the H F Consulting agreed soil re-use values for a residential end use as outlined in the Soils Validation Strategy for the Protection of Controlled Waters. A summary of exceedances is presented in the table below, and the chemical screening results are presented in full in **Appendix D**.

Summary of Exceedances of H Fraser Consulting Reuse Criteria for a Commercial End Use				
Contaminant	**No. of Exceedances**	**Location of Exceedances (Depth in m)**	**Concentration Range (mg/kg)**	**Screening Value (mg/kg)**
Cyanide (Total)	7	P14-2 (1.80), Q14-1 (0.50), Q17-1 (0.30), U16-1 (1.00), V10-2 (1.50), V12-2 (1.60), V18-1 (0.50)	2.35 – 20.90	2.02
Manganese	2	P15-2 (2.20), P16-1 (1.30)	34400.00 – 93900.00	33300.00
Phenanthrene	2	Q17-2 (0.30), T10-1 (0.30)	44400 – 60800.00	27000.00
Fluoranthene	7	P15-2 (2.20), Q14-1 (0.50), Q17-2 (1.50), R15-2 (1.20), T10-1 (0.30), T10-3 (2.90), V10-1 (0.30)	7750.00 – 58300.00	6640.00

Summary of Exceedances of H Fraser Consulting Reuse Criteria for a Commercial End Use				
Contaminant	**No. of Exceedances**	**Location of Exceedances (Depth in m)**	**Concentration Range (mg/kg)**	**Screening Value (mg/kg)**
Benzo(b)fluoranthene	8	P15-2 (2.20), Q14-1 (0.50), Q17-2 (1.50), R15-2 (1.20), T10-1 (0.30), T10-2 (1.00), U16-1 (1.00), V10-1 (0.30)	55.90 – 20800.00	3420.00
Benzo(k)fluoranthene	3	Q14-1 (0.50), Q17-2 (1.50), T10-1 (0.30)	14.00 – 7620.00	5050.00

The results show that with the exception of total cyanide, manganese, phenanthrene, fluoranthene, benzo(b)fluoranthene and benzo(k)fluoranthene, there are no exceedances of the reuse criteria recorded during the 2021 ground investigation. The location of exceedances are shown on RLL Drawing 18669-RLL-24-XX-DR-O-0751-P01, **Appendix A**.

Recorded exceedances shall be managed, via the earthworks operation, in accordance with the HFC Glan Llyn: Soils Validation Strategy for the Protection of Controlled Waters.

Soil chemical testing certificates are presented within the RLL Phase 4B & 5D Desk Study and Ground Investigation Report (18669-RLL-22-XX-RP-O-0328-P03).

4.4 Visual and Olfactory Evidence of Contamination

During the 2021 intrusive investigation, visual or olfactory evidence of contamination was recorded in nine locations within the Made Ground, ranging from slight hydrocarbon sheens on water to sulphurous and hydrocarbon odours; and in one location a slight biofilm on water. Given the low number of locations where visual or olfactory evidence of hydrocarbon contamination was identified, the presence of significant gross contamination unsuitable for retention within the wider development is considered unlikely. No further evidence of a source of the visual or olfactory contamination was encountered. During the proposed turnover within Phase 4B & 5D a watching brief will be maintained.

5 Conclusion

In 2021 RLL submitted a CWDQRA for the wider Glan Llyn development site. This assessment incorporated a comprehensive dataset of concentrations of contamination recorded in soils across the development. Further assessment has been undertaken comparing soil concentrations recorded within the Site area with those of the wider residential Glan Llyn development site used in the CWDQRA.

This assessment has concluded that the dataset used in the CWDQRA is largely representative of the levels of contamination present within the Site and therefore adoption of the calculated re-use criteria and recommendations presented within the CWDQRA are appropriate for the Site.

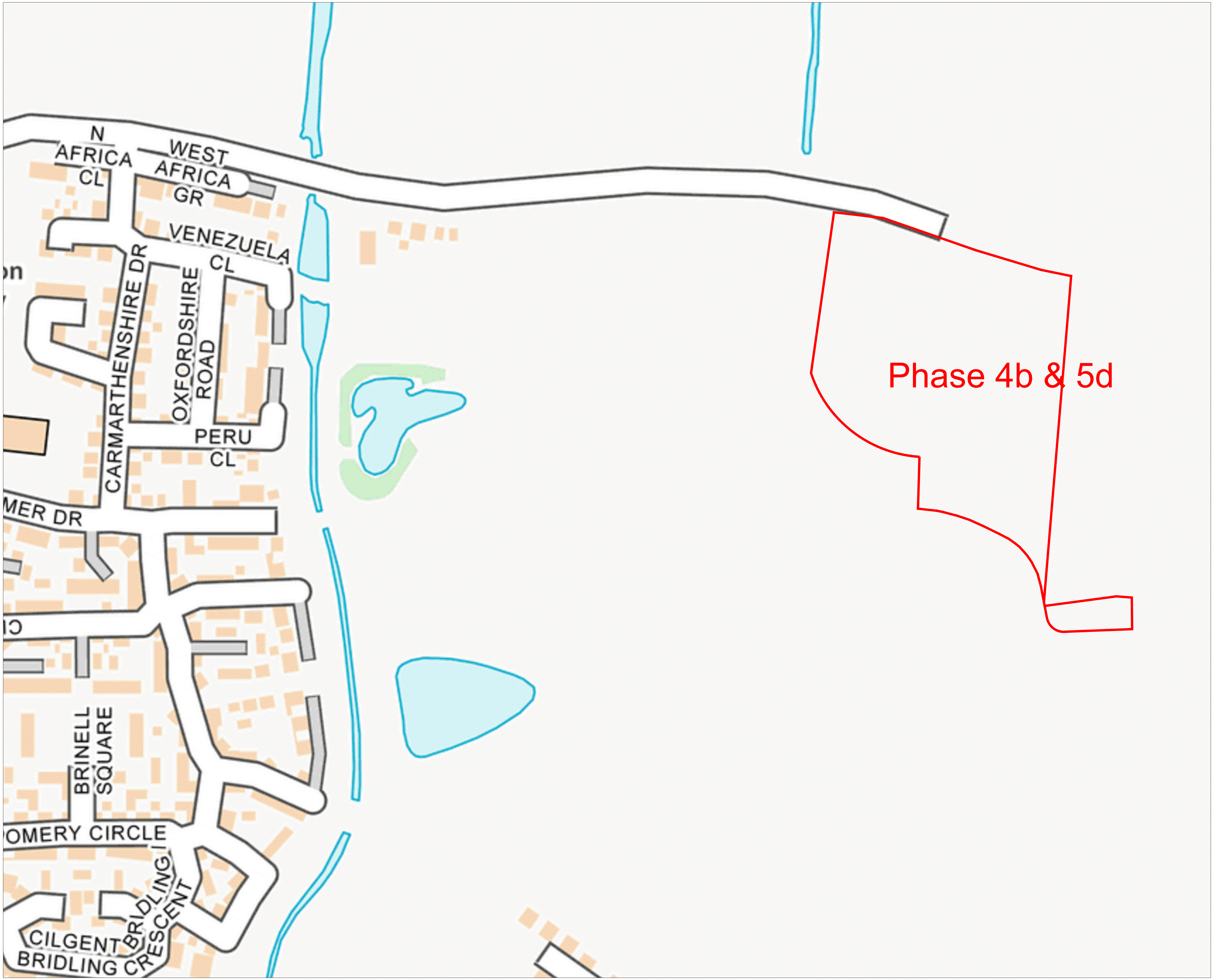
Following an assessment of soil chemical testing data from within the Site, exceedances of the reuse criteria for cyanide, manganese, phenanthrene, fluoranthene, benzo(b)fluoranthene and benzo(b)fluoranthene have been identified that may represent a risk to Controlled Waters.

The soil reuse criteria have been conservatively calculated considering only dilution of contamination by intercepted surface water from the finished development. In reality subsurface degradation and attenuation will occur as these contaminants migrate laterally though the ground, further reducing they concentrations prior to dilution within the on-site private drainage system.

It is recommended that further delineation and assessment of the identified exceedances of cyanide, manganese, phenanthrene, fluoranthene, benzo(b)fluoranthene and benzo(b)fluoranthene (as shown on RLL Drawing 18669-RLL-25-XX-RP-O-0751-P03) are undertaken as part of the remediation works, with unsuitable material being removed as necessary, in order to ensure that they do not present a risk to controlled waters.

A Remediation Strategy has been prepared for Phase 4B & 5D (18669-RLL-24-XX-RP-O-0587-P01) outlining required remedial measures for the Site.

Appendix A: Drawings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CARMARTHENSHIRE DR
OXFORDSHIRE ROAD
PERU CL
on
MER DR
BRINELL SQUARE
OMERY CIRCLE
BRIDLING CRESCENT
CILGENT
BRIDLING CRES
Phase 4b & 5d

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ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.

ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

KEY:

Approximate Site Boundary

Rev	Date	Amendments	By	Chk
P02	10/09/2024	Update to site boundary, excluding Vertase Area	AMS	CW

Client
St Modwen Developments

Project
P18-669 Llanwern Reclamation

Drawing Title
Phase 4b & 5d
Site Location Plan

INFORMATION

	Drawn	Checked	Date
1:1250 @ A1	SR	CW	06.09.22

Drawing No.	Rev.
18669-RLL-22-XX-DR-O-0323	P02

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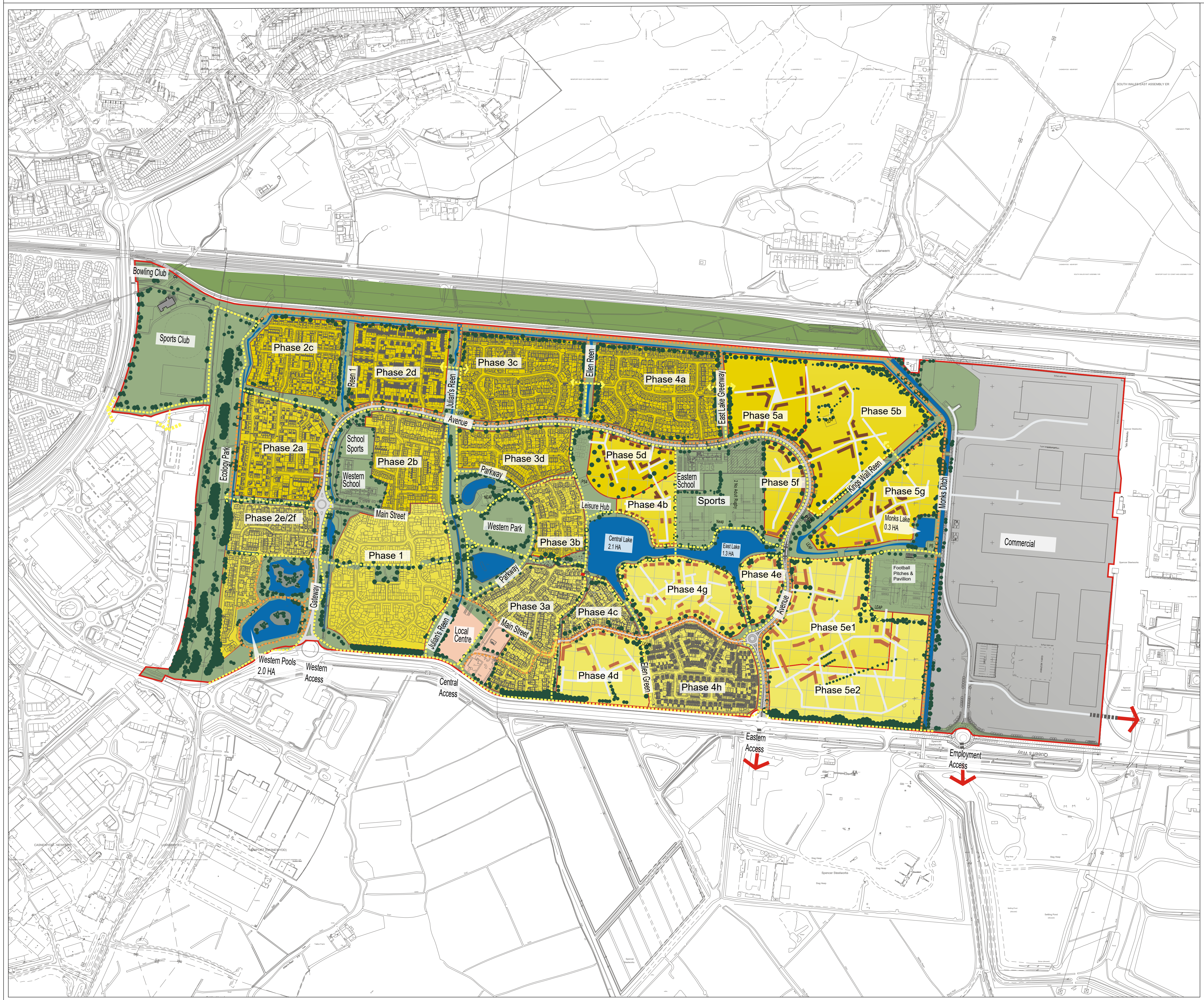
Glan Llyn -ESAMP Indicative Masterplan


Bowling Club
Sports Club
Phase 2c
Phase 2d
Reen 1
Phase 3c
Ellen Reen
Phase 4a
East Lake Greenway
Julian's Reen
Phase 5a
Phase 5b
Avenue
Phase 2a
Ecology Park
School Sports
Western School
Phase 2b
Phase 3d
Parkway
Phase 5d
Eastern School
Phase 5f
Kings Wall Reen
Phase 5g
Monks Ditch
Main Street
Leisure Hub
Phase 4b
Sports
Phase 2e/2f
Western Park
Monks Lake 0.3 HA
Phase 3b
Central Lake 2.1 HA
East Lake 1.3 HA
Commercial
Phase 1
Phase 4e
Football Pitches & Pavillion
Parkway
Phase 4g
Gateway
Phase 3a
Phase 4c
Avenue
Julian's Reen
Local Centre
Main Street
Phase 5e1
Phase 4d
Ellen Green
Phase 4h
Phase 5e2
Western Pools 2.0 HA
Western Access
Central Access
Eastern Access
Employment Access
Queens Way

SGP
Architects + Masterplanners

Waterfront House,
2a Smith Way, Grove Park,
Enderby, Leicester,
LE19 1SX
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www.stephengeorge.co.uk

SGP File Ref: 8111-08-A011
Project No: 8111-08
Drawn By: NV
Date: 10/04/2019

Drawing No: 8111-08-A012
Rev: **Rev P19**
Scale: 1:5000 @A1

Notes:
Residential areas quoted are approximate gross site areas and include Leaps, Laps and on plot road infrastructure

Notes:
Residential areas quoted are approximate gross site areas and include Leaps, Laps and on plot road infrastruclayture

0 50 100 200 250 300 400 500
Metres at scale 1:5000

ST.MODWEN

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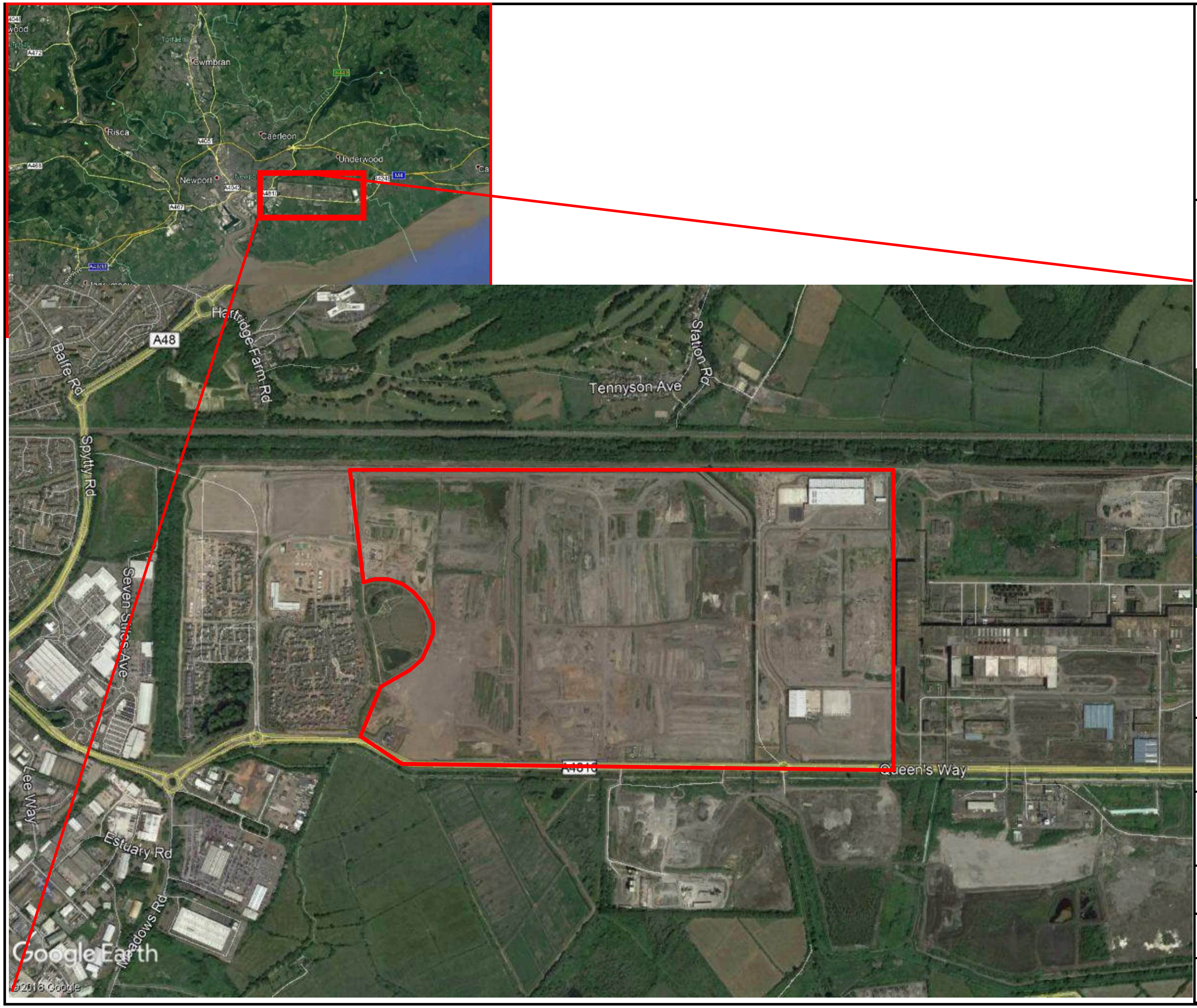
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Cwmbran
Risca
Caerleon
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Newport
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A468
A467
M4
Hartridge Farm Rd
A48
Balfe Rd
Tennyson Ave
Station Rd
Spytty Rd
Seven Stiles Ave
Lee Way
Estuary Rd
Meadows Rd
A4810
Queen's Way
Google Earth
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Key

Redline boundary

ansea
M50
M48
M4
M49
M32
Cardiff
Bristol
rnstaple

CLIENT

ST. MODWEN DEVELOPMENTS

PROJECT

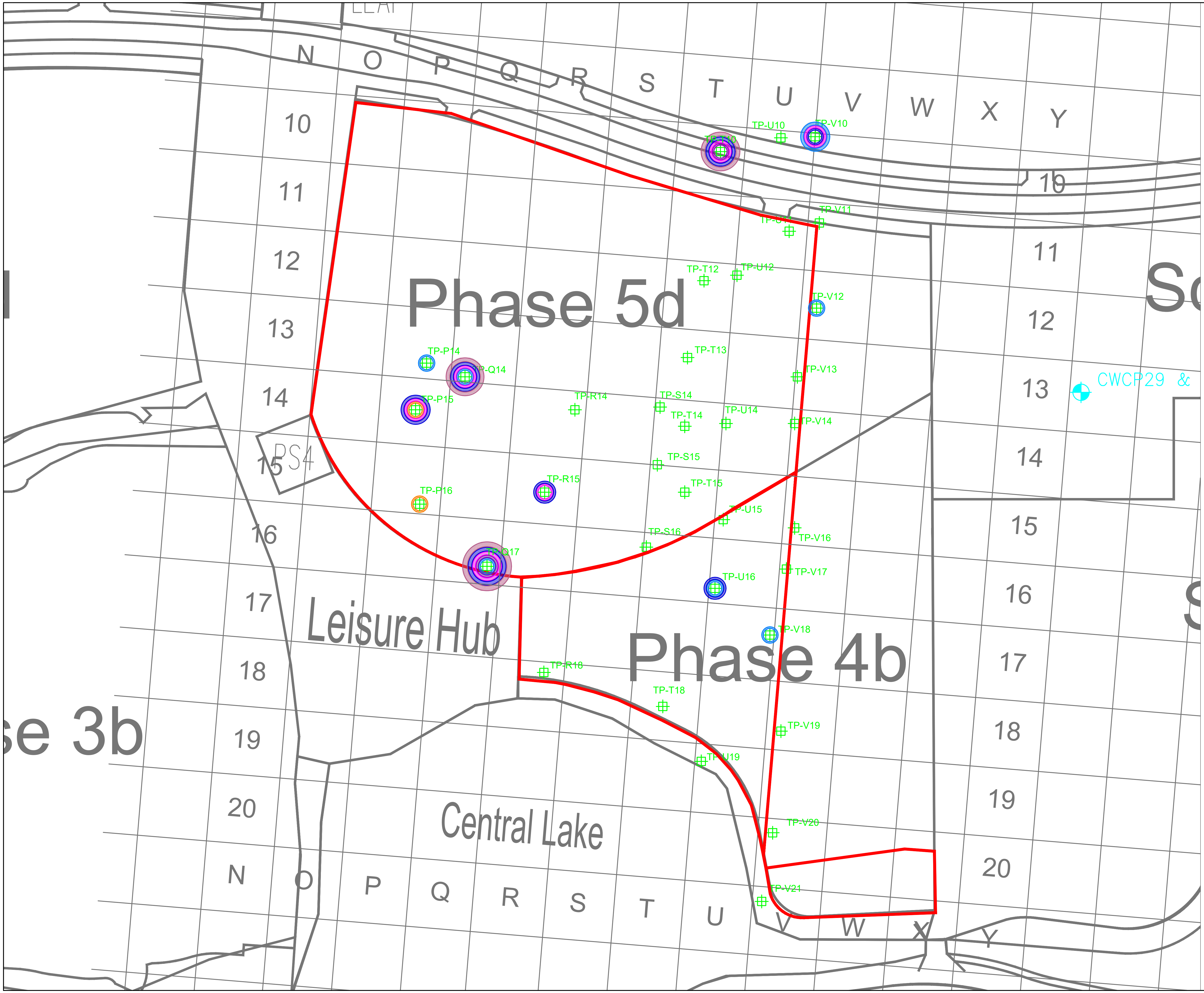
LLANWERN SITE LOCATION PLAN

STATUS

FOR INFORMATION

DRAWN	CHECKED	DATE
ET	CW	19/08/2019

PROJECT NUMBER	DRAWING NUMBER	REV.
P18-669	18669-RLE-19-XX-DR-O-0004	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Phase 5d
Phase 4b
Leisure Hub
Central Lake
PS4
se 3b
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CWCP29 &
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TP-V10
TP-V11
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TP-V19
TP-U19
TP-V20
TP-V21

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KEY:

▭	**Site Boundary**
⌖ TP-W32	**Rodgers Leask GI 2020/21**
⌖ CWCP20	**CWRA Borehole**
○	**Cyanide Exceedance Location**
○	**Benzo(b)fluoranthene Exceedance Location**
○	**Benzo(k)fluoranthene Exceedance Location**
○	**Fluoranthene Exceedance Location**
○	**Phenanthracene Exceedance Location**
○	**Manganese Exceedance Location**

Rev	Date	Amendments	By	Chk
P01	09/06/2025	First Issue	AMS	CW

RLRE

Client

Revantage Real Estate

Project

P18-669 Llanwern Reclamation
Phase 4B & 5D

Drawing Title

Exceedance Location Plan
HFC Soil Re-Use Values

INFORMATION

	Drawn	Checked	Date
NTS	AMS	CW	09/06/25

Drawing No. 18669-RLL-25-XX-DR-O-0751

Rev. P01

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Appendix B: Chemical Screening

Client: Rodgers Leask Environmental	Customer Sample ID			Residential Soil Re-use Values (Table 2.1)	Number of Exceedances	P14-1	P14-2	P15-1	P15-2	P16-1	P16-2	Q14-1	Q14-2	Q17-1	Q17-2
	Depth					0.30-0.30	1.80-1.80	0.30-0.30	2.20-2.20	0.30-0.30	1.30-1.30	0.50-0.50	1.60-1.60	0.30-0.30	1.50-1.50
	Sample Type					SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
	Sampled Date					26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021
	Sample Received Date					28/01/2021	28/01/2021	28/01/2021	28/01/2021	27/01/2021	27/01/2021	28/01/2021	28/01/2021	27/01/2021	27/01/2021
	Final Instruction Date					08/02/2021	08/02/2021	08/02/2021	08/02/2021	03/02/2021	03/02/2021	08/02/2021	08/02/2021	03/02/2021	03/02/2021
	Report Completed Date									09/02/2021	09/02/2021			09/02/2021	09/02/2021
	SDG					210128-35	210128-35	210128-35	210128-35	210127-42	210127-42	210128-35	210128-35	210127-42	210127-42
	Lab Sample Number					23621438	23621447	23621452	23621293	23613950	23613957	23621418	23621429	23613939	23613943
	Sample Temperature					10.2	10.2	10.2	10.2	5.4	5.4	10.2	10.2	5.4	5.4
Determinand	**Method**	**Units**	**LOD**												
Colour	PM024	No units				Dark Brown	Dark Brown	Dark Brown	Black	Grey	Grey	Black	Black	Dark Brown	Grey
Description	PM024	No units				Loamy Sand	Loamy Sand	Loamy Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Inclusion 1)	PM024	No units				Stones	Stones	Stones	Stones	Stones	Stones	None	None	None	Stones
Inclusion 2)	PM024	No units				None	None	None	None	None	N/A	Stones	Stones	Stones	N/A
Moisture Content Ratio (% of as received sample)	PM024	%				16.00	11.00	11.00	8.50	8.60	10.00	9.10	13.00	9.80	14.00
Asbestos Quantification - Gravimetric - %	TM304	%	0.001												
Date of Analysis	TM048	No units				08/02/2021	-	05/02/2021	-	03/02/2021	-	08/02/2021	-	03/02/2021	-
Analysed By	TM048	No units				Marcin Magdziarek	-	Paul Poynton	-	Paul Poynton	-	Marcin Magdziarek	-	Paul Poynton	-
Asbestos Quantification - PCOM Evaluation - %	TM304	%	0.001					<0.001		-	-			-	-
Additional Asbestos Components (Using TM048)	TM304	No units						None		-	-			-	-
Analysts Comments	TM304	No units						NA		-	-			-	-
Asbestos Quantification - Total - %	TM304	%	0.001					<0.001		-	-			-	-
Chrysotile (White) Asbestos	TM048	No units				Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Amosite (Brown) Asbestos	TM048	No units				Not Detected	-	Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Crocidolite (Blue) Asbestos	TM048	No units				Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Fibrous Anthophyllite	TM048	No units				Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Fibrous Tremolite	TM048	No units				Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Fibrous Actinolite	TM048	No units				Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Non-Asbestos Fibre	TM048	No units				Not Detected	-	Not Detected	-	Detected	-	Not Detected	-	Not Detected	-
Comments	TM048	No units				-	-	ACM fragment in soil	-	-	-	-	-	-	-
Soil Organic Matter (SOM)	TM132	%	0.35			49.50	6.36	3.19	1.59	18.80	2.16	-	-	22.80	21.90
pH	TM133	pH Units	1			11.40	11.90	12.80	12.70	12.40	12.60	8.98	8.94	12.50	12.10
Cyanide, Total	TM153	mg/kg	1	2.02E+00	7	1.06	6.23	<1	<1	<1	<1	6.24	<1	2.35	<1
Exchangeable Ammonia as N	TM024	mg/kg	12	154	0	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12
Arsenic	TM181	mg/kg	0.6	2533.00	0	<6	<6	6.85	<6	78.60	<6	<6	8.89	<6	<6
Cadmium	TM181	mg/kg	0.02	73.00	0	0.91	1.56	1.71	1.75	<0.2	0.63	0.54	0.64	<0.2	0.69
Chromium	TM181	mg/kg	0.9	9431.00	0	234.00	421.00	741.00	783.00	378.00	546.00	62.30	17.50	522.00	426.00
Copper	TM181	mg/kg	1.4	451.00	0	18.10	<14	36.50	22.60	54.40	22.50	<14	46.40	16.30	28.90
Iron	TM181	mg/kg	1000	3.05E+05	0	103000.00	144000.00	141000.00	162000.00	144000.00	127000.00	23500.00	19500.00	139000.00	114000.00
Lead	TM181	mg/kg	0.7	15700.00	0	23.10	26.00	16.30	<7	55.20	10.10	35.30	38.80	26.40	25.00
Manganese	TM181	mg/kg	0.13	33300.00	2	18000.00	21400.00	32300.00	34400.00	93900.00	27400.00	17500.00	522.00	24900.00	28600.00
Mercury	TM181	mg/kg	0.14	132.00	0	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	2.13	<1.4	<1.4	<1.4
Nickel	TM181	mg/kg	0.2	11500.00	0	11.10	5.46	21.30	14.30	50.80	8.48	5.35	18.40	12.60	14.90
Selenium	TM181	mg/kg	1	702.00	0	13.20	<10	15.00	19.80	71.30	12.70	14.30	<10	19.00	14.70
Vanadium	TM181	mg/kg	0.2	1606.00	0	270.00	413.00	680.00	655.00	416.00	473.00	62.80	21.40	416.00	475.00
Zinc	TM181	mg/kg	1.9	1.38E+05	0	63.00	66.70	76.90	40.80	95.30	51.70	77.70	90.40	54.80	106.00
Phenol	TM062 (S)	mg/kg	0.01	3.05	0	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	0.01	0.01
Cresols	TM062 (S)	mg/kg	0.01			<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.02
Xylenols	TM062 (S)	mg/kg	0.015	74.00	0	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Phenols, Total Detected monohydric	TM062 (S)	mg/kg	0.035			<0.035	<0.035	<0.035	0.05	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
Total Aliphatics >C5-C10	TM089	µg/kg	50			67.80	<50	<50	<50	171.00	159.00	<50	384.00	58.80	122.00
Total Aromatics >EC5-EC10	TM089	µg/kg	50			<50	<50	<50	<50	61.30	52.20	<50	81.70	<50	<50
GRO >C5-C10	TM089	µg/kg	20			67.80	<20	<20	<20	232.00	211.00	<20	466.00	58.80	122.00
GRO Surrogate % recovery**	TM089	%				92.80	73.60	90.80	77.10	102.00	61.50	11.10	31.50	9.60	77.20
Aliphatics >C5-C6	TM089	µg/kg	10	7.30E+04	0	<10	<10	<10	<10	35.00	32.20	<10	48.30	13.30	26.70
Aliphatics >C6-C8	TM089	µg/kg	10	3.59E+05	0	34.50	<10	<10	<10	42.70	72.20	<10	230.00	30.00	45.20
Aliphatics >C8-C10	TM089	µg/kg	10	2.84E+06	0	33.30	<10	<10	<10	93.00	54.40	<10	106.00	15.50	49.90
Aliphatics >C10-C12	TM414	µg/kg	1000	2.25E+07	0	1740.00	<1000	<1000	<1000	<1000	<1000	4080.00	1420.00	<1000	<1000
Aliphatics >C12-C16	TM414	µg/kg	1000	4.50E+08	0	23300.00	<1000	1320.00	<1000	1640.00	<1000	7920.00	6300.00	2100.00	2800.00
Aliphatics >C16-C21	TM414	µg/kg	1000	5.66E+10	0	64200.00	1220.00	5290.00	2230.00	5250.00	3980.00	54000.00	6450.00	11800.00	6860.00
Aliphatics >C21-C35	TM414	µg/kg	1000	5.66E+10	0	125000.00	5810.00	39300.00	15300.00	38900.00	31300.00	35200.00	10700.00	118000.00	78500.00
Aliphatics >C35-C44	TM414	µg/kg	1000	5.66E+10	0	25400.00	1760.00	12000.00	3860.00	9520.00	6170.00	3870.00	<1000	24400.00	56300.00
Total Aliphatics >C10-C44	TM414	µg/kg	5000			239000.00	9190.00	57900.00	22000.00	56000.00	42600.00	105000.00	25800.00	157000.00	145000.00
Total Aliphatics & Aromatics >C10-C44	TM414	µg/kg	10000			301000.00	13200.00	97200.00	53000.00	89800.00	62700.00	485000.00	57100.00	223000.00	391000.00
Aromatics >EC5-EC7	TM089	µg/kg	10	8510	0	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aromatics >EC7-EC8	TM089	µg/kg	10	1.77E+05	0	<10	<10	<10	<10	<10	16.70	<10	11.50	<10	<10
Aromatics >EC8-EC10	TM089	µg/kg	10	1.44E+05	0	21.40	<10	<10	<10	61.30	35.50	<10	70.20	<10	33.60
Aromatics > EC10-EC12	TM414	µg/kg	1000	2.27E+05	0	1310.00	<1000	<1000	<1000	1400.00	<1000	19000.00	<1000	1760.00	9430.00
Aromatics > EC12-EC16	TM414	µg/kg	1000	4.51E+05	0	6340.00	<1000	<1000	<1000	3020.00	<1000	22500.00	6860.00	2250.00	21000.00
Aromatics > EC16-EC21	TM414	µg/kg	1000	1.42E+06	0	14700.00	1110.00	5680.00	7270.00	13700.00	6530.00	98800.00	8550.00	16000.00	76100.00
Aromatics > EC21-EC35	TM414	µg/kg	1000	1.13E+07	0	35800.00	1510.00	29900.00	21500.00	14700.00	11700.00	218000.00	14400.00	41900.00	126000.00
Aromatics >EC35-EC44	TM414	µg/kg	1000	1.13E+07	0	3490.00	<1000	3470.00	1510.00	<1000	<1000	21300.00	<1000	4040.00	13100.00
Aromatics > EC40-EC44	TM414	µg/kg	1000	1.13E+07	0	<1000	<1000	<1000	<1000	<1000	<1000	1560.00	<1000	<1000	1710.00
Total Aromatics > EC10-EC44	TM414	µg/kg	5000			61700.00	<5000	39300.00	31000.00	33800.00	20100.00	380000.00	31300.00	65900.00	246000.00
Total Aliphatics & Aromatics >C5-C44	TM414	µg/kg	10000			301000.00	<10000	97200.00	53000.00	90000.00	62900.00	485000.00	57500.00	223000.00	391000.00
Naphthalene-d8 % recovery**	TM218	%				85.30	86.00	85.20	84.30	85.40	82.50	82.00	83.40	84.70	79.40
Acenaphthene-d10 % recovery**	TM218	%				86.70	85.20	86.20	84.80	87.40	83.10	82.60	82.80	85.70	82.00
Phenanthrene-d10 % recovery**	TM218	%				89.10	84.10	88.10	86.80	86.60	82.10	82.80	83.10	90.00	79.10
Chrysene-d12 % recovery**	TM218	%				75.60	81.80	81.60	82.70	78.30	75.40	73.80	76.80	89.40	79.30
Perylene-d12 % recovery**	TM218	%				70.30	80.70	77.60	79.30	76.90	75.00	71.90	75.40	87.50	80.80
Naphthalene	TM218	µg/kg	9	2.70E+04	0	1290.00	724.00	231.00	198.00	776.00	386.00	20500.00	442.00	2760.00	24100.00
Acenaphthylene	TM218	µg/kg	12	1.67E+04	0	328.00	41.90	49.40	244.00	367.00	262.00	4250.00	70.00	607.00	14100.00
Acenaphthene	TM218	µg/kg	8	3.00E+04	0	39.90	34.00	49.10	95.70	14.50	19.70	235.00	108.00	76.10	880.00
Fluorene	TM218	µg/kg	10	2.70E+04	0	151.00	47.50	94.50	610.00	83.70	153.00	1820.00	182.00	313.00	16500.00
Phenanthrene	TM218	µg/kg	15	2.70E+04	2	1910.00	423.00	917.00	9330.00	2430.00	3040.00	19200.00	940.00	3390.00	60800.00
Anthracene	TM218	µg/kg	16	3.40E+04	0	441.00	<16	151.00	2740.00	432.00	1220.00	4730.00	144.00	747.00	20900.00
Fluoranthene	TM218	µg/kg	17	6.64E+03	7	2450.00	418.00	1500.00	12300.00	1780.00	3660.00	33300.00	768.00	5540.00	58300.00
Pyrene	TM218	µg/kg	15	7.60E+04	0	1830.00	347.00	1340.00	8950.00	1130.00	2400.00	23500.00	562.00	4030.00	39100.00
Benz(a)anthracene	TM218	µg/kg	14	6.07E+05	0	1080.00	213.00	950.00	4150.00	563.00	1560.00	14900.00	280.00	2690.00	20300.00
Chrysene	TM218	µg/kg	10	6.21E+05	0	1020.00	220.00	952.00	4310.00	460.00	1320.00	12900.00	265.00	2470.00	16900.00
Benzo(b)fluoranthene	TM218	µg/kg	15	3.42E+03	8	1360.00	312.00	1610.00	5020.00	386.00	1530.00	20800.00	248.00	2560.00	20400.00
Benzo(k)fluoranthene	TM218	µg/kg	14	5.05E+03	3	512.00	121.00	551.00	1710.00	189.00	562.00	6690.00	97.50	1240.00	7620.00
Benzo(a)pyrene	TM218	µg/kg	15	3.40E+04	0	868.00	224.00	1160.00	3290.00	349.00	1060.00	11800.00	221.00	2310.00	15300.00
Indeno(1,2,3-cd)pyrene	TM218	µg/kg	18	2.50E+04	0	806.00	190.00	1040.00	2700.00	285.00	859.00	11900.00	117.00	1940.00	12200.00
Dibenzo(a,h)anthracene	TM218	µg/kg	23	8.38E+05	0	117.00	29.20	152.00	373.00	56.20	157.00	1900.00	36.30	427.00	2120.00
Benzo(g,h,i)perylene	TM218	µg/kg	24	1.30E+04	0	606.00	151.00	829.00	2230.00	225.00	653.00	8970.00	150.00	1880.00	10000.00
PAH, Total Detected USEPA 16	TM218	µg/kg	118			14800.00	3500.00	11600.00	58200.00	9530.00	18800.00	197000.00	4630.00	33000.00	340000.00
Dibromofluoromethane**	TM116	%				91.20	99.60	94.40	96.00	104.00	108.00	80.50	98.40	94.90	106.00
Toluene-d8**	TM116	%				94.40	96.10	99.70	97.70	96.40	97.40	88.80	92.90	87.80	97.10
4-Bromofluorobenzene**	TM116	%				74.80	93.70	93.30	95.10	93.30	99.80	67.50	73.00	73.60	96.10
Methyl Tertiary Butyl Ether	TM116	µg/kg	10			<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Benzene	TM116	µg/kg	9	3.80E+03	0	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180
Toluene	TM116	µg/kg	7	1.28E+05	0	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140
Ethylbenzene	TM116	µg/kg	4	8.00E+04	0	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80
p/m-Xylene	TM116	µg/kg	10	7.40E+04	0	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
o-Xylene	TM116	µg/kg	10	7.40E+04	0	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Naphthalene	TM116	µg/kg	13	2.70E+04	0	<260	385.00	<260	<260	<260	<260	956.00	<260	443.00	547.00
Sum of Detected Xylenes	TM116	mg/kg	0.02			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Sum of BTEX	TM116	µg/kg	40			<800	<800	<800	<800	<800	<800	<800	<800	<800	<800

Customer Sample ID	R14-1	R14-2	R15-1	R15-2	R18-1	R18-2	S14-1	S14-2	S15-1	S15-2	S16-1	S16-2
Depth	0.10-0.10	1.70-1.70	0.50-0.50	1.20-1.20	0.60-0.60	1.80-1.80	0.50-0.50	1.30-1.30	0.70-0.70	1.40-1.40	0.90-0.90	2.20-2.20
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Sampled Date	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	26/01/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
Sample Received Date	28/01/2021	28/01/2021	28/01/2021	28/01/2021	27/01/2021	27/01/2021	05/02/2021	05/02/2021	05/02/2021	05/02/2021	06/02/2021	06/02/2021
Final Instruction Date	08/02/2021	08/02/2021	08/02/2021	08/02/2021	03/02/2021	03/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021	15/02/2021	15/02/2021
Report Completed Date					09/02/2021	09/02/2021	23/02/2021	23/02/2021	23/02/2021	23/02/2021	19/02/2021	19/02/2021
SDG	210128-35	210128-35	210128-35	210128-35	210127-42	210127-42	210205-65	210205-65	210205-65	210205-65	210206-39	210206-39
Lab Sample Number	23621397	23621406	23621287	23621351	23614011	23613914	23672951	23672957	23672963	23672967	23677975	23678020
Sample Temperature	10.2	10.2	10.2	10.2	5.4	5.4	9.0	9.0	9.0	9.0	8.7	8.7
Determinand												
Colour	Dark Brown	Dark Brown	Dark Brown	Black	Dark Brown	Dark Brown	Black	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown
Description	Sandy Loam	Loamy Sand	Loamy Sand	Sand	Loamy Sand	Sand	Sand	Sand	Sand	Sand	Loamy Sand	Sand
Inclusion 1)	Stones	Stones	Stones	None	Stones	None	Stones	Stones	Stones	Stones	Stones	Stones
Inclusion 2)	Vegetation	None	Vegetation	Stones	Brick	Stones	Vegetation	None	Vegetation	None	None	Crushed Brick
Moisture Content Ratio (% of as received sample)	13.00	14.00	6.30	11.00	7.70	17.00	13.00	14.00	9.90	32.00	11.00	19.00
Asbestos Quantification - Gravimetric - %							0.00					
Date of Analysis	05/02/2021	-	05/02/2021	-	03/02/2021	-	11/02/2021	-	11/02/2021	-	15/02/2021	-
Analysed By	James Richards	-	James Richards	-	Paul Poynton	-	Marcin Magdziarek	-	Paul Poynton	-	Marcin Magdziarek	-
Asbestos Quantification - PCOM Evaluation - %	<0.001				-	-	<0.001	-	-	-	-	-
Additional Asbestos Components (Using TM048)	None				-	-	None	-	-	-	-	-
Analysts Comments	NA				-	-	-	-	-	-	-	-
Asbestos Quantification - Total - %	<0.001				-	-	<0.001	-	-	-	-	-
Chrysotile (White) Asbestos	Detected	-	Not Detected	-	Not Detected	-	Detected	-	Not Detected	-	Not Detected	-
Amosite (Brown) Asbestos	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Crocidolite (Blue) Asbestos	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Fibrous Anthophyllite	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Fibrous Tremolite	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Fibrous Actinolite	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Non-Asbestos Fibre	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-
Comments	Fibre bundles in soil	-	-	-	-	-	Loose fibres in soil	-	-	-	-	-
Soil Organic Matter (SOM)	5.97	22.60	12.40	20.50	7.29	8.69	71.20	29.30	17.10	65.90	61.70	32.10
pH	8.97	11.10	10.80	11.30	11.10	10.90	9.30	10.60	10.60	8.33	11.10	8.96
Cyanide, Total	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Exchangeable Ammonia as N	<12	<12	<12	<12	<12	15.60	<12	<12	<12	<12	<12	<12
Arsenic	13.40	<6	10.60	<6	9.32	12.10	5.83	<6	9.45	<6	<6	6.47
Cadmium	2.19	1.00	2.14	1.11	0.43	0.22	0.33	0.48	1.59	<0.2	<0.2	<0.2
Chromium	106.00	235.00	184.00	300.00	58.10	45.80	39.20	27.40	89.90	11.90	83.60	11.70
Copper	31.30	25.60	33.60	14.50	22.10	32.40	16.20	<14	33.90	27.40	<14	22.60
Iron	129000.00	73100.00	93400.00	94800.00	66600.00	33700.00	30800.00	53800.00	171000.00	41300.00	40100.00	24200.00
Lead	143.00	11.50	146.00	9.90	52.20	29.80	29.90	61.70	97.30	32.00	22.20	20.20
Manganese	8710.00	14100.00	10400.00	16600.00	4170.00	2950.00	4130.00	3230.00	8150.00	724.00	4880.00	4100.00
Mercury	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<0.1	<1	<0.1	<1	<1	<1
Nickel	30.10	20.20	34.00	9.65	20.20	24.40	11.80	8.00	22.00	28.20	8.99	19.90
Selenium	<10	<10	<10	<10	<10	<10	1.80	<10	<1	<10	<10	<10
Vanadium	174.00	373.00	228.00	249.00	95.30	61.30	59.50	46.40	134.00	33.80	94.10	31.10
Zinc	482.00	113.00	420.00	82.50	137.00	48.60	87.00	143.00	380.00	55.90	55.30	73.80
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01
Cresols	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01
Xylenols	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Phenols, Total Detected monohydric	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	0.05	<0.035	<0.035	<0.035	<0.035
Total Aliphatics >C5-C10	<50	259.00	53.40	66.10	<50	315.00	<50	<50	<50	<50	725.00	125.00
Total Aromatics >EC5-EC10	<50	147.00	<50	<50	<50	190.00	<50	<50	<50	<50	403.00	53.30
GRO >C5-C10	<20	406.00	53.40	66.10	<20	505.00	<20	<20	<20	<20	1130.00	179.00
GRO Surrogate % recovery**	71.50	24.30	78.10	29.80	11.70	80.90	3.80	13.40	17.30	5.80	14.80	134.00
Aliphatics >C5-C6	<10	31.30	<10	<10	<10	10.90	<10	<10	<10	<10	71.20	14.90
Aliphatics >C6-C8	<10	150.00	24.60	42.60	10.80	52.00	<10	<10	<10	<10	359.00	45.90
Aliphatics >C8-C10	<10	77.70	28.80	23.50	<10	252.00	<10	<10	<10	<10	295.00	64.50
Aliphatics >C10-C12	<1000	<1000	<1000	<1000	<1000	4650.00	6370.00	1080.00	<1000	<1000	17600.00	<1000
Aliphatics >C12-C16	<1000	4200.00	<1000	<1000	3770.00	19700.00	13600.00	5430.00	1900.00	<1000	77200.00	8060.00
Aliphatics >C16-C21	<1000	10500.00	4270.00	2740.00	9540.00	81100.00	18500.00	9240.00	5490.00	2600.00	87500.00	15800.00
Aliphatics >C21-C35	<1000	49300.00	26700.00	12100.00	31000.00	241000.00	37300.00	18400.00	24000.00	20500.00	60000.00	16600.00
Aliphatics >C35-C44	<1000	44200.00	5850.00	1340.00	7110.00	34800.00	9370.00	4800.00	6700.00	6740.00	12000.00	3110.00
Total Aliphatics >C10-C44	<5000	109000.00	37200.00	17300.00	52200.00	381000.00	85100.00	38900.00	38700.00	30300.00	254000.00	43600.00
Total Aliphatics & Aromatics >C10-C44	<10000	145000.00	59200.00	34000.00	92700.00	429000.00	145000.00	98600.00	79300.00	47400.00	323000.00	59500.00
Aromatics >EC5-EC7	<10	36.00	<10	<10	<10	10.90	<10	<10	<10	<10	91.50	<10
Aromatics >EC7-EC8	<10	59.20	<10	15.70	<10	10.90	<10	<10	<10	<10	115.00	11.20
Aromatics >EC8-EC10	<10	52.20	19.20	15.70	<10	168.00	<10	<10	<10	<10	197.00	42.20
Aromatics > EC10-EC12	<1000	<1000	<1000	<1000	<1000	<1000	1670.00	<1000	<1000	<1000	4410.00	<1000
Aromatics > EC12-EC16	<1000	4100.00	<1000	1060.00	3550.00	1070.00	11500.00	5350.00	2160.00	<1000	31500.00	2420.00
Aromatics > EC16-EC21	1270.00	7960.00	2170.00	4630.00	8580.00	2380.00	15000.00	11500.00	9310.00	<1000	14500.00	2830.00
Aromatics > EC21-EC35	2940.00	20100.00	18100.00	9320.00	26100.00	41900.00	30900.00	39600.00	27600.00	15800.00	17200.00	9700.00
Aromatics >EC35-EC44	<1000	2950.00	1460.00	<1000	1950.00	2170.00	<1000	2300.00	1070.00	<1000	<1000	<1000
Aromatics > EC40-EC44	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Total Aromatics > EC10-EC44	5710.00	35600.00	22000.00	16600.00	40500.00	47700.00	60100.00	59700.00	40600.00	17100.00	68800.00	16000.00
Total Aliphatics & Aromatics >C5-C44	<10000	145000.00	59200.00	34100.00	92700.00	429000.00	145000.00	98600.00	79300.00	47400.00	324000.00	59700.00
Naphthalene-d8 % recovery**	87.30	75.80	83.40	82.30	78.30	85.70	97.30	79.30	77.10	86.50	101.00	98.60
Acenaphthene-d10 % recovery**	87.00	74.60	85.00	82.60	78.90	87.40	103.00	84.50	82.80	86.30	102.00	98.40
Phenanthrene-d10 % recovery**	88.20	74.00	88.30	84.50	77.50	78.50	107.00	84.60	80.60	59.30	101.00	98.20
Chrysene-d12 % recovery**	80.60	70.70	81.30	76.20	72.00	40.30	97.00	81.20	81.10	34.20	89.90	86.30
Perylene-d12 % recovery**	78.40	77.50	76.90	70.50	70.40	20.60	82.80	72.50	70.40	25.50	77.30	87.30
Naphthalene	91.50	265.00	187.00	2040.00	269.00	126.00	614.00	734.00	726.00	102.00	376.00	169.00
Acenaphthylene	29.10	<60	43.20	1240.00	<60	23.00	129.00	253.00	313.00	<12	28.00	39.10
Acenaphthene	<8	<40	29.70	94.40	102.00	27.90	27.20	25.70	<40	16.40	53.70	17.10
Fluorene	19.60	65.90	49.60	1330.00	176.00	38.60	118.00	138.00	181.00	44.40	150.00	43.70
Phenanthrene	162.00	427.00	370.00	11400.00	974.00	209.00	1120.00	1380.00	1670.00	150.00	649.00	257.00
Anthracene	39.00	<80	97.30	2090.00	241.00	52.00	152.00	322.00	485.00	<16	72.70	46.90
Fluoranthene	264.00	435.00	573.00	12000.00	1340.00	244.00	1120.00	2170.00	2690.00	68.10	358.00	287.00
Pyrene	202.00	371.00	480.00	8030.00	1140.00	195.00	822.00	1570.00	2010.00	57.40	298.00	216.00
Benz(a)anthracene	140.00	242.00	271.00	4100.00	922.00	100.00	512.00	951.00	1260.00	36.80	165.00	120.00
Chrysene	144.00	262.00	230.00	3300.00	789.00	88.70	602.00	805.00	1180.00	54.60	286.00	131.00
Benzo(b)fluoranthene	201.00	295.00	383.00	4550.00	676.00	98.20	796.00	1300.00	1730.00	55.90	271.00	114.00
Benzo(k)fluoranthene	69.60	83.00	125.00	1540.00	315.00	37.70	244.00	410.00	559.00	<14	78.30	51.60
Benzo(a)pyrene	119.00	227.00	220.00	2750.00	635.00	53.00	383.00	698.00	1020.00	25.50	135.00	98.80
Indeno(1,2,3-cd)pyrene	118.00	165.00	201.00	2610.00	410.00	39.20	280.00	623.00	878.00	<18	87.30	89.10
Dibenzo(a,h)anthracene	<23	<115	32.80	415.00	<115	<23	98.70	140.00	184.00	<23	34.40	<23
Benzo(g,h,i)perylene	90.40	179.00	170.00	1900.00	360.00	29.40	328.00	502.00	689.00	<24	127.00	82.90
PAH, Total Detected USEPA 16	1690.00	3020.00	3460.00	59400.00	8350.00	1360.00	7340.00	12000.00	15600.00	611.00	3170.00	1760.00
Dibromofluoromethane**	108.00	92.40	105.00	91.50	105.00	119.00	112.00	114.00	98.50	106.00	100.00	112.00
Toluene-d8**	99.60	92.40	99.80	91.60	94.90	96.80	102.00	100.00	93.60	94.60	92.90	97.60
4-Bromofluorobenzene**	88.90	72.90	91.40	77.30	86.70	83.90	100.00	98.80	73.90	75.70	76.80	94.30
Methyl Tertiary Butyl Ether	<200	<200	<200	<200	<200	<200	<2000	<2000	<200	<200	<200	<200
Benzene	<180	<180	<180	<180	<180	<180	<1800	<1800	<180	<180	205.00	<180
Toluene	<140	282.00	<140	196.00	<140	<140	<1400	<1400	<140	<140	380.00	<140
Ethylbenzene	<80	<80	<80	<80	<80	<80	<800	<800	<80	<80	<80	<80
p/m-Xylene	<200	<200	<200	<200	<200	<200	<2000	<2000	<200	<200	271.00	<200
o-Xylene	<200	<200	<200	<200	<200	<200	<2000	<2000	<200	<200	<200	<200
Naphthalene	<260	<260	<260	<260	<260	<260	<2600	<2600	<260	<260	<260	<260
Sum of Detected Xylenes	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<4	<4	<0.4	<0.4	<0.4	<0.4
Sum of BTEX	<800	<800	<800	<800	<800	<800	<8000	<8000	<800	<800	856.00	<800

Customer Sample ID	T10-1	T10-2	T10-3	T12-1	T13-1	T13-2	T14-1	T14-2	T15-1	U10-1	U10-2	U11-1
Depth	0.30-0.30	1.00-1.00	2.90-2.90	0.15-0.15	0.40-0.40	1.10-1.10	0.30-0.30	1.40-1.40	1.00-1.00	1.00-1.00	1.50-1.50	1.00-1.00
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Sampled Date	03/02/2021	03/02/2021	03/02/2021	04/02/2021	03/02/2021	03/02/2021	03/02/2021	03/02/2021	03/02/2021	02/02/2021	02/02/2021	02/02/2021
Sample Received Date	04/02/2021	04/02/2021	04/02/2021	05/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021	05/02/2021	04/02/2021	04/02/2021	04/02/2021
Final Instruction Date	10/02/2021	10/02/2021	10/02/2021	11/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021	11/02/2021	10/02/2021	10/02/2021	10/02/2021
Report Completed Date	26/02/2021	26/02/2021	26/02/2021	23/02/2021	26/02/2021	26/02/2021	26/02/2021	26/02/2021	23/02/2021	26/02/2021	26/02/2021	26/02/2021
SDG	210204-77	210204-77	210204-77	210205-65	210204-77	210204-77	210204-77	210204-77	210205-65	210204-77	210204-77	210204-77
Lab Sample Number	23666051	23666060	23666068	23672946	23666114	23666124	23666133	23666144	23672941	23666173	23666182	23666154
Sample Temperature	8.8	8.8	8.8	9.0	8.8	8.8	8.8	8.8	9.0	8.8	8.8	8.8
Determinand												
Colour	Black	Black	Black	Dark Brown	Black	Dark Brown	Grey	Grey	Dark Brown	Dark Brown	Dark Brown	Dark Brown
Description	Sand	Sand	Silt Loam	Sand	Sand	Sandy Loam	Sandy Loam	Sand	Sand	Sandy Loam	Sand	Sand
Inclusion 1)	Stones	Stones	Stones	Stones	None	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Inclusion 2)	Vegetation	Vegetation	None	None	Stones	N/A	None	None	Vegetation	Crushed Brick	Vegetation	Vegetation
Moisture Content Ratio (% of as received sample)	1.10	11.00	35.00	3.00	9.70	14.00	12.00	32.00	4.10	10.00	14.00	1.60
Asbestos Quantification - Gravimetric - %	0.00											
Date of Analysis	10/02/2021	-	10/02/2021	-	10/02/2021	-	11/02/2021	-	11/02/2021	10/02/2021	-	09/02/2021
Analysed By	Christian Hallam	-	Christian Hallam	-	Christian Hallam	-	Paul Poynton	-	Christian Hallam	Christian Hallam	-	James Richards
Asbestos Quantification - PCOM Evaluation - %	<0.001	-	-	-	-	-	-	-	-	-	-	-
Additional Asbestos Components (Using TM048)	None	-	-	-	-	-	-	-	-	-	-	-
Analysts Comments	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos Quantification - Total - %	<0.001	-	-	-	-	-	-	-	-	-	-	-
Chrysotile (White) Asbestos	Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Amosite (Brown) Asbestos	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Crocidolite (Blue) Asbestos	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Fibrous Anthophyllite	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Fibrous Tremolite	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Fibrous Actinolite	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Non-Asbestos Fibre	Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected
Comments	Fibre bundles in soil.	-	-	-	-	-	-	-	-	-	-	-
Soil Organic Matter (SOM)	34.80	35.00	-	2.17	24.30	7.57	36.50	84.00	55.70	13.10	28.10	6.24
pH	10.90	11.80	11.70	10.70	10.00	8.67	9.03	9.22	9.93	9.58	10.20	10.50
Cyanide, Total	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Exchangeable Ammonia as N	<12	<12	30.60	<12	<12	<12	<12	<12	<12	<12	<12	<12
Arsenic	5.87	<6	<6	<6	2.47	6.48	<6	6.93	3.72	6.33	7.37	3.37
Cadmium	0.78	<0.2	0.32	<0.2	0.10	<0.2	0.33	<0.2	0.30	0.32	<0.2	0.39
Chromium	214.00	59.90	31.40	29.00	20.00	42.90	10.30	12.40	22.70	42.90	95.30	144.00
Copper	15.40	<14	18.60	<14	5.72	<14	<14	29.00	8.49	19.70	15.60	14.80
Iron	59900.00	20900.00	17400.00	11200.00	12400.00	19600.00	14700.00	14800.00	20400.00	60300.00	47000.00	85900.00
Lead	41.10	18.20	23.90	<7	14.40	27.30	30.20	27.80	14.00	41.30	47.00	1.08
Manganese	13300.00	4060.00	2810.00	5290.00	4480.00	3430.00	2760.00	5500.00	3200.00	5150.00	5410.00	13300.00
Mercury	<0.1	<1	<1	<1	<0.1	<1	<1	<1	<0.1	<1	<1	<0.1
Nickel	10.50	5.86	6.74	2.01	3.76	15.30	6.21	30.00	6.21	14.20	12.60	8.82
Selenium	4.50	<10	<10	<10	3.55	<10	<10	<10	1.59	<10	<10	4.90
Vanadium	222.00	65.90	41.60	47.50	39.90	98.20	25.30	28.30	32.60	90.20	138.00	277.00
Zinc	151.00	57.60	82.80	<19	61.50	60.50	74.20	61.60	66.30	117.00	161.00	30.80
Phenol	<1	<1	<1	<0.01	<1	<1	<1	<0.1	<0.01	<1	<1	<1
Cresols	<1	<1	<1	<0.01	<1	<1	<1	<0.1	<0.01	<1	<1	<1
Xylenols	<1.5	<1.5	<1.5	<0.015	<1.5	<1.5	<1.5	<0.15	<0.015	<1.5	<1.5	<1.5
Phenols, Total Detected monohydric	<3.5	<3.5	<3.5	<0.035	<3.5	<3.5	<3.5	<0.35	<0.035	<3.5	<3.5	<3.5
Total Aliphatics >C5-C10	217.00	311.00	97.00	<50	<50	<50	<50	<50	<50	<50	53.40	128.00
Total Aromatics >EC5-EC10	82.90	148.00	<50	<50	<50	<50	<50	<50	<50	<50	<50	56.90
GRO >C5-C10	300.00	459.00	97.00	<20	<20	<20	<20	<20	<20	<20	53.40	185.00
GRO Surrogate % recovery**	16.80	13.60	0.70	57.50	58.00	65.00	23.20	26.00	12.00	55.00	53.00	89.00
Aliphatics >C5-C6	17.20	22.60	10.80	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aliphatics >C6-C8	95.00	134.00	58.50	<10	28.90	<10	<10	<10	<10	<10	19.70	42.70
Aliphatics >C8-C10	105.00	154.00	27.70	<10	20.00	<10	<10	<10	<10	<10	33.60	85.30
Aliphatics >C10-C12	4740.00	5800.00	52300.00	<1000	<1000	<1000	<1000	<1000	1230.00	<1000	<1000	<1000
Aliphatics >C12-C16	17500.00	20600.00	186000.00	<1000	4360.00	<1000	5130.00	<1000	4350.00	1440.00	1780.00	1280.00
Aliphatics >C16-C21	26900.00	42200.00	811000.00	3530.00	7640.00	<1000	13100.00	1360.00	11200.00	6320.00	7410.00	4200.00
Aliphatics >C21-C35	35500.00	78600.00	778000.00	15700.00	19800.00	<1000	19600.00	10600.00	31100.00	14800.00	17300.00	7580.00
Aliphatics >C35-C44	21700.00	38500.00	188000.00	4270.00	3740.00	<1000	<1000	<1000	4700.00	2230.00	2690.00	1120.00
Total Aliphatics >C10-C44	106000.00	186000.00	2020000.00	24200.00	36400.00	<5000	39200.00	12400.00	52500.00	24900.00	29200.00	14200.00
Total Aliphatics & Aromatics >C10-C44	302000.00	323000.00	2690000.00	33500.00	66200.00	<10000	91400.00	23200.00	118000.00	249000.00	101000.00	41700.00
Aromatics >EC5-EC7	<10	19.20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aromatics >EC7-EC8	13.10	26.00	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aromatics >EC8-EC10	69.80	103.00	18.50	<10	13.30	<10	<10	<10	<10	<10	22.00	56.90
Aromatics > EC10-EC12	4490.00	3420.00	26800.00	<1000	<1000	<1000	1010.00	<1000	<1000	1140.00	<1000	<1000
Aromatics > EC12-EC16	13800.00	14900.00	151000.00	<1000	3470.00	<1000	5070.00	<1000	4030.00	9130.00	3360.00	<1000
Aromatics > EC16-EC21	58100.00	37200.00	265000.00	1230.00	5080.00	<1000	7270.00	1300.00	12400.00	68800.00	16800.00	3790.00
Aromatics > EC21-EC35	111000.00	78200.00	224000.00	6640.00	19000.00	1510.00	33300.00	8190.00	44800.00	133000.00	47100.00	21200.00
Aromatics >EC35-EC44	8350.00	4070.00	9970.00	<1000	1860.00	<1000	5570.00	<1000	3930.00	11800.00	3760.00	2230.00
Aromatics > EC40-EC44	<1000	<1000	1250.00	<1000	<1000	<1000	<1000	<1000	<1000	1810.00	<1000	<1000
Total Aromatics > EC10-EC44	196000.00	138000.00	677000.00	9230.00	29800.00	<5000	52200.00	10800.00	65800.00	224000.00	71900.00	27600.00
Total Aliphatics & Aromatics >C5-C44	303000.00	324000.00	2690000.00	33500.00	66300.00	<10000	91400.00	23200.00	118000.00	249000.00	101000.00	41900.00
Naphthalene-d8 % recovery**	83.20	95.70	89.50	78.60	93.90	88.10	85.20	75.60	80.00	96.20	82.10	95.90
Acenaphthene-d10 % recovery**	87.70	101.00	97.60	80.70	89.10	86.70	83.90	71.70	83.80	93.60	85.30	93.30
Phenanthrene-d10 % recovery**	84.80	104.00	85.80	83.10	85.90	90.20	84.10	52.40	89.50	96.90	85.10	94.70
Chrysene-d12 % recovery**	76.60	90.90	53.60	80.50	78.30	116.00	79.40	38.70	87.80	96.20	77.90	95.80
Perylene-d12 % recovery**	71.30	77.50	29.70	73.10	78.30	111.00	70.80	38.00	74.80	98.10	71.10	101.00
Naphthalene	6900.00	2900.00	12300.00	118.00	313.00	71.10	359.00	115.00	528.00	676.00	606.00	36.10
Acenaphthylene	7740.00	675.00	1710.00	30.50	79.20	26.50	94.10	29.50	140.00	391.00	400.00	15.30
Acenaphthene	834.00	195.00	754.00	11.70	<40	<8	13.80	<8	28.30	58.40	53.10	28.50
Fluorene	8800.00	852.00	3550.00	40.60	66.70	27.20	66.20	35.20	101.00	280.00	320.00	24.20
Phenanthrene	44400.00	4890.00	11900.00	338.00	566.00	185.00	623.00	230.00	1060.00	2460.00	2630.00	515.00
Anthracene	14200.00	1220.00	2100.00	84.40	124.00	43.80	104.00	<16	281.00	739.00	637.00	82.30
Fluoranthene	47300.00	6420.00	8250.00	480.00	678.00	259.00	689.00	234.00	1650.00	5050.00	4150.00	1680.00
Pyrene	32800.00	4810.00	5860.00	342.00	511.00	202.00	490.00	165.00	1260.00	3340.00	2740.00	1480.00
Benz(a)anthracene	15500.00	2680.00	2120.00	228.00	299.00	135.00	350.00	107.00	886.00	2440.00	1640.00	1120.00
Chrysene	11800.00	2630.00	2230.00	259.00	378.00	151.00	394.00	104.00	875.00	2320.00	1580.00	1220.00
Benzo(b)fluoranthene	17200.00	4010.00	1960.00	295.00	447.00	218.00	592.00	109.00	1330.00	3140.00	2090.00	1410.00
Benzo(k)fluoranthene	5660.00	1360.00	566.00	108.00	147.00	66.40	174.00	<14	400.00	1060.00	652.00	701.00
Benzo(a)pyrene	11400.00	2280.00	900.00	162.00	273.00	112.00	259.00	94.40	725.00	1930.00	1210.00	1230.00
Indeno(1,2,3-cd)pyrene	8560.00	1620.00	376.00	130.00	255.00	92.50	250.00	93.50	566.00	1570.00	1050.00	1170.00
Dibenzo(a,h)anthracene	1840.00	449.00	168.00	32.70	<115	<23	63.30	<23	144.00	356.00	234.00	214.00
Benzo(g,h,i)perylene	7180.00	1650.00	412.00	110.00	251.00	94.00	231.00	82.70	491.00	1270.00	892.00	1000.00
PAH, Total Detected USEPA 16	242000.00	38600.00	55200.00	2770.00	4390.00	1680.00	4750.00	1400.00	10500.00	27100.00	20900.00	11900.00
Dibromofluoromethane**	111.00	103.00	95.30	107.00	96.10	106.00	107.00	107.00	104.00	104.00	124.00	113.00
Toluene-d8**	94.10	92.10	78.00	100.00	91.90	97.60	94.90	94.60	101.00	96.90	101.00	102.00
4-Bromofluorobenzene**	74.40	70.60	52.90	92.50	72.70	87.10	71.20	70.80	101.00	86.10	92.50	88.80
Methyl Tertiary Butyl Ether	<200	<200	<2000	<200	<200	<200	<200	<200	<2000	<200	<200	<200
Benzene	<180	<180	<1800	<180	<180	<180	<180	<180	<1800	<180	<180	<180
Toluene	<140	<140	2410.00	<140	<140	<140	<140	<140	<1400	<140	<140	<140
Ethylbenzene	<80	<80	<800	<80	<80	<80	<80	<80	<800	<80	<80	<80
p/m-Xylene	<200	<200	<2000	<200	<200	<200	<200	<200	<2000	<200	<200	<200
o-Xylene	<200	<200	<2000	<200	<200	<200	<200	<200	<2000	<200	<200	<200
Naphthalene	937.00	4400.00	<2600	<260	<260	<260	<260	<260	<2600	<260	<260	<260
Sum of Detected Xylenes	<0.4	<0.4	<4	<0.4	<0.4	<0.4	<0.4	<0.4	<4	<0.4	<0.4	<0.4
Sum of BTEX	<800	<800	<8000	<800	<800	<800	<800	<800	<8000	<800	<800	<800

Client: Rodgers Leask Environmental	Customer Sample ID				U11-2	U12-1	U12-2	U14-1	U14-2	U15-1	U16-1	U16-2	U19-1	V10-1	V10-2	V11-1	V11-2	V12-1	V12-2	V13-1	V14-1	V16-1	V16-2	V16-3	V17-1	V18-1	V18-2	V19-1	V20-1	V21-1
	Depth			Residential Soil Re-use Values (Table 2.1)	1.40-1.40	0.60-0.60	1.90-1.90	0.30-0.30	2.00-2.00	1.00-1.00	1.00-1.00	2.00-2.00	0.30-0.30	0.30-0.30	1.50-1.50	0.50-0.50	1.60-1.60	1.00-1.00	1.60-1.60	1.00-1.00	0.30-0.30	1.00-1.00	1.80-1.80	2.20-2.20	1.00-1.00	0.50-0.50	1.50-1.50	0.50-0.50	1.30-1.30	0.50-0.50
	Sample Type				SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
	Sampled Date				02/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021	03/02/2021	04/02/2021	04/02/2021	05/02/2021	02/02/2021	02/02/2021	02/02/2021	02/02/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/2/2021	2/1/2021	2/1/2021	2/1/2021
	Sample Received Date				04/02/2021	05/02/2021	05/02/2021	05/02/2021	05/02/2021	05/02/2021	05/02/2021	05/02/2021	06/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021	2/3/2021
	Final Instruction Date				10/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021	15/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021	2/10/2021
	Report Completed Date				26/02/2021	23/02/2021	23/02/2021	23/02/2021	23/02/2021	23/02/2021	23/02/2021	23/02/2021	19/02/2021	26/02/2021	26/02/2021	26/02/2021	26/02/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021	2/17/2021
	SDG				210204-77	210205-65	210205-65	210205-65	210205-65	210205-65	210205-65	210205-65	210206-39	210204-77	210204-77	210204-77	210204-77	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41	210203-41
	Lab Sample Number				23666163	23673002	23673008	23672993	23672997	23672977	23672982	23672987	23678044	23666192	23666203	23665991	23666096	23656304	23656309	23656299	23656291	23656275	23656279	23656284	23656355	23656342	23656346	23656336	23656330	23656325
	Sample Temperature				8.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0	8.7	8.8	8.8	8.8	8.8	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Determinand	**Method**	**Units**	**LOD**																											
Colour	PM024	No units			Dark Brown	Black	Dark Brown	Black	Dark Brown	Black	Black	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown
Description	PM024	No units			Sand	Sand	Sand	Sand	Stone/Soil	Sand	Sand	Sand	Loamy Sand	Sandy Loam	Sand	Sand	Sand	Gravel	Loamy Sand	Loamy Sand	Sandy Silt Loam	Sand	Sand	Sand	Loamy Sand	Sandy Silt Loam	Loamy Sand	Sandy Loam	Sand	Sandy Silt Loam
Inclusion 1)	PM024	No units			Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Inclusion 2)	PM024	No units			None	None	Vegetation	None	None	Vegetation	Vegetation	Vegetation	Vegetation	None	Vegetation	Vegetation	None	None	None	Vegetation	None	None	None	None	None	Vegetation	Vegetation	Vegetation	None	None
Moisture Content Ratio (% of as received sample)	PM024	%			4.40	9.90	9.70	11.00	6.80	0.00	3.60	12.00	11.00	12.00	13.00	0.38	14.00	8.60	15.00	12.00	11.00	10.00	3.50	10.00	17.00	11.00	21.00	7.80	12.00	10.00
Asbestos Quantification - Gravimetric - %	TM304	%	0.001							0.0039																				
Date of Analysis	TM048	No units			-	-	11/02/2021	-	11/02/2021	11/02/2021	-	11/02/2021	-	09/02/2021	-	10/02/2021	-	09/02/2021	-	-	09/02/2021	-	09/02/2021	-	09/02/2021	09/02/2021	-	-	09/02/2021	-
Analysed By	TM048	No units			-	-	Christian Hallam	-	Marcin Magdziarek	Paul Poynton	-	Christian Hallam	-	Paul Poynton	-	Christian Hallam	-	Paul Poynton	-	-	Paul Poynton	-	Paul Poynton	-	James Richards	Marcin Magdziarek	-	-	James Richards	-
Asbestos Quantification - PCOM Evaluation - %	TM304	%	0.001		-	-	-	-	-	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Asbestos Components (Using TM048)	TM304	No units			-	-	-	-	-	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Analysts Comments	TM304	No units			-	-	-	-	-	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos Quantification - Total - %	TM304	%	0.001		-	-	-	-	-	0.0039	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysotile (White) Asbestos	TM048	No units			-	-	Not Detected	-	Not Detected	Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Amosite (Brown) Asbestos	TM048	No units			-	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Crocidolite (Blue) Asbestos	TM048	No units			-	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Fibrous Anthophyllite	TM048	No units			-	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Fibrous Tremolite	TM048	No units			-	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Fibrous Actinolite	TM048	No units			-	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Non-Asbestos Fibre	TM048	No units			-	-	Not Detected	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	-	Not Detected	-	Not Detected	Not Detected	-	-	Not Detected	-
Comments	TM048	No units			-	-	-	-	-	Degraded textile ACM debris in soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Organic Matter (SOM)	TM132	%	0.35		1.64	27.80	4.52	30.20	<0.35	41.40	44.30	31.70	8.26	22.90	9.09	9.67	42.80	1.74	16.60	11.20	8.81	4.10	-	12.50	71.90	5.90	50.70	3.43	4.41	11.00
pH	TM133	pH Units	1		10.90	9.05	9.87	9.24	10.90	9.51	8.89	9.84	12.00	10.70	11.60	11.00	11.10	9.78	10.90	10.20	10.40	9.96	9.97	8.71	10.50	8.53	10.50	11.40	11.10	10.10
Cyanide, Total	TM153	mg/kg	1	2.02E+00	<1	<1	<1	<1	<1	<1	4.06	1.46	<1	1.70	2.67	<1	1.18	<1	4.35	<1	<1	<1	<1	<1	<1	20.90	<1	<1	<1	<1
Exchangeable Ammonia as N	TM024	mg/kg	12	154	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12
Arsenic	TM181	mg/kg	0.6	2533.00	<6	2.68	<6	2.71	<6	3.49	<6	5.23	<6	8.20	<6	4.94	<6	<6	4.61	6.06	6.72	<6	<6	<6	<6	<6	6.22	15.50	<6	14.50
Cadmium	TM181	mg/kg	0.02	73.00	<0.2	0.09	<0.2	0.11	<0.2	0.23	<0.2	0.36	0.89	0.54	0.20	0.81	<0.2	<0.2	0.30	0.23	0.75	0.28	<0.2	<0.2	0.59	0.50	0.71	0.56	0.35	0.61
Chromium	TM181	mg/kg	0.9	9431.00	302.00	36.90	11.50	9.06	46.20	14.10	93.70	25.20	476.00	94.30	82.70	127.00	56.50	<9	34.10	10.50	89.20	40.90	17.10	15.40	27.80	<9	86.90	66.10	10.50	<9
Copper	TM181	mg/kg	1.4	451.00	<14	7.98	<14	6.92	<14	6.65	16.70	11.90	<14	25.10	<14	13.10	<14	<14	10.40	<14	14.30	<14	<14	<14	<14	<14	<14	44.20	71.70	<14
Iron	TM181	mg/kg	1000	3.05E+05	76300.00	<10000	<10000	<10000	<10000	12000.00	49100.00	24500.00	154000.00	74200.00	38300.00	68300.00	44800.00	<10000	22400.00	20700.00	67200.00	41000.00	14100.00	15300.00	23100.00	128000.00	33800.00	96400.00	53700.00	232000.00
Lead	TM181	mg/kg	0.7	15700.00	<7	27.10	8.31	3.62	<7	15.90	89.40	408.00	31.50	92.30	26.50	35.30	19.40	<7	28.60	11.90	51.10	16.60	400.00	8.08	36.50	23.20	27.30	32.40	12.80	41.10
Manganese	TM181	mg/kg	0.13	33300.00	11300.00	3880.00	831.00	3530.00	4430.00	1080.00	4590.00	2040.00	28200.00	8280.00	5260.00	16600.00	5360.00	5590.00	4620.00	2950.00	7640.00	6910.00	3220.00	3340.00	4840.00	8720.00	10500.00	8110.00	3330.00	4560.00
Mercury	TM181	mg/kg	0.14	132.00	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1	<1	<1	<1	<0.1	<1	<1	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	TM181	mg/kg	0.2	11500.00	9.85	4.33	8.92	3.24	<2	4.15	10.20	10.80	10.10	17.50	8.48	8.72	8.36	<2	5.65	6.82	13.80	5.54	4.98	14.30	6.84	5.69	7.15	17.40	6.41	22.90
Selenium	TM181	mg/kg	1	702.00	10.10	2.89	<10	2.11	<10	<1	<10	<1	12.00	<10	<10	4.40	<10	<10	3.12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Vanadium	TM181	mg/kg	0.2	1606.00	265.00	32.40	24.50	20.30	29.90	31.00	56.60	23.40	409.00	234.00	184.00	443.00	128.00	21.00	73.80	24.50	159.00	53.20	50.30	44.40	40.30	21.90	87.30	131.00	52.30	80.10
Zinc	TM181	mg/kg	1.9	1.38E+05	40.00	52.70	23.00	36.90	<19	33.50	207.00	107.00	86.10	288.00	207.00	177.00	83.60	<19	93.20	52.70	167.00	63.20	20.20	27.60	78.70	98.10	44.80	110.00	44.00	87.30
Phenol	TM062 (S)	mg/kg	0.01	3.05	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1	<1	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01
Cresols	TM062 (S)	mg/kg	0.01		<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1	<1	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.11	0.02	0.01	<0.01	<0.01	<0.01
Xylenols	TM062 (S)	mg/kg	0.015	74.00	<1.5	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<1.5	<1.5	<1.5	<1.5	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.07	<0.015	<0.015	<0.015	<0.015	<0.015
Phenols, Total Detected monohydric	TM062 (S)	mg/kg	0.035		<3.5	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<3.5	<3.5	<3.5	<3.5	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	0.19	<0.035	<0.035	<0.035	<0.035	<0.035
Total Aliphatics >C5-C10	TM089	µg/kg	50		<50	<50	<50	<50	<50	<50	<50	144.00	<50	<50	50.60	55.20	169.00	<50	146.00	121.00	<50	<50	<50	<50	<50	101.00	402.00	<50	<50	<50
Total Aromatics >EC5-EC10	TM089	µg/kg	50		<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	73.10	<50	62.50	<50	<50	<50	<50	<50	<50	52.60	214.00	<50	<50	<50
GRO >C5-C10	TM089	µg/kg	20		<20	<20	<20	<20	<20	<20	<20	144.00	<20	<20	50.60	55.20	242.00	<20	209.00	121.00	<20	<20	<20	<20	<20	153.00	616.00	<20	<20	<20
GRO Surrogate % recovery**	TM089	%			103.00	9.50	107.00	9.10	98.20	32.60	10.50	44.10	56.20	55.00	77.00	59.00	87.00	114.00	58.60	63.20	63.00	74.60	79.30	83.50	73.40	72.00	115.00	75.00	74.30	76.00
Aliphatics >C5-C6	TM089	µg/kg	10	7.30E+04	<10	<10	<10	<10	<10	<10	<10	12.50	<10	<10	<10	<10	15.10	<10	14.20	11.40	<10	<10	<10	<10	<10	<10	25.20	<10	<10	<10
Aliphatics >C6-C8	TM089	µg/kg	10	3.59E+05	15.70	<10	<10	<10	<10	<10	<10	65.00	11.30	<10	31.10	30.10	67.30	<10	60.20	51.30	<10	<10	<10	<10	<10	22.40	156.00	<10	<10	<10
Aliphatics >C8-C10	TM089	µg/kg	10	2.84E+06	16.70	<10	<10	<10	<10	<10	<10	66.10	12.40	<10	19.60	25.10	87.00	<10	72.00	58.10	<10	<10	<10	<10	<10	78.40	221.00	<10	<10	<10
Aliphatics >C10-C12	TM414	µg/kg	1000	2.25E+07	<1000	1190.00	<1000	1270.00	<1000	<1000	1110.00	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	1590.00	<1000	<1000	<1000	<1000	1780.00	3510.00	1610.00	<1000	<1000	<1000
Aliphatics >C12-C16	TM414	µg/kg	1000	4.50E+08	<1000	3720.00	<1000	5130.00	<1000	2400.00	3620.00	1990.00	1500.00	3130.00	1230.00	<1000	2080.00	<1000	22400.00	25800.00	1400.00	<1000	<1000	<1000	13000.00	34000.00	18700.00	4240.00	2990.00	1740.00
Aliphatics >C16-C21	TM414	µg/kg	1000	5.66E+10	<1000	6440.00	<1000	13200.00	<1000	9340.00	6290.00	4310.00	5900.00	33800.00	16000.00	2440.00	10200.00	<1000	45200.00	49500.00	6500.00	1710.00	10100.00	3200.00	48100.00	37900.00	31000.00	13100.00	11000.00	12000.00
Aliphatics >C21-C35	TM414	µg/kg	1000	5.66E+10	1670.00	11400.00	3540.00	39500.00	<1000	26100.00	18100.00	6990.00	59600.00	30500.00	53600.00	14900.00	42800.00	2930.00	54100.00	84700.00	28300.00	8380.00	9920.00	7200.00	147000.00	48200.00	36000.00	84200.00	32200.00	47500.00
Aliphatics >C35-C44	TM414	µg/kg	1000	5.66E+10	<1000	<1000	<1000	5170.00	<1000	2890.00	4700.00	<1000	10200.00	7460.00	13400.00	4930.00	13600.00	<1000	5900.00	20400.00	20600.00	4790.00	<1000	<1000	44800.00	34700.00	25600.00	86900.00	7040.00	20700.00
Total Aliphatics >C10-C44	TM414	µg/kg	5000		<5000	23300.00	5100.00	64200.00	<5000	41200.00	33800.00	13400.00	77200.00	75000.00	84400.00	22800.00	68700.00	<5000	128000.00	182000.00	57400.00	15200.00	21000.00	11000.00	254000.00	158000.00	113000.00	189000.00	53300.00	82200.00
Total Aliphatics & Aromatics >C10-C44	TM414	µg/kg	10000		29700.00	75700.00	25000.00	111000.00	<10000	84200.00	80400.00	43200.00	93000.00	581000.00	146000.00	49000.00	98500.00	<10000	169000.00	234000.00	128000.00	42000.00	30300.00	48000.00	401000.00	370000.00	220000.00	327000.00	61500.00	112000.00
Aromatics >EC5-EC7	TM089	µg/kg	10	8510	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	17.60	<10	<10	<10
Aromatics >EC7-EC8	TM089	µg/kg	10	1.77E+05	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	11.00	15.10	<10	14.20	10.30	<10	<10	<10	<10	<10	<10	49.10	<10	<10	<10
Aromatics >EC8-EC10	TM089	µg/kg	10	1.44E+05	11.50	<10	<10	<10	<10	<10	<10	44.50	<10	<10	12.70	17.10	58.00	<10	48.40	38.80	<10	<10	<10	<10	<10	52.60	147.00	<10	<10	<10
Aromatics > EC10-EC12	TM414	µg/kg	1000	2.27E+05	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	1600.00	<1000	<1000	<1000	<1000	<1000	<1000	1190.00	<1000	<1000	<1000	2330.00	1960.00	2400.00	<1000	<1000	<1000
Aromatics > EC12-EC16	TM414	µg/kg	1000	4.51E+05	<1000	3460.00	<1000	3640.00	<1000	2750.00	3130.00	<1000	<1000	13900.00	1970.00	<1000	1490.00	<1000	4070.00	7590.00	3880.00	<1000	<1000	<1000	15200.00	17400.00	10200.00	3250.00	<1000	1900.00
Aromatics > EC16-EC21	TM414	µg/kg	1000	1.42E+06	6660.00	8690.00	8030.00	7600.00	<1000	8830.00	10500.00	3890.00	2430.00	134000.00	7020.00	6060.00	4560.00	<1000	10100.00	13000.00	15800.00	4560.00	3290.00	9300.00	21400.00	42900.00	12900.00	11700.00	1200.00	3320.00
Aromatics > EC21-EC35	TM414	µg/kg	1000	1.13E+07	18600.00	34200.00	10500.00	32400.00	<1000	29500.00	31300.00	21000.00	11700.00	317000.00	47900.00	17800.00	22500.00	<1000	23600.00	29000.00	44700.00	14900.00	4350.00	25600.00	104000.00	96200.00	42400.00	80100.00	5660.00	22100.00
Aromatics >EC35-EC44	TM414	µg/kg	1000	1.13E+07	1840.00	5470.00	<1000	2270.00	<1000	1670.00	<1000	3740.00	<1000	40000.00	4350.00	<1000	<1000	<1000	1980.00	2220.00	5230.00	6230.00	<1000	1100.00	3540.00	52900.00	39000.00	42500.00	<1000	2100.00
Aromatics > EC40-EC44	TM414	µg/kg	1000	1.13E+07	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	6880.00	<1000	<1000	<1000	<1000	<1000	<1000	1290.00	2600.00	<1000	<1000	<1000	13200.00	11300.00	19000.00	<1000	<1000
Total Aromatics > EC10-EC44	TM414	µg/kg	5000		27300.00	52300.00	19900.00	46300.00	<5000	43000.00	46700.00	29800.00	15800.00	506000.00	61600.00	26200.00	29800.00	<5000	40200.00	52300.00	70800.00	26800.00	9300.00	37000.00	147000.00	211000.00	107000.00	138000.00	8170.00	29700.00
Total Aliphatics & Aromatics >C5-C44	TM414	µg/kg	10000		27300.00	75700.00	25000.00	111000.00	<10000	84200.00	80400.00	43400.00	93000.00	581000.00	146000.00	49100.00	98800.00	<10000	169000.00	235000.00	128000.00	42000.00	30300.00	48000.00	401000.00	370000.00	220000.00	327000.00	61500.00	112000.00
Naphthalene-d8 % recovery**	TM218	%			79.90	98.80	79.20	102.00	81.70	79.30	78.50	77.00	98.90	86.40	79.00	93.10	96.80	83.90	91.90	81.10	74.60	87.00	99.50	85.20	90.70	84.40	91.40	81.20	82.80	85.50
Acenaphthene-d10 % recovery**	TM218	%			80.10	106.00	83.30	108.00	83.30	81.50	84.80	82.90	97.00	84.00	83.40	92.80	95.70	85.20	91.70	88.00	84.80	86.80	97.80	83.90	89.30	86.40	91.60	90.80	88.00	86.20
Phenanthrene-d10 % recovery**	TM218	%			80.60	104.00	83.60	90.60	83.90	83.20	82.80	81.90	97.80	86.50	87.20	97.70	98.20	91.10	91.80	95.00	81.60	89.70	91.60	87.40	89.40	85.00	91.30	82.00	93.00	100.00
Chrysene-d12 % recovery**	TM218	%			79.30	96.80	79.60	86.60	78.60	79.70	83.40	83.40	96.70	99.40	82.50	99.90	97.20	89.90	84.50	85.00	75.60	87.50	69.10	80.50	75.90	84.00	78.30	85.00	88.40	123.00
Perylene-d12 % recovery**	TM218	%			77.80	86.40	73.10	77.40	72.10	70.70	70.20	74.10	101.00	95.70	77.40	101.00	97.20	84.60	89.00	76.90	71.80	83.60	53.90	71.00	70.20	75.60	76.20	76.80	82.70	109.00
Naphthalene	TM218	µg/kg	9	2.70E+04	24.40	851.00	48.40	662.00	30.70	258.00	1150.00	780.00	282.00	944.00	321.00	724.00	322.00	26.10	472.00	263.00	632.00	113.00	166.00	68.80	1710.00	864.00	1900.00	<180	42.90	292.00
Acenaphthylene	TM218	µg/kg	12	1.67E+04	<12	267.00	22.20	200.00	15.70	97.20	567.00	459.00	98.60	904.00	209.00	314.00	178.00	<12	61.60	113.00	315.00	55.80	25.00	15.60	38.70	<240	56.40	<240	<12	82.30
Acenaphthene	TM218	µg/kg	8	3.00E+04	81.40	32.10	<8	<80	<8	23.60	45.10	<40	<8	86.40	64.10	58.60	38.30	<8	116.00	50.20	<160	<8	<8	<8	132.00	669.00	168.00	<160	11.00	12.20
Fluorene	TM218	µg/kg	10	2.70E+04	64.10	166.00	17.90	123.00	13.80	91.90	236.00	195.00	55.90	486.00	153.00	267.00	132.00	<10	138.00	167.00	326.00	46.00	48.10	21.50	152.00	<200	196.00	<200	24.10	42.40
Phenanthrene	TM218	µg/kg	15	2.70E+04	1270.00	1720.00	151.00	1150.00	92.40	644.00	2680.00	2090.00	1040.00	3550.00	1340.00	2260.00	1220.00	88.40	991.00	1130.00	2030.00	334.00	247.00	139.00	2140.00	10900.00	2670.00	1000.00	137.00	431.00
Anthracene	TM218	µg/kg	16	3.40E+04	206.00	373.00	38.90	241.00	20.10	149.00	872.00	565.00	234.00	1610.00	417.00	576.00	322.00	<16	235.00	282.00	683.00	107.00	55.50	25.80	311.00	1100.00	495.00	<320	25.00	93.30
Fluoranthene	TM218	µg/kg	17	6.64E+03	2010.00	2520.00	242.00	1450.00	132.00	820.00	5140.00	4030.00	1600.00	7750.00	2550.00	3590.00	2690.00	114.00	1240.00	1340.00	3150.00	484.00	187.00	125.00	1100.00	6420.00	1980.00	2480.00	126.00	503.00
Pyrene	TM218	µg/kg	15	7.60E+04	1660.00	1840.00	175.00	1100.00	91.70	614.00	3800.00	2920.00	1090.00	5700.00	2240.00	2600.00	2100.00	98.40	901.00	968.00	2370.00	342.00	166.00	105.00	750.00	4340.00	1370.00	2120.00	100.00	397.00
Benz(a)anthracene	TM218	µg/kg	14	6.07E+05	882.00	1300.00	118.00	686.00	56.50	506.00	2360.00	1810.00	652.00	5950.00	1660.00	1680.00	1880.00	73.50	572.00	529.00	1270.00	233.00	94.70	69.70	324.00	1470.00	791.00	1030.00	61.00	299.00
Chrysene	TM218	µg/kg	10	6.21E+05	841.00	1410.00	113.00	843.00	58.70	568.00	2140.00	1790.00	680.00	5360.00	1450.00	1580.00	1750.00	90.30	571.00	535.00	1300.00	237.00	141.00	85.00	382.00	1680.00	908.00	1330.00	79.50	375.00
Benzo(b)fluoranthene	TM218	µg/kg	15	3.42E+03	1160.00	2050.00	153.00	1030.00	59.70	705.00	3440.00	2620.00	617.00	8620.00	2220.00	2240.00	1960.00	130.00	810.00	692.00	1670.00	323.00	137.00	101.00	506.00	2270.00	1460.00	1630.00	81.90	553.00
Benzo(k)fluoranthene	TM218	µg/kg	14	5.05E+03	444.00	565.00	48.90	347.00	22.90	227.00	1170.00	775.00	293.00	2820.00	791.00	714.00	741.00	36.30	244.00	220.00	491.00	100.00	41.50	28.50	127.00	637.00	359.00	526.00	23.20	165.00
Benzo(a)pyrene	TM218	µg/kg	15	3.40E+04	799.00	985.00	81.80	534.00	39.10	397.00	1910.00	1440.00	505.00	4850.00	1510.00	1430.00	1710.00	63.60	485.00	386.00	938.00	178.00	66.30	53.60	277.00	1240.00	826.00	800.00	41.50	276.00
Indeno(1,2,3-cd)pyrene	TM218	µg/kg	18	2.50E+04	727.00	867.00	75.10	371.00	31.20	303.00	1840.00	1350.00	429.00	4020.00	1270.00	1130.00	1360.00	53.10	362.00	281.00	642.00	131.00	58.20	37.70	241.00	1130.00	813.00	601.00	30.90	294.00
Dibenzo(a,h)anthracene	TM218	µg/kg	23	8.38E+05	133.00	240.00	<23	<230	<23	87.30	379.00	268.00	79.30	972.00	303.00	247.00	295.00	<23	70.00	76.70	<460	29.70	<23	<23	51.20	<460	122.00	<460	<23	71.10
Benzo(g,h,i)perylene	TM218	µg/kg	24	1.30E+04	591.00	886.00	63.20	432.00	26.90	232.00	1410.00	1010.00	378.00	3390.00	1110.00	1010.00	1150.00	54.80	310.00	270.00	618.00	132.00	58.30	41.40	240.00	1210.00	716.00	618.00	33.30	305.00
PAH, Total Detected USEPA 16	TM218	µg/kg	118		10900.00	16100.00	1350.00	9150.00	692.00	5720.00	29200.00	22100.00	8040.00	57000.00	17600.00	20400.00	17800.00	828.00	7580.00	7300.00	16400.00	2840.00	1490.00	917.00	8470.00	33900.00	14800.00	12100.00	818.00	4190.00
Dibromofluoromethane**	TM116	%			152.00	105.00	107.00	113.00	108.00	105.00	104.00	99.80	106.00	104.00	106.00	102.00	107.00	107.00	107.00	106.00	110.00	105.00	104.00	105.00	116.00	112.00	104.00	109.00	102.00	106.00
Toluene-d8**	TM116	%			102.00	99.90	98.60	99.50	100.00	98.50	99.00	92.60	97.00	97.60	97.00	95.30	97.60	97.80	97.30	97.20	94.00	95.40	99.20	97.40	97.90	98.20	95.30	95.60	97.10	98.70
4-Bromofluorobenzene**	TM116	%			97.20	96.30	90.60	99.00	95.00	87.80	92.40	74.10	92.60	86.80	88.30	77.20	87.80	97.80	88.70	89.20	89.90	88.80	97.50	93.10	91.50	95.10	85.30	92.00	89.20	91.00
Methyl Tertiary Butyl Ether	TM116	µg/kg	10		<200	<2000	<200	<2000	<200	<200	<2000	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Benzene	TM116	µg/kg	9	3.80E+03	<180	<1800	<180	<1800	<180	<180	<1800	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180	<180
Toluene	TM116	µg/kg	7	1.28E+05	<140	<1400	<140	<1400	<140	<140	<1400	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140	<140
Ethylbenzene	TM116	µg/kg	4	8.00E+04	<80	<800	<80	<800	<80	<80	<800	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80
p/m-Xylene	TM116	µg/kg	10	7.40E+04	<200	<2000	<200	<2000	<200	<200	<2000	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
o-Xylene	TM116	µg/kg	10	7.40E+04	<200	<2000	<200	<2000	<200	<200	<2000	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Naphthalene	TM116	µg/kg	13	2.70E+04	<260	<2600	<260	<2600	<260	<260	<2600	<260	<260	<260	<260	290.00	<260	<260	373.00	<260	320.00	<260	<260	<260	<260	769.00	5880.00	<260	<260	<260
Sum of Detected Xylenes	TM116	mg/kg	0.02		<0.4	<4	<0.4	<4	<0.4	<0.4	<4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Sum of BTEX	TM116	µg/kg	40		<800	<8000	<800	<8000	<800	<800	<8000	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800

Appendix E – H F Consulting Soild Validation Strategy

H Fraser Consulting
Contaminated Land
and Hydrogeology

Glan Llyn: Soils validation strategy for protection of controlled waters

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Date: 17/12/2024

Status: FINAL

Reference: 30937 R2

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Prepared by: H Fraser Consulting Ltd

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Contaminated Land
and Hydrogeology

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Version	Author	Approved by	Issue date	Comment
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APPENDICES

Appendix A RTM modelling spreadsheet outputs (electronic)

Appendix B Example RTM spreadsheets (electronic)

1. BACKGROUND

Glan Llyn is a major residential and commercial development in Llanwern, South Wales, on the site of a former steelworks. Planning permission for the development includes planning conditions PC27 and PC28, which relate to the remediation strategy for the on-site soils and the validation of the remediation once achieved.

The initial risk assessment and remediation strategy report was produced by Atkins (2017) and this was subsequently updated by Rodgers Leask (2019-22), as described in Section 2. These documents have been accepted as satisfying PC27 for a number of development phases that are already completed or are currently being developed. Recent efforts to satisfy the requirements of PC28, which relate to the validation of the soil quality following remediation, for the protection of controlled waters, have been subject to considerable discussion with the regulator, NRW, and the planning authority, Newport City Council.

Recent meetings and discussion involving H Fraser Consulting Ltd (HFCL) resulted in agreement in principle on a revised approach to validation reporting, with regard to protection of controlled waters.

1.1 Objective

The objective of this report is to present the revised approach referred to above. This will provide a standard methodology and reference for all future phase validations and thus enable validation to proceed efficiently for all parties.

1.2 Scope of report

The report summarises the remediation work and validation at Glan Llyn to date (Section 2) and presents the updated approach and methodology (Section 3). Section 4 contains reference tables for contaminants of concern, to be applied to validation of soil quality in future validation reporting.

Additional planning conditions related to surface water are not part of the scope of this validation strategy.

This report considers only the elements of the remediation that relate to protection of controlled waters; elements of the remediation strategy that protect human health receptors (for example, placement of vapour membranes) are outside the scope of this report.

2 REMEDIATION WORKS AND VALIDATION TO DATE

2.1 Remediation strategy

The agreed remediation strategy and risk assessment for controlled waters at the site is detailed in Rodgers Leask (2019-22). The remediation strategy is briefly summarised here.

The remediation comprises excavation of Made Ground materials, removal of materials unsuitable for re-use in the development platform, and re-compaction of suitable Made Ground materials as an engineered fill. A drainage layer, formed as part of the normal construction phase, will then be installed above the engineered fill layer, to reduce infiltration to the Made Ground.

The Site has been divided into two strategies broadly responding to the division of the site between residential use and commercial use, referred to as the 'Full Turnover Specification' and the 'One Metre Turnover Specification'. The Full Turnover Specification comprises the excavation of Made Ground to a depth where the natural underlying Tidal Flat Deposits are exposed before a minimum of 2 m of suitable material is placed and reengineered. The One Meter Turnover Specification requires a trim and chase process excavating material to a depth minimum of 5.3 m aOD before approximately 2 m of suitable material is placed and reengineered to a formation level of 7.25 m aOD. Practical measures to identify, remove and validate the absence of gross contamination and known and potential obstructions extending below 5.3 m aOD shall be undertaken.

Several phases of trial pitting have been undertaken across the Site to assess and characterise the Made Ground for suitability for reuse. Material present within the proposed residential area that exceeds residential soil re-use values shall be transferred and re-used in the commercial phase of the development. Where material is not suitable for either a residential or commercial end use, the material will either be treated to allow re-use on site (at the supervising engineers discretion), or arrangements made for off-site disposal.

The remediation work and development are proceeding in phases as shown in Figure 2.1 for the residential area, and Figure 2.2 for the commercial area.

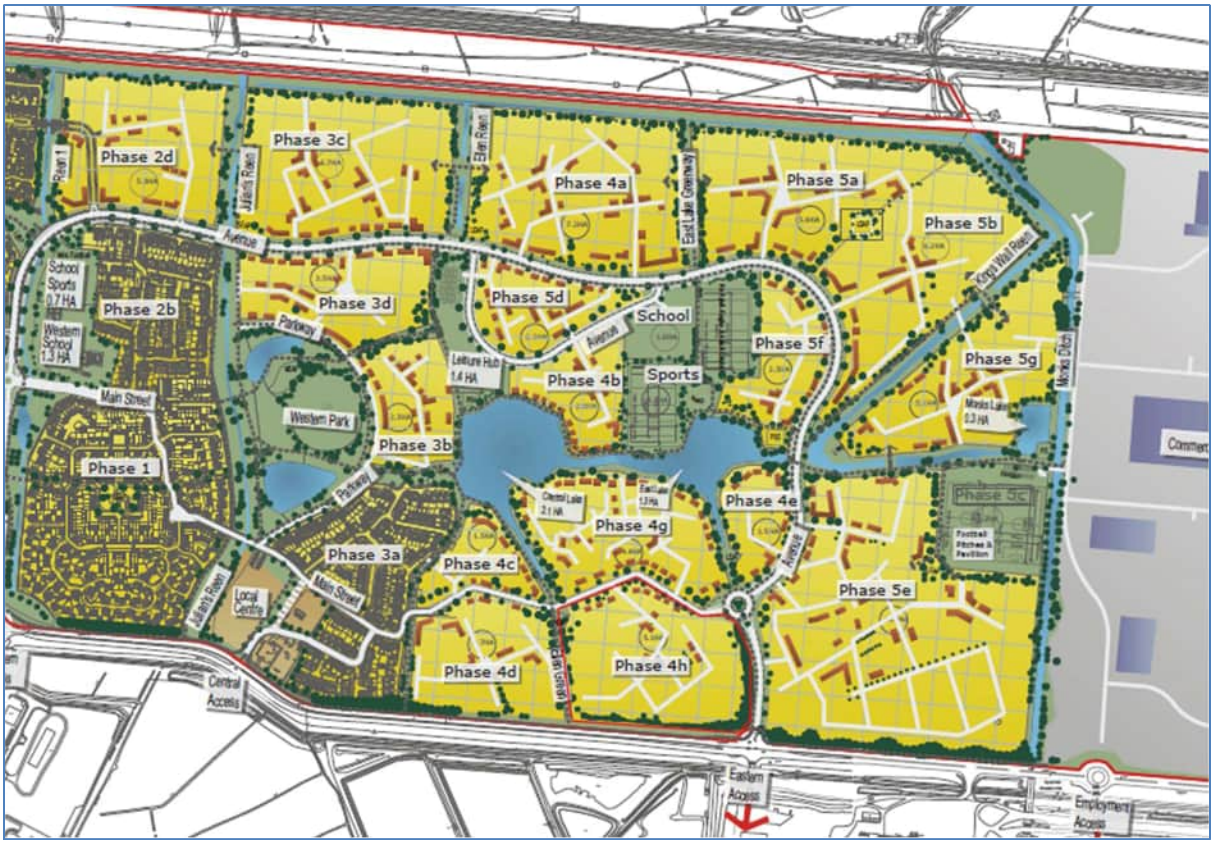
Phase 2d
Phase 3c
Phase 4a
Phase 5a
Phase 5b
Phase 2b
Phase 3d
Phase 5d
School
Phase 5f
Phase 5g
Phase 4b
Sports
Phase 3b
Phase 1
Phase 4e
Phase 5c
Phase 4g
Phase 3a
Phase 4c
Phase 5e
Phase 4h
Phase 4d
Avenue
Parkway
Main Street
Western Park
Julian's Reen
Elver Reen
East Lake Greenway
Kings Wall Reen
Monks Ditch
School Sports 0.7 HA
Western School 1.3 HA
Leisure Hub 1.4 HA
Central Lake 2.1 HA
Monks Lane 0.3 HA
Football Pitches & Pavilion
Local Centre
Central Access
Eastern Access
Employment Access

Figure 2.1 Residential phases

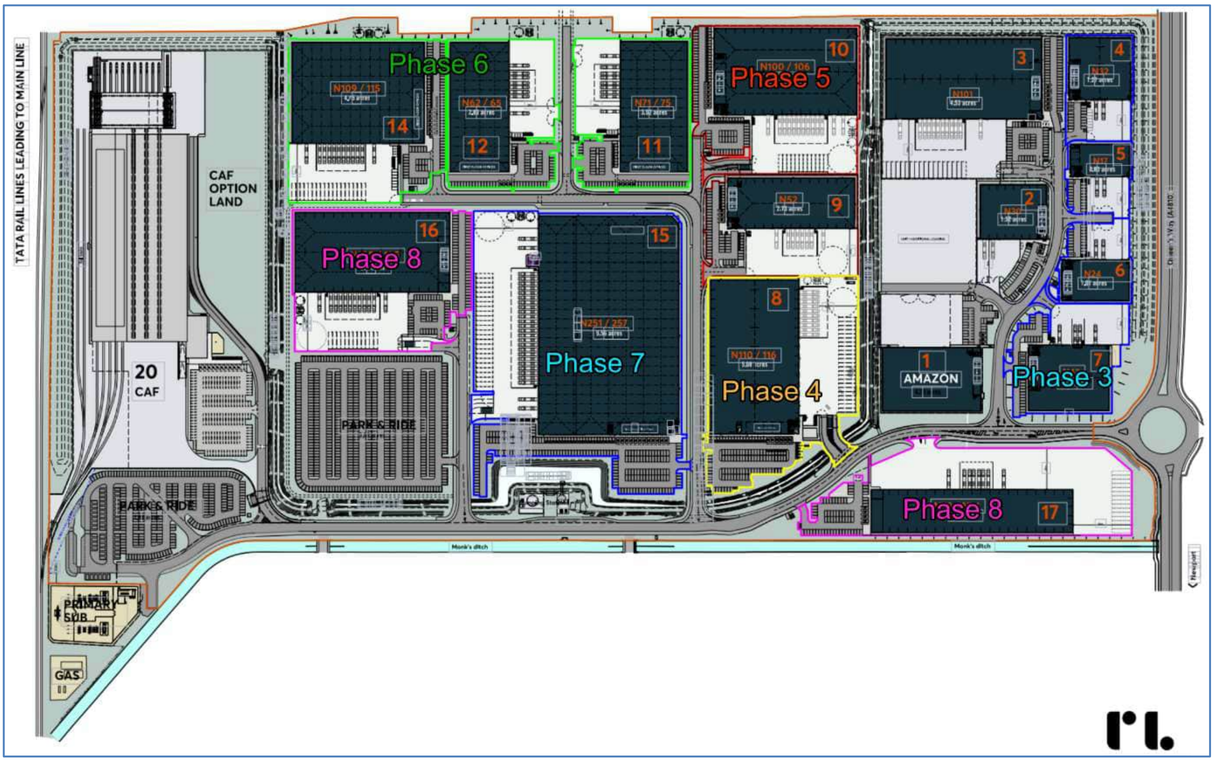
TATA RAIL LINES LEADING TO MAIN LINE
CAF OPTION LAND
20
CAF
PARK & RIDE
PRIMARY SUB
GAS
Phase 6
14
12
11
Phase 5
10
3
4
5
6
2
9
Phase 8
16
Phase 7
15
8
Phase 4
1
AMAZON
7
Phase 3
Phase 8
17
Monk's ditch
Newport

Figure 2.2 Commercial phases

Two planning conditions apply to the site remediation work.

- PC27 requires that, prior to commencement of each phase of development, a risk assessment, remediation strategy and verification plan are submitted to and approved in writing by the Local Authority.
- PC28 requires that prior to commencement of each phase of development (excluding works required for the remediation strategy) a verification report is submitted to and approved in writing by the Local Authority, to demonstrate completion of the remediation strategy and the effectiveness of the remediation.

The site is drained by a number of deep drainage ditches, referred to as reens. Soil re-use values (SRVs) for the protection of controlled waters were derived by Atkins and amended by Rodgers Leask, assuming the following conceptual model.

- 60% of the residential site surface and 95% of the commercial site surface is impermeable. 100% of incident rainfall on impermeable areas either evaporates or is routed via the drainage system directly to the reens.
- 40% of the residential site and 5% of the commercial site has soft landscaping. In these areas infiltration was calculated as 12.85 mm/a, by subtracting evapotranspiration and runoff from the total rainfall figure. Runoff from these areas also passes to the reens.
- 12.85 mm/a infiltrates the drainage layer overlying the engineered fill.
- In the soft landscaping areas, 60% of infiltration drains laterally through the drainage layer into a reen and does not enter the engineered fill.
- 40% of infiltration drains into the engineered fill and migrates through the fill to a reen, dissolving potential contaminants from the fill materials.
- The infiltration that travels through the fill is diluted on reaching the reens by runoff and infiltration through the drainage layer. The relative fluxes of water passing through the fill to clean runoff provides the dilution factor.
- SRVs are calculated by multiplying the Environmental Quality Standard (EQS) by the dilution factor and converting this water concentration into a soil concentration using a partition co-efficient.

This approach was set out originally by Atkins (2017), modified by Rogers Leask (2019-22) and approved by the Local Authority under discharge of PC27 for a number of development phases. The commercial area and the residential area have different remedial targets due to the different ratio of soft landscaping to hardstanding.

Soils re-use values (SRVs) were set out in Rogers Leask (2019-22). A minor update to correct an error in calculation for the residential area was provided by HFCL (2024). The SRVs are reproduced here in Table 2.1.

Table 2.1 Agreed soil re-use values (SRVs)

Determinand	Soil re-use values (mg/kg)	
	Commercial area	Residential area[1]
Inorganic Metals and Metalloids		
Arsenic	1.15E+4	2533
Cadmium	331	73.0
Chromium	4.27E+4	9431
Copper	2042	451
Iron	1.38E+6	3.05E+5
Lead	7.12E+4	1.57E+4
Manganese	1.51E+5	3.33E+4
Mercury	596	132
Nickel	5.21E+4	1.15E+4
Selenium	3178	702
Vanadium	7271	1606
Zinc	6.23E+5	1.38E+5
Other Inorganics		
Ammoniacal Nitrogen	699	154
Cyanide	9.14	2.02
Organics		
Benzene	17.2	3.80
Toluene	582	128
Ethylbenzene	364	80.0
Xylene	336	74.0
Phenol	13.8	3.05
TPH Criteria Working Group		
Aliphatics >C5-C6	331	73.0
Aliphatics >C6-C8	1626	359
Aliphatics >C8-C10	1.29E+4	2841
Aliphatics >C10-C12	1.02E+5	2.25E+4
Aliphatics >C12-C16	2.04E+6	4.50E+5
Aliphatics >C16-C21	2.56E+8	5.66E+7
Aliphatics >C21-C35	2.56E+8	5.66E+7
Aliphatics >C35-C44	2.56E+8	5.66E+7
Aromatics >EC5-EC7	38.5	8.51
Aromatics >EC7-EC8	802	177
Aromatics >EC8-EC10	650	144
Aromatics >EC10-EC12	1027	227
Aromatics >EC12-EC16	2043	451
Aromatics >EC16-EC21	6447	1424
Aromatics >EC21-EC35	5.12E+4	1.13E+4
Aromatics >EC35-EC44	5.12E+4	1.13E+4
Aromatics >EC40-EC44	5.12E+4	1.13E+4
Polyaromatic Hydrocarbons		
Acenaphthylene	75.7	16.7

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[1] Updated per H Fraser Consulting 2024; *30937 TN1D1 Glan Llyn, Llanwern: Soil Quality Verification*

Determinand	Soil re-use values (mg/kg)	
	Commercial area	Residential area[1]
Acenaphthene	135	30.0
Anthracene	155	34.0
Benz(a)anthracene	2748	607
Benzo(a)pyrene	156	34.0
Benzo(b)fluoranthene	15.5	3.42
Benzo(k)fluoranthene	22.9	5.05
Benzo(g,h,i)perylene	60.2	13.0
Chrysene	2812	621
Dibenzo(a,h)anthracene	3793	838
Indeno(1,2,3-cd)pyrene	115	25.0
Fluoranthene	30.1	6.64
Fluorene	123	27.0
Naphthalene	124	27.0
Phenanthrene	123	27.0
Pyrene	346	76.0

2.2 Remediation

Remediation has taken place in phases as shown in Figure 2.1 (residential) and Figure 2.2 (commercial). As of October 2024, remediation has been completed across the majority of the site. Remediation has been validated and approved for Phases 1 to 3 of the residential development and Phases 1 to 3 of the commercial development. These phases were remediated and validated under the site model, risk assessment and remediation strategy developed by Atkins (2017), and therefore had different validation requirements to Phase 4 onwards.

The remediation and verification work on each of the phases includes the following:

- Complete excavation of Made Ground materials to the underlying Tidal Flat Deposits in the residential areas and to a depth minimum of 5.3 m aOD in the commercial area;
- Screening and stockpiling of the excavated material;
- Sampling of stockpile materials;
- Removal of material unsuitable for use;
- Subdivision of the site into backfill zones, generally in a 25x25 m grid;
- Placement of engineered fill in 300 mm layers, zone by zone;
- Sampling of surface materials, post-placement, to provide additional verification data.

As noted in Section 2.1, material originating from the site that was unsuitable for use in the residential area was to be re-used on the commercial area (where agreed SRVs are higher) or, if necessary, removed from site. In practice, all excavated material was stockpiled and tested, and the above criterion applied. That is, if testing of stockpiled material showed it to be unsuitable for residential area backfill, it was moved to the commercial area or removed from the site, in accordance with the stipulations of the remediation strategy (Rodgers Leask, 2019-22).

Table 2.2 shows a summary of where each phase is in the remediation and verification process. Table 2.2 also indicates whether the planning conditions for each phase have been discharged, and whether this was in accordance with the Atkins remediation strategy (RS) or the Rogers Leask RS. Note that part of the residential area that was formerly a coking works has been remediated by

Vertase FLI Ltd (Vertase); HFCL has not reviewed the remediation strategy or soil re-use values for this part of the site. The coking works area includes parts of Phases 4A, 4B, 5A and 5D, as well as the proposed school.

Table 2.2 Summary of phase progress

Phase	Remediation works complete	Discharge of planning conditions *	
		PC27	PC28
Residential			
Phase 1	Yes	Atkins RS	Atkins RS
Phase 2	Yes	Atkins RS	Atkins RS
Phase 3	Yes	Atkins RS	Atkins RS
Coking works	Yes	Vertase	Pending
Phase 4A (compound)	Yes	RL RS / Vertase	Pending
Phase 4B	Yes	Pending	Pending
Phase 4C	Yes	RL RS	Pending
Phase 4D	Yes	RL RS, parts 1 and 2	Pending
Phase 4E	Yes	Pending	Pending
Phase 4G	Yes	Pending	Pending
Phase 4H	Yes	RL RS	Pending
Phase 5A	Yes	Pending	Pending
Phase 5B	Yes	Pending	Pending
Phase 5G	Yes	Pending	Pending
Phase 5D	Yes	Pending	Pending
Phase 5E1	Yes	RL RS	Pending
Phase 5E2	Yes	Pending	Pending
Phase 5F	Ongoing	Pending	Pending
Commercial			
Phase 1 (Amazon)	Yes	Atkins RS	Atkins RS
Phase 2 (CAF)	Yes	Atkins RS	Atkins RS
Phase 3 (Units 4-7)	Yes	Atkins RS	Atkins RS
Phase 4 (Unit 8)	Yes	RL RS	Pending
Phase 5 (Units 9-10)	Yes	RL RS	Pending
Phase 6a (Units 11-14)	Yes	RL RS	Pending
Phase 6b (Units 15 and 16)	Yes	RL RS	Pending
Phase 7 (Park and Ride)	Yes	RL RS	Pending
Phase 8 (Unit 17)	Ongoing	Pending	Pending

* “Pending” indicates that the application has not yet been made.

2.3 Soil testing and validation

Soil samples are taken from each stockpile and sent to an accredited laboratory for analysis of the soil re-use determinands as listed in Table 2.1. An average soil concentration is then obtained for each stockpile. During the placement of the engineering fill each 300 mm layer is taken from a specific stockpile. Each stockpile may be used for multiple layers in one backfill zone, or across multiple zones. Rogers Leask maintains a materials management database, so that there is a record of the soil analytical results for each stockpile and which stockpile was used for each layer in each backfill zone. A variable number of layers is laid down in each zone to achieve the desired ground surface level.

Surface verification samples may be taken upon completion of the engineered fill placement, principally for validation of human health criteria rather than controlled waters.

All samples are sent to an accredited laboratory for analysis of the determinands listed in Table 2.1. It is assumed the surface verification samples are representative of the top 100 mm of soil, since they are taken using a trowel.

Hundreds of soil samples are relevant to each backfill zone, and these can be taken as a group to represent the quality of soils used in the remediation.

A database of all the soil analytical results for each phase is developed. This includes all the surface verification samples taken across the phase, and all soil samples from any stockpiles used in the engineered fill. The 95%ile of all the analytical results is compared to the soil re-use values. Any determinands where the 95%ile exceeds the SRV is taken forward as a Contaminant of Concern (CoC) for that phase.

2.4 Issues arising

During the remediation verification for Phase 4H (residential) and Phases 4 and 5 (Units 8-10, commercial) exceedances of the SRVs were identified for certain parameters in specific areas of backfill during the verification process. It was therefore not possible to validate the remediation in those cases. An updated approach was consequently developed which combined a more detailed statistical analysis and enhanced data presentation, supplemented where needed by contaminant transport modelling. Where data presentation was unable to show that a contaminant presented no risk, modelling was applied to predict the concentration that would reach the surface water receptors. This updated approach allows for advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway.

The approach was agreed with NRW for Phase 4H and Units 8-10. This report sets out a streamlined approach to applying the same methodology, which involves the derivation of zoned reference values for all identified contaminants of concern across the site. This updated methodology, which will be applied to verification of future phases, is described in detail in Section 3.

As long as a sufficient number of robust sample analyses is available to represent the backfill material in each phase, the updated approach can be used to provide appropriate validation against the agreed soil criteria, without the need for additional consideration of subsurface water quality within the fill.

The updated SRVs derived by Rodgers Leask depend on the existence of a drainage layer above the fill. The drainage layer needs to be composed of appropriate granular material and evidence of its installation layer will form part of the requirement for the discharge of PC28.

3 UPDATED APPROACH AND METHODOLOGY

The following methodology is recommended for the future phases going forward. This methodology has been developed following discussion with NRW and agreement on the principles to be followed. An overview of the process is given here first, with further clarification of each stage in the following sub-sections.

Distance-specific reference values have been derived using Remedial Targets Methodology spreadsheets (RTM, see Environment Agency, 2006) to model the attenuation of contaminants during transport in the saturated zone. This allows for advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway. Reference values have been tabulated for three different travel distances to the compliance point. Comparison of reference values against measured soil concentrations can then determine whether contaminants are expected to reach the receptors at unacceptable concentrations. Full details of the derivation of the reference tables are provided in Sections 3.1 to 3.3.

For each development phase, a screening exercise will be carried out on all the contaminants of concern identified in the site-wide RL Remediation Strategy, as described in Section 3.4. Contaminants of Concern (CoCs) for that phase will be defined as determinands for which the 95%ile of the analytical results from the fill materials exceeded the SRV. (This maintains consistency with previous validation reporting.) The remaining CoCs will then be moved forward for further assessment.

In this further assessment a thorough statistical and spatial analysis will be carried out on the stockpile verification samples for these contaminants. This will include a calculation of the Upper Confidence Limit of the mean (UCLmean) for each backfill zone across the Phase (see Section 3.4). The UCLmean for each backfill area will then be compared to the tabulated reference values.

3.1 Development of reference tables

The agreed SRVs (Rodgers Leask, 2019-22) were calculated assuming that water infiltrates the engineered fill and travels to a reen, where it is then diluted in the volume of runoff across the site. The calculation only allows for dilution in the reen and does not allow for transport processes such as advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway. The site drainage strategy (Rodgers Leask, 2017) requires that a minimum depth of 300 mm of water always remains in the reens. This serves various purposes including dilution of groundwater from the Made Ground.

New reference values have now been derived using RTM spreadsheets to model the attenuation of contaminants during transport in the saturated zone. This allows for advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway.

Generic modelling reference tables are developed, so that modelling is not required for each individual phase. Instead, the concentration for each CoC in each backfill zone can be checked against the reference tables. Reference values in the tables are given for three specific distances (12.5 m, 37.5 m and 62.5 m)[2].

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[2] 12.5 m was selected because it represents the half of the distance across a standard remediation grid square. Grid squares measure 25 m square and were used across most of the Glan Llyn site as backfill zones. 37.5 m represents the distance across one and a half grid squares, i.e. the travel distance from a backfill zone that is one removed from the

The RTM has been used to assess the attenuation of contaminant concentrations through the engineered fill. To do this a 'Level 3' groundwater assessment has been undertaken as follows.

- The target concentration at the compliance point is taken to be the pore water concentration in equilibrium with the previously calculated SRV (Table 2.1). This is representative of the groundwater concentration before dilution at the point of discharge into the reen.
- The source area has been taken as the area of a standard backfill zone (25 m by 25 m).
- A time period of 1,000 years has been used.[3]
- The reference value is calculated as the target soil concentration in equilibrium with the groundwater remedial target taken from the RTM Level 3 groundwater assessment.

Equivalent pore water concentrations for a given soil concentration, and vice versa, are calculated using the equation below.

$$C_p = \frac{C_s}{\left(K_d + \frac{\theta_w + \theta_a H}{\rho}\right)}$$

Where:

C_s = soil concentration (mg/kg)
C_p = pore water concentration (mg/l)
K_d = soil-water partition coefficient (l/kg)
θ_w = water-filled soil porosity (fraction)
θ_a = air-filled soil porosity (fraction)
ρ = bulk density (g/cm^3)
H = Henry's Law constant (dimensionless)

3.2 Input parameters

The model input parameters are shown in Table 3.1 (general parameters) and Table 3.2 (contaminant-specific input parameters). The models were run with no degradation in the sorbed phase (i.e. degradation was only allowed in the dissolved phase), which is a conservative approach.

When considering contaminant degradation, a range of values is usually provided by reference books, dependent on conditions such as the redox state of the environment. In these cases we conservatively assumed the longest given half-life, which usually corresponds to anaerobic conditions.

In general, model input parameters were based on those adopted by Atkins in the earliest derivation of soil re-use values, to provide consistency with previous approaches.

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reen. 62.5 m represents the distance across 2 and a half grid squares, i.e. the travel distance from a backfill zone that is two removed from the reen.

[3] One thousand years is considered to represent a reasonably conservative time scale for any impacts to become apparent, and to allow a proportionate approach to contaminants that sorb to the extent that travel times are very long, in accordance with section 5.5 of the Remedial Targets Methodology (Environment Agency, 2006).

Table 3.1 General model parameters

Input parameters	symbol	value	Unit	Source
Plume thickness at source	Sy	1.98	m	Table 2-2 Atkins
Saturated aquifer thickness	da	2.1	m	Table 2-2 Atkins
Bulk density of aquifer materials	r	1.36	g/cm^3	Table 5-3 Atkins
Effective porosity of aquifer	n	0.08	fraction	Table 5.3.1 RL Remediation strategy
Water filled porosity	θ_w	0.5	fraction	Table 5-3 Atkins
Air filled porosity	θ_a	0.0037	fraction	Table 5-3 Atkins
Hydraulic gradient	i	0.0133	fraction	Table 5.3.1 RL Remediation strategy
Hydraulic conductivity of aquifer	K	1.00E-06	m/s	Hydraulic conductivity data given in RL, 2024[4]
Width of plume	S_z	25	m	Size of backfill zone
Distance to compliance point	x	12.5 37.5 62.5	m	
Time since pollutant entered groundwater	t	365,000	days	1,000 years

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[4] Rodgers Leask, 2024, Phase 4H, Glan Llyn, Newport, Chemical Validation Report draft. Similar values have been reported from Phase 4A compound and Units 8-10 in the Commercial area.

Table 3.2 Contaminant-specific model parameters

Determinand	Commercial RL Soil re-use criteria[1]	Residential RL Soil re-use criteria[2]	Henry's Law Constant (H)[3]	Soil Organic Carbon-Water Partitioning Coefficient (koc)[3]	Solid/Liquid Partition Coefficient (Kd)[3]	Half life[4]	Commercial Compliance Target	Residential Compliance Target
Units	mg/kg	mg/kg	(cm^3/cm^3)	(-)	l/kg	Days	mg/l	mg/l
Inorganic Metals and Metalloids								
Arsenic	11,469	2,533	1	-	134	1.00E+99	85.352	18.851
Cadmium	331	73	1	-	776	1.00E+99	0.426	0.094
Chromium	42,699	9,431	1	-	5,336	1.00E+99	8.002	1.767
Copper	2,042	451	1	-	1,199	1.00E+99	1.703	0.376
Iron	1,379,516	304,690	1	-	810	1.00E+99	1,702.328	375.989
Lead	71,246	15,736	1	-	34,877	1.00E+99	2.043	0.451
Manganese	150,836	33,315	1	-	720	1.00E+99	209.386	46.247
Mercury	596	132	1	-	5,000	1.00E+99	0.119	0.026
Nickel	52,109	11,509	1	-	7,652	1.00E+99	6.810	1.504
Selenium	3,178	702	1	-	186	1.00E+99	17.051	3.767
Vanadium	7,271	1,606	1	-	213	1.00E+99	34.076	7.527
Zinc	622,690	137,532	1	-	33,558	1.00E+99	18.555	4.098
Other Inorganics								
Ammoniacal Nitrogen	699	154	1	-	1	1,095 [5]	510.284	112.379
Cyanide	9	2	1	-	5	15 [6]	1.702	0.372
Organics								
Benzene	17	4	0.182	27	1	720	17.081	3.769
Toluene	582	128	0.221	178	4	28	125.920	27.716
Ethylbenzene	364	80	0.300	432	10	228	34.051	7.492
Xylene	336	74	0.220	260	6	365	51.113	11.27

Determinand	Commercial RL Soil re-use criteria[1]	Residential RL Soil re-use criteria[2]	Henry's Law Constant (H)[3]	Soil Organic Carbon-Water Partitioning Coefficient (koc)[3]	Solid/Liquid Partition Coefficient (Kd)[3]	Half life[4]	Commercial Compliance Target	Residential Compliance Target
Units	**mg/kg**	**mg/kg**	**(cm^3/cm^3)**	**(-)**	**l/kg**	**Days**	**mg/l**	**mg/l**
Phenol	14	3	0.000068	29	1	28	13.063	2.836
TPH Criteria Working Group								
TPH Aliphatic C5-C6	331	73	33	794	19	8	16.989	3.752
TPH Aliphatic C6-C8	1,626	359	50	3,981	95	8	17.029	3.759
TPH Aliphatic C8-C10	12,861	2,841	80	31,623	755	8	17.021	3.760
TPH Aliphatic C10-C12	102,089	22,548	120	25,1189	5,996	365	17.024	3.760
TPH Aliphatic C12-C16	2,036,743	449,851	520	501,1872	119,643	730	17.023	3.760
TPH Aliphatic C16-C21	256,407,138	56,632,055	4,900	630,957,344	15,062,116	1.00E+99	17.023	3.760
TPH Aliphatic C21-C35	256,407,138	56,632,055	4,900	630,957,344	15,062,116	1.00E+99	17.023	3.760
TPH Aliphatic C35-C44	256,407,138	56,632,055	4,900	630,957,344	15,062,116	1.00E+99	17.023	3.760
TPH Aromatic C5-C7	39	9	0.230	79	2	730	16.269	3.589
TPH Aromatic C7-C8	802	177	0.270	251	6	28	125.878	27.79
TPH Aromatic C8-C10	650	144	0.480	1,585	38	365	16.949	3.753
TPH Aromatic C10-C12	1,027	227	0.140	2,512	60	258	17.013	3.760
TPH Aromatic C12-C16	2,043	451	0.0500	5,012	120	800	16.973	3.747
TPH Aromatic C16-C21	6,447	1,424	0.0100	15,849	378	120	17.039	3.764
TPH Aromatic C21-C35	51,166	11,301	0.000670	125,893	3,005	1,059	17.025	3.760
TPH Aromatic C35-C44	51,166	11,301	0.000670	125,893	3,005	1.00E+99	17.025	3.760
TPH Aromatic C40-C44	51,166	11,301	0.000670	125,893	3,005	1.00E+99	17.025	3.760
Polyaromatic Hydrocarbons								
Acenaphthene	76	17	0.00490	18,621	445	204	0.170	0.0375

Determinand	Commercial RL Soil re-use criteria[1]	Residential RL Soil re-use criteria[2]	Henry's Law Constant (H)[3]	Soil Organic Carbon-Water Partitioning Coefficient (koc)[3]	Solid/Liquid Partition Coefficient (Kd)[3]	Half life[4]	Commercial Compliance Target	Residential Compliance Target
Units	mg/kg	mg/kg	(cm^3/cm^3)	(-)	l/kg	Days	mg/l	mg/l
Acenaphthylene	135	30	0.00340	33,113	791	120	0.170	0.0379
Anthracene	155	34	0.00160	38,019	908	920	0.170	0.0374
Benzo(a)anthracene	2,748	607	0.000240	676,083	16,139	1,360	0.170	0.0376
Benzo(a)pyrene	156	34	0.0000190	426,580	10,183	2,120	0.0153	0.00334
Benzo(b)fluoranthene	15	3	0.000200	2,238,721	53,442	1,219	0.000289	0.0000636
Benzo(k)fluoranthene	23	5	0.0000340	3,311,311	79,047	4,280	0.000289	0.0000645
Benzo(g,h,i)perylene	60	13	0.0000300	8,709,636	207,915	1,300	0.000289	0.0000625
Chrysene	2,812	621	0.0000260	691,831	16,515	2,000	0.170	0.0376
Dibenz(a,h)anthracene	3,793	838	0.000000600	933,254	22,279	1,880	0.170	0.0376
Indeno(1,2,3-cd)pyrene	115	25	0.0000660	16,595,869	396,174	1,460	0.000289	0.0000631
Fluoranthene	30	7	0.000420	117,490	2,805	880	0.0107	0.00235
Fluorene	123	27	0.00320	30,200	721	120	0.170	0.0374
Naphthalene	124	27	0.0170	1,514	36	258	3.417	0.742
Phenanthrene	123	27	0.00130	30,200	721	402	0.170	0.0374
Pyrene	346	76	0.000370	85,114	2,032	3,796	0.170	0.0374

[1] Rodgers Leask (2019-22); [2] H Fraser Consulting (2024); [3] Rodgers Leask (2019-22), Appendix; [4] Howard et al. (1991); [5] Buss et al. (2004); [6] WFD UK Technical Advisory Group

3.3 Results

The RTM spreadsheet model can be applied to one contaminant and one transport distance at a time. With 59 contaminants and three distances, and different SRVs for the residential and commercial sites, the total number of models that were required for this report is therefore 354. The resulting reference values are given in Section 4. Appendix A provides the summarised outputs of the RTM assessments in more detail.

In both Section 4 and Appendix A, for each contaminant the remedial soil target is given at a distance of 12.5 m, 37.5 m, and 62.5 m from the compliance point. Two reference tables have been produced, one for the commercial site, and one for the residential site.

Some examples of the RTM spreadsheet calculations are provided electronically in Appendix B.

3.4 Statistical methodology

A summary of the general statistical methods referred to in the methodology is given here.

Box plots and histograms are used to present the range of data visually. Box plots show the minimum value of the data set, the range of data falling between the 25th and 75th percentile, the mean value and the maximum value. They are useful to visually assess whether the data points are evenly distributed throughout the range. Histograms show the data distributed by the number of data points within specific ranges and are useful for identifying the distribution of data across the range, and for identifying whether higher values are common or rare in the data set.

The 95th percentile of a dataset is the highest value in a set of data after removing the top 5% of values. Referred to in this report as the “95%ile”.

For any data set, there is uncertainty associated with the estimate of the mean value; a conservative assessment of the mean value can be made by calculating a 95 % Upper Confidence Limit (UCL) in the mean. This will be done using Student’s t-distribution method, which is appropriate for distributions with a small number of samples. The 95% upper confidence limit (UCL) is a probability statement that indicates a 95% confidence that the true population mean is less than or equal to the calculated UCL. This report refers to the 95% upper confidence limit in the mean value as “UCLmean”.

For each 25x25 m backfill zone the UCLmean will be calculated by taking the average stockpile value for each 300 mm layer, and the average of any surface verification samples (taken from the top 100 mm) falling within that backfill zone. An overall weighted average and UCLmean will then be calculated for that whole soil profile in each backfill zone, with the layer and surface verification samples weighted by thickness (300 mm for each layer and 100 mm for the surface verification samples).

3.5 Summary of the approach

Generic modelling reference tables are developed in the next section, so that modelling is not required for each individual phase – rather the recorded values for each CoC can be checked against the reference tables.

Reference values in the tables are given for specific distances.

For each of the remaining site phases the following methodology will be implemented.

1. The 95%ile of all analytical results across the entire phase area (including stockpile and surface verification samples) will be calculated for all contaminants identified in the site-wide Remediation Strategy. These contaminants are as listed in Table 2.1.
2. The 95%ile value will be screened against the SRVs (Table 2.1). Any exceedances will be shortlisted as Contaminants of Concern (CoCs) for this phase and further assessment will be carried out.
3. Some CoCs are shown by the reference tables to have such slow travel times that they will not travel 12.5 m in the 1,000-year assessment period. These are marked "no impact" in the reference tables and they will be eliminated from the CoC shortlist.
4. For each remaining shortlisted CoC a thorough statistical and spatial analysis will be carried out. This will include the following:
    - Presentation of the entire data set as a box plot;
    - Presentation of the entire data set as a histogram; and
    - Spatial assessment of the data, with an average concentration and UCLmean concentration calculated for each 25x25 m backfill zone.
5. The UCLmean concentration for each 25x25 m backfill zone will be compared to the 12.5 m reference values. If any of the backfill zones exceed the reference values for 12.5 m, the UCLmean will be compared to the 37.5 m and the 62.5 m reference values tables as appropriate given the distance of the backfill zone from the nearest reen.

Table 4.1 and Table 4.2 in the following section set out the reference values for the residential and commercial parts of the site respectively. If any backfill zones are found to fail the relevant reference value checks, contingency actions will be required, as discussed in Section 3.6.

3.6 Contingency actions

Failure of backfilled soils to meet the appropriate reference values will require additional contingency action. Any such eventualities would need to be agreed on a case-by-case basis, since the appropriate actions may be different in each case.

The first contingency action would therefore be for the site owner to propose and for NRW to agree the appropriate work, given the specific circumstances of the failure. Appropriate works are likely to include one or more from the following list:

- further monitoring actions and additional soils testing to more closely define the soils in question;
- isolation of a volume of soils deemed to have failed the criteria;
- excavation and replacement of soils deemed to have failed the criteria; and
- installation of flow barriers (such as low permeability clays) to appropriately lengthen the flow pathway from such a source area to the reen system.

3.7 Validation of drainage layer

The Rogers Leask SRVs (and hence the new reference values in this report) were derived assuming that 60% of infiltration is intercepted by a drainage layer above the engineered fill. It is therefore important that the presence of a drainage layer comprising clean granular material (e.g. 6F5 or Type 1) is evidenced as follows:

- Materials import receipts including description of the materials
- Photographic evidence of the extent of the materials (e.g. aerial photographs)
- Photographic evidence of the type and depth of the materials on a 75 m x 75 m grid

The sequencing of site works is such that the drainage layer will be placed post-commencement of construction works, and will therefore need to be validated separately from the engineered fill materials.

3.8 Validation of hydraulic conductivity

The Rogers Leask SRVs assume that there is a sufficient contrast between the hydraulic conductivity of the drainage layer (high) and the engineered fill (low) that most of the infiltration travels laterally through the drainage layer. The calculations do not however specify a value for hydraulic conductivity. The reference values derived in this report assume a hydraulic conductivity of 1×10^{-6} m/d or less for the engineered fill.

It is proposed that the hydraulic conductivity of the fill is validated by taking at least three hydraulic conductivity measurements per phase, with a guide density of one test per 6.25 ha.

3.9 Groundwater sampling

Provided that there are sufficient soil samples available to have confidence in the quality of the soils materials, it is not considered necessary to provide groundwater sampling data to support discharge of PC28. [5]

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[5] Note that groundwater monitoring may be required to support an application to discharge PC29, or to support an application for an environmental permit to discharge water from the reens to the wider environment. However, that is outside the scope of this report and will be dealt with separately.

4 REFERENCE TABLES FOR CONTAMINANTS OF CONCERN

In these tables the reference values shown are for comparison with UCLMean calculated soil concentrations in backfill zones at Glan Llyn.

Where a cell shows "No impact", the RTM spreadsheet predicts that the contaminant will not travel the indicated distance within the modelled time frame. (Where this occurs it results from a combination of the slow groundwater velocity, the degradation of the contaminant and its retardation (sorption) within the fill material.)

Other cell values show the remedial target for soil, calculated by the spreadsheet to meet the agreed soil reuse value at the reen margin. Where a cell shows ">1E+06" this means that the remedial target calculated is greater than 10^6 mg/kg, which cannot plausibly be reached.

4.1 Residential

Table 4.1 Residential phase reference tables, by distance from reen

Contaminant	Remedial Target (Residential) mg/kg		
	12.5 m	37.5 m	62.5 m
Metals and metalloids			
Arsenic	>1E+06	No impact	No impact
Cadmium	No impact	No impact	No impact
Chromium	No impact	No impact	No impact
Copper	No impact	No impact	No impact
Iron	No impact	No impact	No impact
Lead	No impact	No impact	No impact
Manganese	No impact	No impact	No impact
Mercury	No impact	No impact	No impact
Nickel	No impact	No impact	No impact
Selenium	>1E+06	No impact	No impact
Vanadium	No impact	No impact	No impact
Zinc	No impact	No impact	No impact
Other inorganics			
Ammoniacal Nitrogen	260.0	872.3	3,322
Cyanide	>1E+06	>1E+06	>1E+06
Organics			
Benzene	8.271	40.68	207.7
Ethylbenzene	703.5	20,947	466,939
Phenol	109,647	>1E+06	>1E+06
Toluene	>1E+06	>1E+06	>1E+06
Xylene	313.7	3,777	38,464
Petroleum hydrocarbons			
TPH Aliphatic C5-C6	>1E+06	>1E+06	>1E+06
TPH Aliphatic C6-C8	>1E+06	>1E+06	>1E+06
TPH Aliphatic C8-C10	No impact	No impact	No impact
TPH Aliphatic C10-C12	No impact	No impact	No impact
TPH Aliphatic C12-C16	No impact	No impact	No impact
TPH Aliphatic C16-C21	No impact	No impact	No impact
TPH Aliphatic C21-C35	No impact	No impact	No impact

Contaminant	Remedial Target (Residential) mg/kg		
	12.5 m	37.5 m	62.5 m
TPH Aliphatic C35-C44	No impact	No impact	No impact
TPH Aromatic C5-C7	18.32	88.80	448.6
TPH Aromatic C7-C8	>1E+06	>1E+06	>1E+06
TPH Aromatic C8-C10	1,558	>1E+06	>1E+06
TPH Aromatic C10-C12	17,730	>1E+06	No impact
TPH Aromatic C12-C16	>1E+06	No impact	No impact
TPH Aromatic C16-C21	No impact	No impact	No impact
TPH Aromatic C21-C35	No impact	No impact	No impact
TPH Aromatic C35-C44	No impact	No impact	No impact
TPH Aromatic C40-C44	No impact	No impact	No impact
Polyaromatic hydrocarbons			
Acenaphthene	No impact	No impact	No impact
Acenaphthylene	No impact	No impact	No impact
Anthracene	No impact	No impact	No impact
Benzo(a)anthracene	No impact	No impact	No impact
Benzo(a)pyrene	No impact	No impact	No impact
Benzo(b)fluoranthene	No impact	No impact	No impact
Benzo(g,h,i)perylene	No impact	No impact	No impact
Benzo(k)fluoranthene	No impact	No impact	No impact
Chrysene	No impact	No impact	No impact
Di-benz(a,h)anthracene	No impact	No impact	No impact
Fluoranthene	No impact	No impact	No impact
Fluorene	No impact	No impact	No impact
Indeno(1,2,3-cd)pyrene	No impact	No impact	No impact
Naphthalene	366.6	895,675	>1E+06
Phenanthrene	No impact	No impact	No impact
Pyrene	No impact	No impact	No impact

4.2 Commercial

Table 4.2 Commercial phase reference tables, by distance from reen

Contaminant	Remedial Target (Commercial) mg/kg		
	12.5 m	37.5 m	62.5 m
Metals and metalloids			
Arsenic	>1E+06	No impact	No impact
Cadmium	No impact	No impact	No impact
Chromium	No impact	No impact	No impact
Copper	No impact	No impact	No impact
Iron	No impact	No impact	No impact
Lead	No impact	No impact	No impact
Manganese	No impact	No impact	No impact
Mercury	No impact	No impact	No impact
Nickel	No impact	No impact	No impact
Selenium	>1E+06	No impact	No impact

Contaminant	**Remedial Target (Commercial) mg/kg**		
	12.5 m	**37.5 m**	**62.5 m**
Vanadium	No impact	No impact	No impact
Zinc	No impact	No impact	No impact
Other inorganics			
Ammoniacal Nitrogen	1,181	3,961	15,084
Cyanide	>1E+06	>1E+06	>1E+06
Organics			
Benzene	37.48	184.3	941.3
Toluene	>1E+06	>1E+06	>1E+06
Ethylbenzene	3,197	95,209	>1E+06
Xylene	1,423	17,137	174,505
Phenol	504,959	>1E+06	>1E+06
Petroleum hydrocarbons			
TPH Aliphatic C5-C6	>1E+06	>1E+06	>1E+06
TPH Aliphatic C6-C8	>1E+06	>1E+06	>1E+06
TPH Aliphatic C8-C10	No impact	No impact	No impact
TPH Aliphatic C10-C12	No impact	No impact	No impact
TPH Aliphatic C12-C16	No impact	No impact	No impact
TPH Aliphatic C16-C21	No impact	No impact	No impact
TPH Aliphatic C21-C35	No impact	No impact	No impact
TPH Aliphatic C35-C44	No impact	No impact	No impact
TPH Aromatic C5-C7	83.04	402.5	2,034
TPH Aromatic C7-C8	>1E+06	>1E+06	>1E+06
TPH Aromatic C8-C10	7,035	>1E+06	>1E+06
TPH Aromatic C10-C12	80,215	>1E+06	No impact
TPH Aromatic C12-C16	>1E+06	No impact	No impact
TPH Aromatic C16-C21	No impact	No impact	No impact
TPH Aromatic C21-C35	No impact	No impact	No impact
TPH Aromatic C35-C44	No impact	No impact	No impact
TPH Aromatic C40-C44	No impact	No impact	No impact
Polyaromatic hydrocarbons			
Acenaphthene	No impact	No impact	No impact
Acenaphthylene	No impact	No impact	No impact
Anthracene	No impact	No impact	No impact
Benzo(a)anthracene	No impact	No impact	No impact
Benzo(a)pyrene	No impact	No impact	No impact
Benzo(b)fluoranthene	No impact	No impact	No impact
Benzo(k)fluoranthene	No impact	No impact	No impact
Benzo(g,h,i)perylene	No impact	No impact	No impact
Chrysene	No impact	No impact	No impact
Di-benz(a,h)anthracene	No impact	No impact	No impact
Fluoranthene	No impact	No impact	No impact
Fluorene	No impact	No impact	No impact
Indeno(1,2,3-cd)pyrene	No impact	No impact	No impact
Naphthalene	1,687	>1E+06	>1E+06
Phenanthrene	No impact	No impact	No impact

Contaminant	Remedial Target (Commercial) mg/kg		
	12.5 m	37.5 m	62.5 m
Pyrene	No impact	No impact	No impact

5 VALIDATION REPORT AND DISCHARGE OF PLANNING CONDITION 28

It is proposed that, for each Phase, the discharge of PC28 is split into two parts as follows.

5.1 Discharge of PC28 Part 1

A validation report is to be submitted to demonstrate the quality of the engineered fill materials to include:

- Description of remediation activities
- Summary of soil movements (tickets for import and export of materials to be provided if relevant)
- Presentation of soils validation data (laboratory certificates and summary tables)
- Screening against RL SRVs to identify CoCs
- Statistical assessment and screening against reference values for CoCs
- Presentation of hydraulic conductivity data for the engineered fill

5.2 Discharge of PC28 Part 2

A validation report is to be submitted to demonstrate the presence, thickness and nature of the drainage layer, to include:

- A description of the works undertaken
- Materials import receipts including description of the materials (typically 6F2 or Type 1 materials)
- Photographic evidence of the extent of the materials (e.g. aerial photographs)
- Photographic evidence of the type and depth of the materials on a 75 m x 75 m grid (or finer grid as appropriate for the size of the plot)

6 REFERENCES

Atkins, 2017, Glan Llyn, Llanwern: Llanwern Controlled Waters Detailed Quantitative Risk Assessment.

Buss, SR, Herbert, AW, Morgan, P et al, 2004. A review of ammonium attenuation in soil and groundwater. *QJEG v 37.*

Environment Agency, 2006. Remedial Targets Methodology: hydrogeological risk assessment for land contamination.

HFCL, 2024. Glan Llyn, Llanwern: soil quality verification. Correction to calculated re-use criteria for soils at Glan Llyn (residential).

Howard, PH, Boethling, RS, Jarvis, WF, Meylan, WM and Michalenko, EM, 1991. Handbook of environmental degradation rates.

Rodgers Leask, 2019-2022: Glan Llyn Llanwern Sitewide: Controlled Waters DQRA 2019 Update.

Rodgers Leask, 2017: Glan Llyn surface water drainage strategy.

APPENDIX A

RTM modelling spreadsheet outputs (electronic)

APPENDIX B

Example RTM spreadsheets (electronic)

Appendix F – Remediation Strategy Addendum Information

Technical Note

Project:	P18-669 Glan Llyn, Newport
Subject:	Remediation Strategy Addendum Information
Date:	January 2022
Document Reference:	18669-RLL-22-XX-RP-O-0192
Prepared by	Chris Wilson BSc (Hons) MCIWEM
Reviewed by	Howel Morris BSc (Hons) MSc CGeol FGS

A site wide Remediation Strategy was submitted by Rodgers Leask Limited (RLL) in November 2021 for the Glan Llyn development in Newport pursuant to the discharge of condition 27 of outline planning approval 06/0471. The Senior Scientific Officer (Steve Manning) at Newport City Council (NCC) reviewed and provided a response. This note provides addendum information to the Remediation Strategy following correspondence with the Senior Scientific Officer. The paragraphs numbered below relate to the points raised by NCC and discussed in the correspondence between NCC and RLL (Technical Note 187), presented in **Appendix A**.

1. Pictorial versions of the earthworks process intended to enhance the conceptual site model (CSM) for the residential and commercial parts of the development have been prepared and are presented in **Drawings**. The Made Ground in the residential areas will be cleared to the natural underlaying clay before placement of suitable material from within the phase and from pre validated stockpiles to achieve the required formation level. Photographs of the process are inserted. The commercial area will undergo an excavation/ trim to 2m below formation level with obstructions and unsuitable material removed to natural clay before suitable material from the trim exercise and the residential site is re-engineered to achieve formation level.

2. The removal of unsuitable material from the residential phases and the turnover and placement of retained suitable Made Ground in 300mm layers is intended reduce the contamination risks (Phase 4h – vapour) by thinly spreading and compacting source material to improve consistency and reduce permeability. Monitoring (chemical surface validation sampling, gas monitoring and, where appropriate, vapour monitoring in each residential phase) will be undertaken following the remedial earthworks to assess the remediated condition and the contamination status of the formation surface. The Validation Report (submitted pursuant to the approval of NCC & partial discharge of planning condition 28) will recommended appropriate mitigation measures, if required, in addition to the clean cover as part of the listed developer actions.

3. The post remedial earthworks formation in residential areas will undergo chemical sampling (greater than 1 per 50m^2) in addition to the pre-remediation testing to comply with the recommended testing frequency but also provide information to assess the contamination status of the formation surface as recommended by NCC. The surface contamination status,

in addition to earthworks validation, will be assessed to recommend the form of mitigation measures in addition to the clean cover.

4. A clean cover provision of 600mm in landscape areas is accepted. The landscape areas will also undergo formation surface chemical sampling to assess the contamination status and whether mitigation measures are required in addition to 600mm of clean cover.

5. The trim and chase strategy (also referred to as the 1m turnover) within the Remediation Strategy applies only to the central business park. The business park will have the benefit of at least 2m of re-engineered material underlying the construction material before the hardstanding or floor slabs area constructed. This is presented in the commercial area pictorial earthworks CSM (**Drawings**). The re-engineered material will have a reduced permeability in comparison with undisturbed in situ Made Ground and the hydraulic gradient would likely be away from the engineered material towards the undisturbed Made Ground. The hydraulic gradient would protect the engineered profile.

6. The Validation Report for each phase includes a section on the developer actions. The actions typically comprise the provision of clean cover and gas protection measures. The final form of the developer actions are to be confirmed following the post remedial works monitoring and validation sampling.

General Items

It is noted that the LPA and the project team await the comments from Natural Resources Wales (NRW) regarding the controlled waters.

The NRW and NCC have accepted an invite to attend site on 26th January 2022.

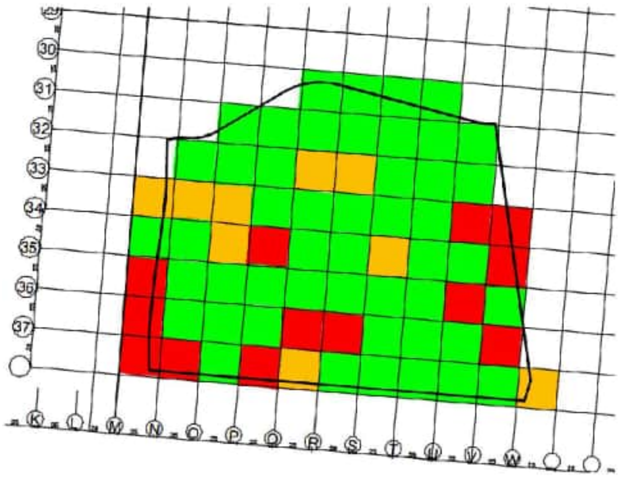
It is hoped that a greater understanding of the proposed Remediation Strategy has been provided in the correspondence. It is understood that the potential mitigation measures (to break pathways) will be reviewed following the assessment of the contamination status of the surface formation. This will comprise chemical sampling of the formation surface, shallow gas monitoring of the phase and, where appropriate, vapour monitoring.

Llanwern Residential Phases, Conceptual Site Model

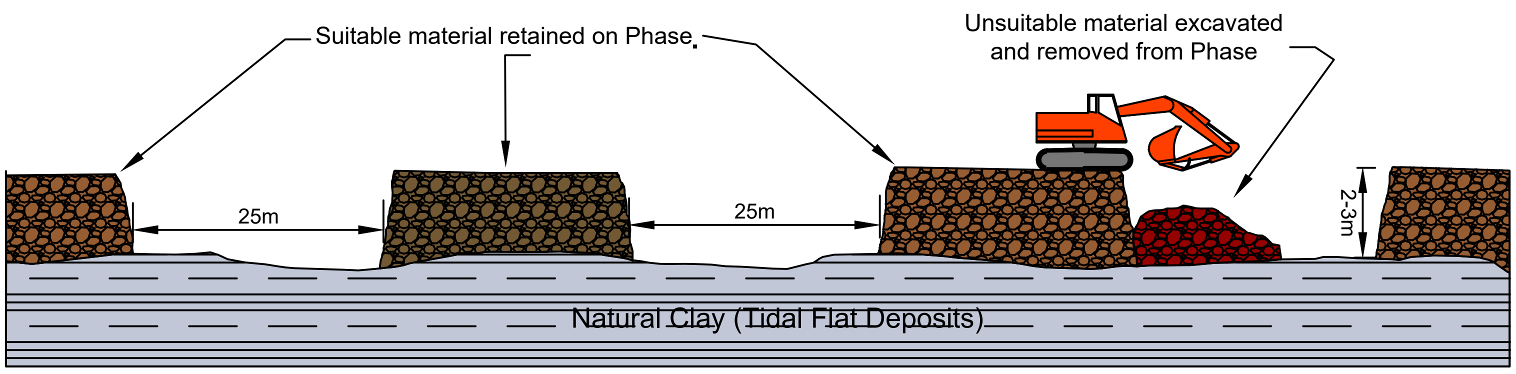
1. Pre-Reclamation Sampling Exercise

Chemical assessment undertaken on in-situ made ground and stockpiled material. Sampling across a 25m grid identifies chemically unsuitable material within phase.

Made Ground to be excavated to natural Clay and removed for treatment or re-use on commercial area.	🟥
Potential for re-use within plot following turnover.	🟧
Made Ground to be turned over for re use within plot.	🟩



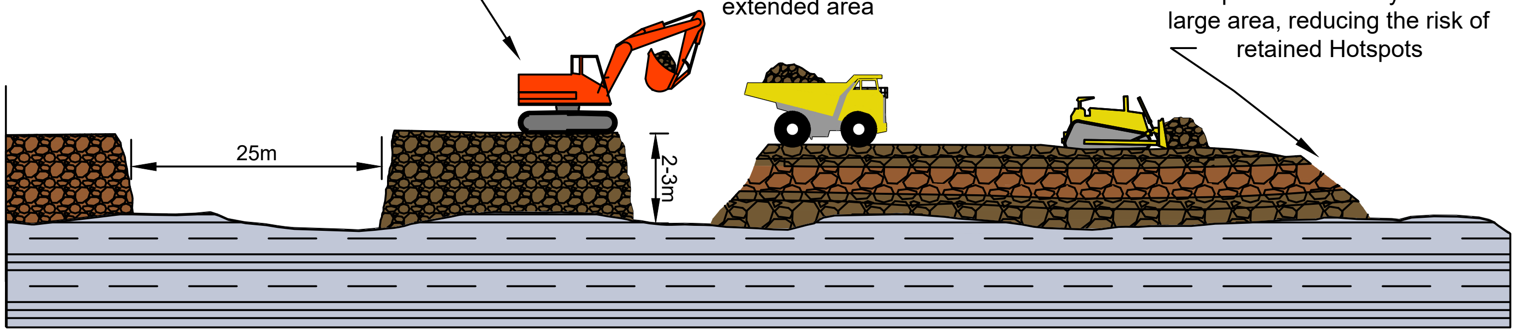
2. Unsuitable material removed from Site. Phase ready for turnover.



Suitable material retained on Phase.

Unsuitable material excavated and removed from Phase

3. Turnover Exercise

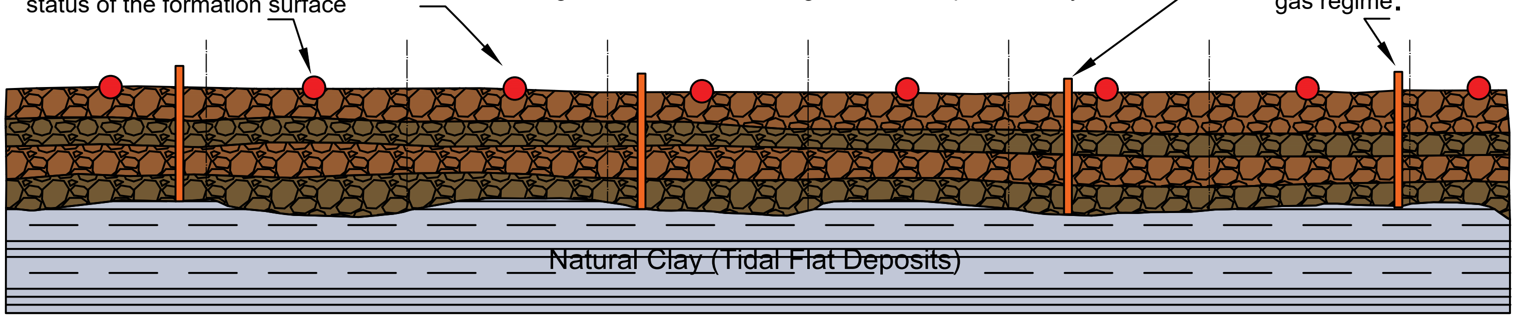


Retained Made Ground excavated to natural Clay

Suitable Excavated material placed and compacted as a 300mm layer over an extended area

Pre validated Made Ground is imported to achieve levels. Material is compacted in thin layers over a large area, reducing the risk of retained Hotspots

4. Post Earthworks Additional Surface Validation



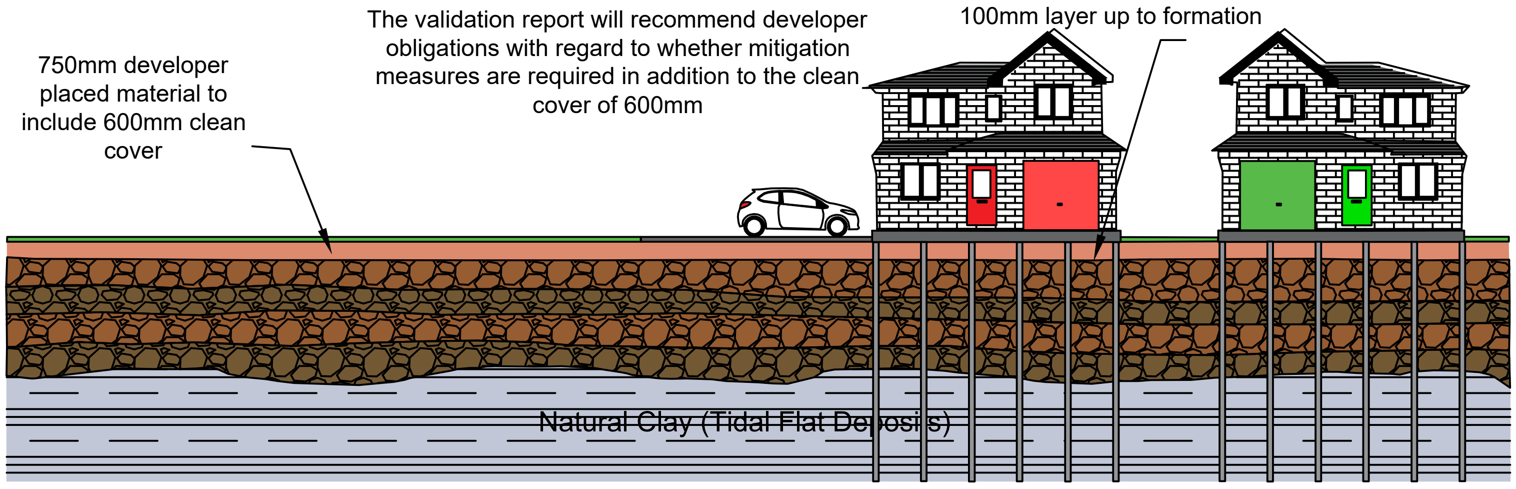
Gridded surface validation undertaken across phase to assess the contamination status of the formation surface

The turnover is anticipated to the improve the chemical profile and consistency of the Made Ground whilst also reducing water infiltration through decreased permeability.

Shallow gas monitoring and, where appropriate, vapour monitoring undertaken to assess post remedial gas regime.

Natural Clay (Tidal Flat Deposits)

5. Developed Site



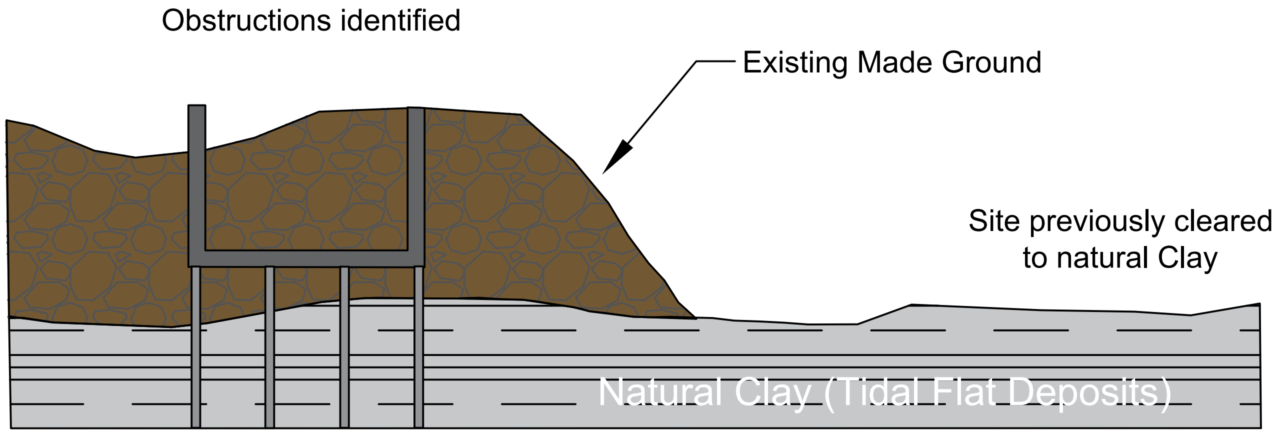
Possible mitigation measures if required:
-Geo-membrane (no dig/ bio retardation)
-Site won natural clay placed in a 100mm layer up to formation

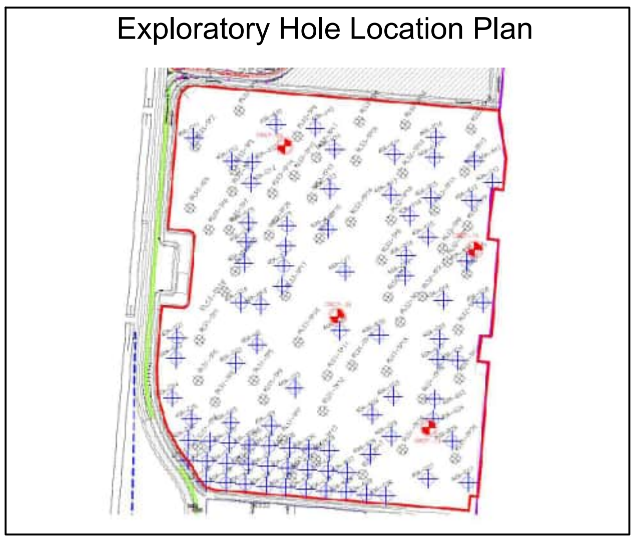
The validation report will recommend developer obligations with regard to whether mitigation measures are required in addition to the clean cover of 600mm

750mm developer placed material to include 600mm clean cover

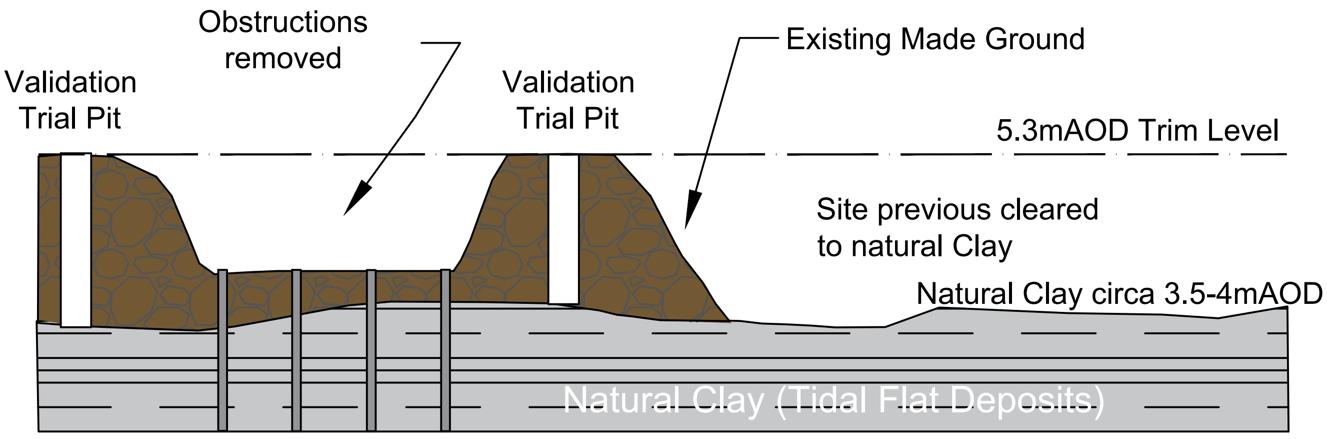
Llanwern Business Park, Conceptual Site Model

1. Site Pre-Trim


Obstructions identified
Existing Made Ground
Site previously cleared to natural Clay
Natural Clay (Tidal Flat Deposits)


Exploratory Hole Location Plan

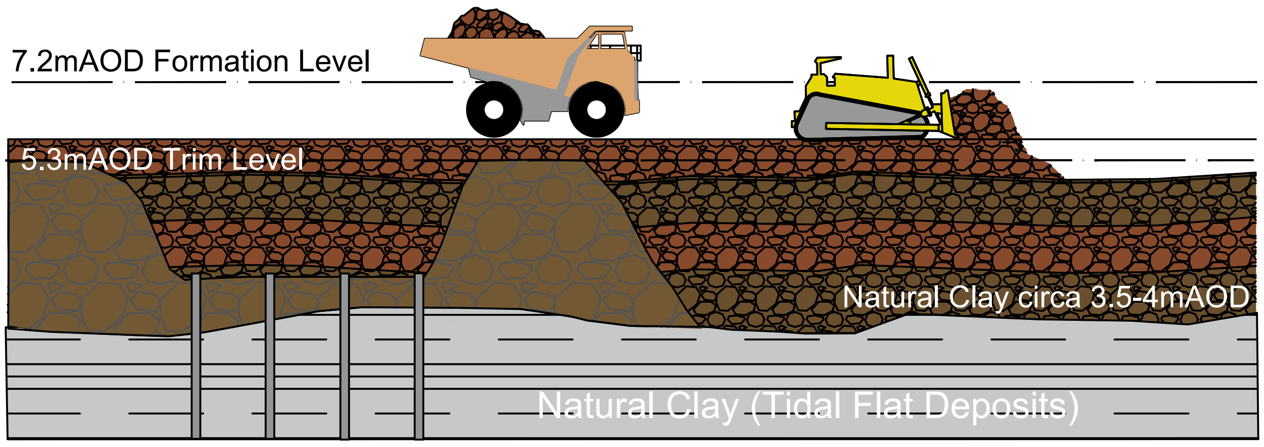
2. Site Trimmed to 5.3mAOD and obstructions removed


Validation Trial Pit
Obstructions removed
Validation Trial Pit
Existing Made Ground
5.3mAOD Trim Level
Site previous cleared to natural Clay
Natural Clay circa 3.5-4mAOD
Natural Clay (Tidal Flat Deposits)

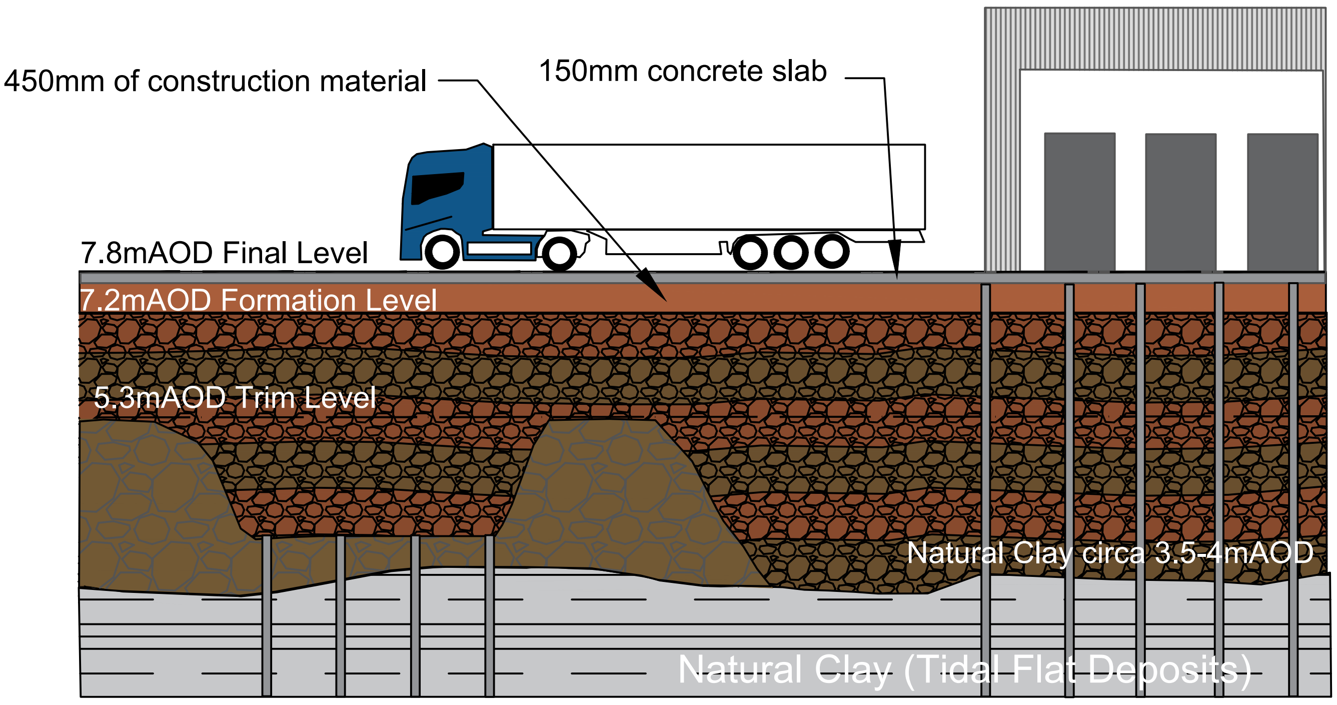
3. Fill engineered across site to formation level.

Suitable material from the trim exercise and material from the residential site placed and compacted as a 300mm layer over an extended area

Made Ground is imported to achieve levels. Material is compacted in thin layers over a large area, reducing the risk of retained Hotspots


7.2mAOD Formation Level
5.3mAOD Trim Level
Natural Clay circa 3.5-4mAOD
Natural Clay (Tidal Flat Deposits)

3. Developed Site Including 0.6m of clean cover material


450mm of construction material
150mm concrete slab
7.8mAOD Final Level
7.2mAOD Formation Level
5.3mAOD Trim Level
Natural Clay circa 3.5-4mAOD
Natural Clay (Tidal Flat Deposits)

Appendix A – TN187, LPA Comments

Technical Note

Project:	P18-669 Glan Llyn, Newport
Subject:	Phase 4h Response to LPA Comments
Date:	December 2021
Document Reference:	18669-RLE-21-XX-RP-O-0187
Prepared by	Chris Wilson BSc (Hons) MCIWEM
Reviewed by	Howel Morris BSc (Hons) MSc CGeol FGS

It is worth stating that all made ground will be removed and only suitable material will be used in the formation of the plot. The Phase II report for Phase 4h reports the pre remediation conditions and all of the made ground will have been excavated to a validated natural clay. The full turnover of the made ground is exceptional and hugely conservative as it allows for the visual and olfactory assessment of all of the made ground in addition to chemical assessment. Approximately 40% of the made ground from Phase 4h has already been removed and stockpiled for treatment or reuse in the commercial area.

Comments:

1. Detailed cut and fill/reuse drawings for all areas requiring remediation are sought so that extents and depths can be better understood prior to works.

The site will have all unsuitable made ground removed and the remaining made ground assessed as suitable for retention will be turned over to the underlying natural clay. The removal or turnover of all of the made ground is a conservative approach where 100% of the made ground is excavated. A normal ground investigation would cover less than 1% of the material and therefore there is confidence in the consistency and suitability of the material. The natural clay will be sampled as a part of the validation testing. A base of excavation drawing showing the surface of the natural deposits and relevant validation information will be provided within the validation report. Is there an existing drawing which confirms this conceptually ? it is important NCC has a clear picture of what is intended as well as what is done.

2. Will the removal of contaminated material be sufficient to remove the vapour pathway for hydrocarbons into dwellings/garden areas ? Yes, although as a precaution we will undertake vapour monitoring post earthworks. The CSM in appendix D makes no reference to this. a vapour pathways will remain after made ground remediation then full protection of dwellings, services and garden areas needs to be considered for the benefit of future developers and the onward developer documentation trail. It is noted that a post remedial vapour assessment is proposed however this pathway needs to be included in the CSM for completeness. Accepted, we will update the CSM as an addendum to the report. Both items in red text are supported.

3. The Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground are noted and cause concern given their high levels at a what will be depth of only 600mm below residential gardens. Engineered cover systems appear to be warranted and not simple cover systems; in view of significantly elevated levels that will exist below cover. The *earthworks will provide an engineered difficult dig layer of low permeability which will be validated to assess compliance with the earthworks specification. The formation created would prove a difficult dig for a JCB even without the 600mm above.* This aspect is noted however it is the contamination status of the final formations surface that will dictate the degree to which additional separation from domestic digging activity contact is required through engineered cover. *The use of a semi permeable or impermeable membrane incorporating a bright orange geomembrane should be considered as part of engineered cover to deter against digging beneath clean material – a combined anti-dig/capillary break layer should also be considered as part of the remedial approach for final development. This is considered necessary to prevent both the upward migration of any contamination into cover systems and contact with material beneath them. The use of a 'Bentomat' type system (geotextiles with bentonite clay layer) to prevent infiltration may be warranted in this situation given the nature of contaminated material being proposed for reuse beneath cover and proposals regarding this are sought. Although 600mm is specified in the remediation strategy the formation level is set 750mm below the final ground level. Could the proposed developer actions regarding cover be recommended following review of the validation report. It is anticipated that the average concentrations will be well below the proposed thresholds. The remedial criteria is based on an average approach and the complete removal of made ground across the plot with placement of validated site won made ground. The turnover of the made ground will cause improvement of the material, where the organic concentrations are likely to be reduced, from the pre remediated state reported in the phase II report. The post remedial conditions are designed to be much improved and we can provide an isopachyte of concentrations to assist in zoning the site should enhanced protection measure be required.* This appears to be a suitably pragmatic approach to specifying final developer cover and must take the form of an engineered cover system design with detailed drawings so that requirements are clear to all when available.

4. The proposed cover of only 300mm in landscaped areas does not appear sufficient given the level of contamination that will remain as a result of the proposed Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground. Either the reuse levels are made more conservative given the level of proposed cover ; or the level of cover is increased to a minimum of 600mm. 600mm is likely to be acceptable. 600mm will be accepted as suggested subject to its engineered nature. *Incorporation of the features in 3 above would be relevant in landscaped areas also for any thickness of cover. The reengineered ground is likely to be provide a sufficient no dig barrier.* This aspect is noted however it is the contamination status of the final formations surface that will dictate the degree to which additional separation from domestic digging activity contact is required through engineered features.

5. It is not clear whether the one metre turn over specification will prevent any lateral movement of contaminants into regions that have had the full turnover applied of full turn over ? The 1m turnover applies to the central business park where the interception of rainfall is >90% when the site is developed and the proposed levels are to be raised providing at least 2m of low permeability reengineered material above the base of excavation. The remediation strategy proposed by RLE recommends full turnover in the residential areas. Where this meets the remediation strategy proposed by Vertase FLI, the full depth of reengineered made ground would retard migration from the 1m turnover strategy. or what the significance of this would be? Graphical illustration of how this will work between areas of the two specifications is sought. If there is any risk of migration from one meter turnover regions into full turnover regions then an approach where all regions undergo full turnover may be worth considering ? This has been assessed as part of the CWRA, appended to the remediation strategy, the hydraulic gradient would suggest that the direction of migration would be from the engineered material to the non engineered material. Thus protecting the fully engineered profile. However the likely volume of perched water will be reduced due to *the reduced permeability of the engineered profile.* This aspect is noted and may require further consideration by NRW – copied in for comment.

6. Onward developer action documentation needs to be provided in advance of any developers being in the frame; and the format of this is sought at this stage. A general developer actions list can be provided. The actions typically comprise the provision of clean cover and gas protection measures. Accepted that a draft format may be all that is possible at this stage in view of finalising developer engineered cover design further to validation of this first remedial phase.

It is important that the LPA obtain comments from NRW in respect of this site as controlled waters are clearly a sensitive receptor and Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground are concerningly high. The strategy is intended to deliver an acceptable water quality into the surface waters by turning over the made ground and creating a consistent low permeability, 2m thick, engineered material. This is intended inhibit the percolation of rainwater into the made ground. The compaction also reduces the ability to disturb the made ground without the use of heavy mechanical means. This aspect is noted however it is the contamination status of the final formations surface that will dictate the degree to which additional separation from end user digging activity contact is required.

I am not at present reassured that the human health pathway will be sufficiently mitigated at both made ground remedial and developer remedial stages and as such the above matters need to be addressed before any consideration can be given to support for discharge. We would like to invite the local authority to attend site for a walkover as the benefit and scale of the remediation works are better understood during a site visit. A site meeting is welcomed and I would suggest NRW are invited to such a meeting also.

1.

Technical Note

Project:	P18-669 Glan Llyn, Newport
Subject:	CWDQRA Validation Plan
Date:	June 2022
Document Reference:	18669-RLL-22-XX-RP-O-0260
Prepared by	Chris Wilson BSc (Hons) MCIWEM
Reviewed by	Howel Morris BSc (Hons) MSc CGeol FGS

A site wide Remediation Strategy was submitted by Rodgers Leask Limited (RLL) in November 2021 for the Glan Llyn development in Newport pursuant to the sitewide discharge of part of condition 27 of the outline planning approval 06/0471. Natural Resources Wales (NRW) reviewed the strategy and the appended updated controlled water detailed quantitative risk assessment (CWDQRA). A meeting was held with NRW on 20th April 2022 and following the meeting RLL has prepared this CWDQRA validation plan to verify that material with contaminants of concern exceeding the criteria are placed at the appropriate distance from a surface water, to assess whether the hydraulic conductivity and the pore water chemical concentrations within the reengineered material are as assumed in the CWDQRA. This note provides the method to collect and assess the CWDQRA validation information as an addendum to the remediation strategy and also presents a number of points as a continency plan.

Contaminants of Concern Validation

The updated CWDQRA identified some exceedances for concentrations of contaminants of concern (CoC) in relation to a 20m compliance distance. A further assessment has shown material recording concentrations exceeding the 20m compliance criteria for the CoC is suitable when placed at a distance of greater than 30m from the compliance point. The phase specific validation report will show that material with CoC exceeding the 20m compliance criteria has been placed at a suitable distance i.e. greater than 30m.

Hydraulic Conductivity Validation

The updated CWDQRA recognises the benefits of excavating and reengineering the made ground on the permeability of the material. The earthworks validation report presents test results characterising the made ground and standard results for compaction and air voids validating that the compaction requirements have been achieved. It is considered helpful, as a line of evidence to support the poor drainage characterisation of the reengineered material, to undertake falling head tests, and where possible rising head tests, upon and within the reengineered material.

The formation falling head tests are to be undertaken using a cylinder to hold a head of water against the formation surface. Approximately 10 falling head tests will be undertaken per phase or a minimum of 1 test per 100m^2. Whilst the dimensions of the falling head test are not complaint with BRE Soakaway test, the monitoring and assessment will be undertaken in accordance with the BRE. The standard dimensions of the BRE Soakaway test would damage the formation and potentially be influenced by the underlying clay.

The falling and rising head tests will be undertaken on the shallow monitoring wells installed, following the earthworks, in the reengineered made ground. Up to 8 shallow monitoring locations will be installed in each phase.

The CWDQRA describes the permeability of piling mat post construction. The validation report shall include, as part of the developer obligations, confirmation or verification of construction material/ piling mat with the suitable permeability characteristics in accordance with the CWDQRA & Remediation Strategy.

Pore Water Concentration Assessment

The updated DQCWRA assumed pore water concentrations as shown in Table 1.

Table 1. Calculated Pore-water Concentrations for Contaminants of Concern (CoC) Modelled in P20 Remedial Target Worksheets

Determinands	**Calculated Porewater Concentrations (mg/l) based upon laboratory derived totals soil concentrations (mg/kg) and 1806 (No.) Soil Samples**		
	Average	Upper 95 % Percentile	Maximum
Iron	113.57	314.67	2949.27
Manganese	12.00	44.70	566.00
Vanadium	0.97	3.01	13.498
Benzo(a)pyrene	2.85E-4	0.00113	0.07
Benzo(b)fluoranthene	0.0767	0.28	20.77
Naphthalene	0.231	0.165	128.68

It is intended, as part of the validation, to then compare the field chemical concentrations with the pore water concentrations adopted within the CWDQRA. This will only be possible where perched water is encountered. Where water is present within the shallow monitoring wells the sample will be collected using a peristaltic (low flow) pump.

The monitoring locations, the positions of the formation surface tests falling head tests, the results and the assessment of the results will be presented in the validation report for each phase.

Following validation of the earthworks to achieve the formation surface, it is proposed that a limited number of monitoring wells are retained (approximately 30% or 3 per phase) or installed in landscaping areas. The validation report for each phase will contain specific information on how this will be achieved. This will allow long-term monitoring of the perched water post construction and build on a sitewide dataset of perched water quality.

Contingency Plan

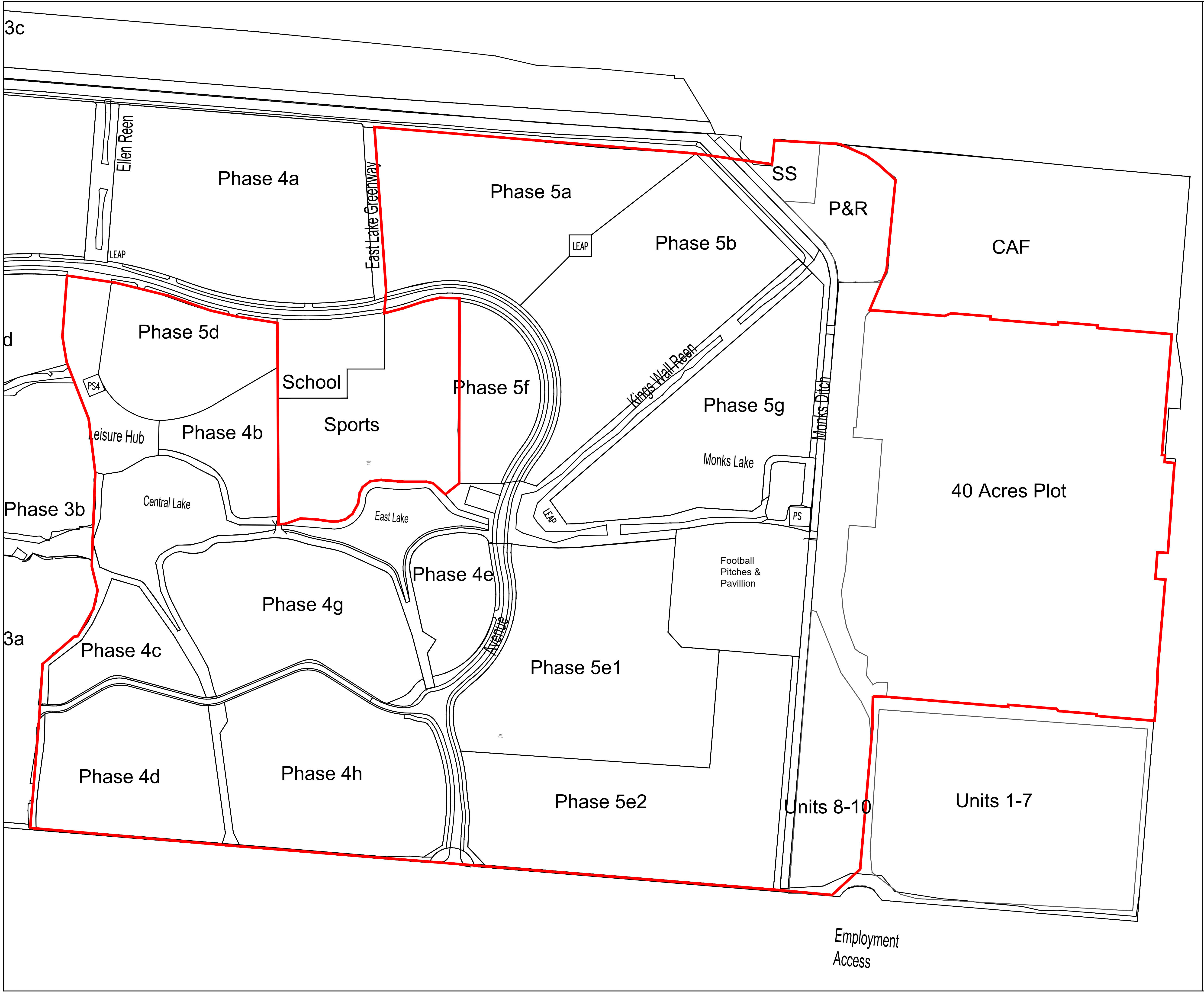
The validation assessment will also, where appropriate, compare results from adjacent phases and site wide monitoring results as part of the validation assessment. The creation of baseline set of data for the site, through the accumulation of results from individual phases, to support the maintenance of suitable site wide surface water quality. The comparison of phase specific information and sitewide information may also be used as contingency where soil concentrations exceed criteria or pore water concentrations exceed modelled parameters but monitoring indicates suitable sitewide conditions.

The CWDQRA also considers that there is a potential for natural attenuation benefits from further improving the existing surface water features on the site, which mainly comprise reens and ponds/small lakes. This is anticipated particularly through:

1. Further establishing the vegetation within the reens which will help reduce the concentrations of organic contaminants and particularly nutrients such as ammoniacal nitrogen. The reens are known to vegetate rapidly and require regular maintenance to remove surplus growth;

2. Undertaking organic matter enrichment of soils along margins of the reens and ponds/lakes into which water penetrating the Made Ground are likely to discharge. This could be undertaken by placement of locally excavated peat (obtained from Alluvial and underlying Tidal Flat Deposits) and other soils containing high concentrations of organic matter. This should enable a further stripping out of low concentrations of PAHs and TPH within these discharge waters. Amendment of these soils with other materials will also be considered, taking into consideration further knowledge of the residual contaminant profile, in order to provide a passive sustainable solution to the long-term remediation of this site.

The preliminary validation plan for Phase 4h is attached to this note as an example of the typical layout of post earthworks validation sampling and monitoring locations for a residential phase.


3c
Ellen Reen
Phase 4a
East Lake Greenway
Phase 5a
LEAP
Phase 5b
SS
P&R
CAF
LEAP
Phase 5d
School
Phase 5f
PS4
Sports
Kings Wall Reen
Phase 5g
Monks Ditch
d
Leisure Hub
Phase 4b
Monks Lake
40 Acres Plot
Phase 3b
Central Lake
East Lake
LEAP
PS
Football
Pitches &
Pavillion
Phase 4e
Phase 4g
3a
Phase 4c
Avenue
Phase 5e1
Phase 4d
Phase 4h
Phase 5e2
Units 8-10
Units 1-7
Employment
Access

GENERAL NOTES

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KEY:

🟥	**REMEDIATION STRATEGY BOUNDARY**
☐	**PHASE BOUNDARIES**

Rev	Date	Amendments	By	Chk
A	03:05:22	Updated Boundary	SR	CW

Client
St Modwen Developments

Project
P18-669 Llanwern Reclamation

Drawing Title
Remediation Strategy
Boundary Plan

INFORMATION

	Drawn	Checked	Date
NTS	SR	CW	27.04.22

Drawing No. Rev.
18669-RLL-22-XX-DR-O-0262 A

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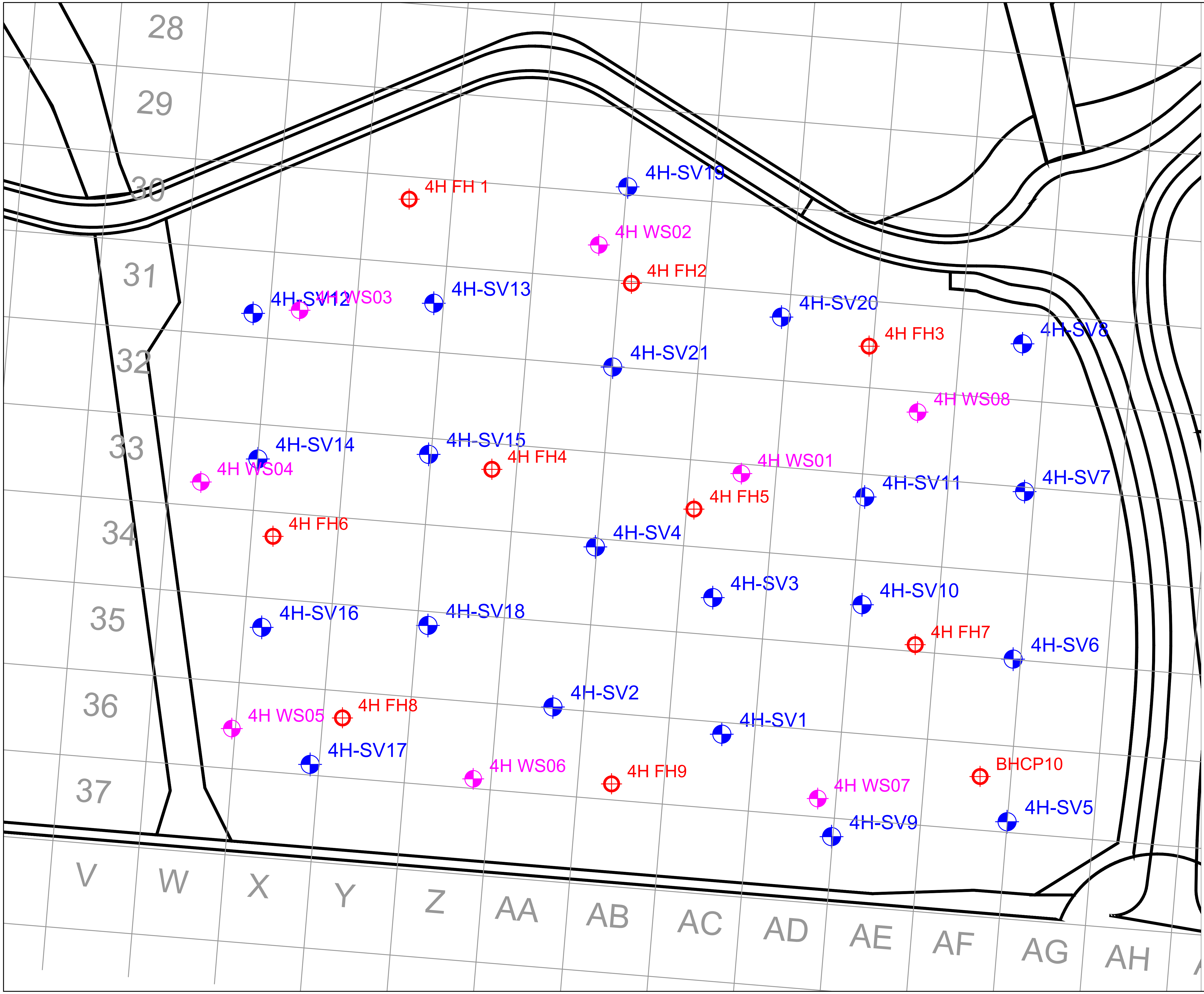
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AF
AG
AH
4H-SV19
4H FH 1
4H WS02
4H FH2
4H-SV12
4H WS03
4H-SV13
4H-SV20
4H FH3
4H-SV8
4H-SV21
4H WS08
4H-SV14
4H-SV15
4H FH4
4H WS04
4H WS01
4H-SV11
4H-SV7
4H FH5
4H FH6
4H-SV4
4H-SV3
4H-SV10
4H-SV16
4H-SV18
4H FH7
4H-SV6
4H-SV2
4H FH8
4H WS05
4H-SV1
4H-SV17
4H WS06
4H FH9
BHCP10
4H WS07
4H-SV5
4H-SV9

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KEY:

⊕ 4H-SV	**SURFACE VALIDATION CHEMICAL SAMPLE LOCATION**
⊕ 4H WS08	**WINDOW SAMPLE LOCATION FOR GAS AND PERCHED WATER MONITORING**
⊕ 4H FH3	**FALLING HEAD TEST LOCATION**

Rev	Date	Amendments	By	Chk

Client

St Modwen Developments

Project

P18-669 Llanwern Reclamation

Drawing Title

Phase 4H Validation Plan

INFORMATION

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