



**FEHILY
TIMONEY**

**CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE & PLANNING**

APPENDIX 3

**Parameters and Results of
Groundwater, landfill gas and
Surface Water Monitoring**

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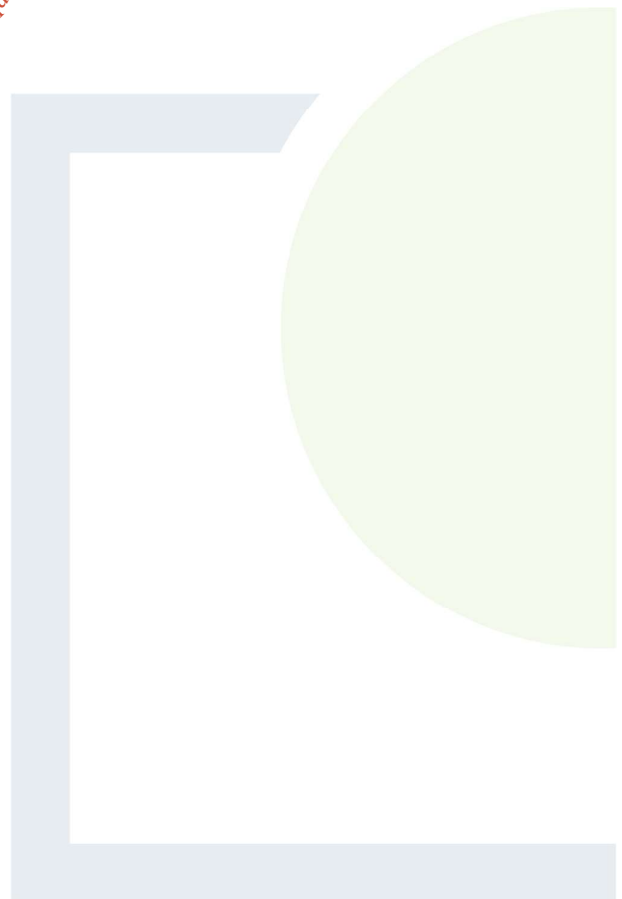


Table 1: Waste Sampling Results – Solid Waste Analysis

Parameter	Units	Inert Waste Acceptance Criteria	Non-Hazardous Waste Acceptance Criteria	Hazardous Waste Acceptance Criteria	Sampling Results - Sample ID
					TP03 (at 2.0 m)
Total Organic Carbon	%	3	5	6	3.7
Loss on Ignition	%	--	--	10	7.0
Total BTEX	mg/kg	6	--	--	< 0.010
Total PCBs (7 Congeners)	mg/kg	1	--	--	< 0.10
TPH Total WAC (Mineral Oil)	mg/kg	500	--	--	< 10
Total (of 17) PAH's	mg/kg	100	--	--	< 2.0
pH		--	>6	--	8.1
Acid Neutralisation Capacity	mol/kg	--	--	--	0.038
Arsenic	mg/kg	0.5	2	25	< 0.050
Barium	mg/kg	20	100	300	< 0.50
Cadmium	mg/kg	0.04	1	5	< 0.010
Chromium	mg/kg	0.5	10	70	< 0.050
Copper	mg/kg	2	50	100	< 0.050
Mercury	mg/kg	0.01	0.2	2	0.015
Molybdenum	mg/kg	0.5	10	30	< 0.050
Nickel	mg/kg	0.4	10	40	< 0.050
Lead	mg/kg	0.5	10	50	0.015
Antimony	mg/kg	0.06	0.7	5	0.012
Selenium	mg/kg	0.1	0.5	7	0.014
Zinc	mg/kg	4	50	200	< 0.50
Chloride	mg/kg	800	15000	25000	32
Fluoride	mg/kg	10	150	500	1.3
Sulphate	mg/kg	1000	20000	50000	140
Total Dissolved Solids	mg/kg	4000	60000	100000	1200
Phenol Index	mg/kg	1	-	-	< 0.30
Dissolved Organic Carbon	mg/kg	500	800	1000	120
Moisture	%				19

* Hazardous Waste Landfill Criteria: >6% TOC

* Items in **bold** are in exceedance of the Inert WAC limit value

- * Items shaded in **green** are in exceedance of the Non-Hazardous WAC limit value
- * Items shaded in **orange** are in exceedance of the Hazardous WAC limit value

Table 2: Groundwater Depth Analysis

Borehole ID	Location Gradient	Ground Level (mAOD)	Depth to Water (m bgl)	Groundwater Level (mAOD)
BH01	Western Site Boundary	12.01	11.05	0.96

*Note: Location gradient is in reference to the identified waste deposition area

Table 3: Groundwater Sampling Results

Parameter	Units	EPA IGV Standards ¹	S.I. No. 9 of 2016 Standards ²	BH01
Inorganics				
Ammoniacal Nitrogen as N	mg/l	0.15	0.175	0.296
Conductivity @ 20 deg.C	mS/cm	1	1.875	0.834
Total Dissolved Solids	mg/l	1000		605
Fluoride	mg/l	1		<0.5
Dissolved Oxygen	mg/l		NAC	9
pH	pH Units	6.5-9.5		7.64
Phosphate (Ortho as PO4)	mg/l		0.03	<0.05
Chloride	mg/l	30	24-187.5	73.2
Total Cyanide	mg/l	0.01	0.0375	<0.05
Total Alkalinity as CaCO3	mg/l		NAC	346
Total Suspended Solids	mg/l			-
Total Oxidised Nitrogen as N	mg/l			5.82
Sulphate (soluble) as S	mg/l	200	187.5	11.2
Total Organic Carbon	mg/l			3.78
Dissolved Metals (Filtered)				
Mercury (diss.filt)	µg/l	1	0.75	<0.01
Arsenic (diss.filt)	µg/l	10	7.5	2.65
Barium (diss.filt)	µg/l	100		32.4
Boron (diss.filt)	µg/l	1000	750	68.4
Cadmium (diss.filt)	µg/l	5	3.75	<0.08
Chromium (diss.filt)	µg/l	30	37.5	<1

Parameter	Units	EPA IGV Standards ¹	S.I. No. 9 of 2016 Standards ²	BH01
Copper (diss.filt)	µg/l	30	1500	1.07
Lead (diss.filt)	µg/l	10	7.5	3.84
Manganese (diss.filt)	µg/l	50		119
Nickel (diss.filt)	µg/l	20	15	2.27
Phosphorus (diss.filt)	µg/l			38.3
Selenium (diss.filt)	µg/l			3.24
Thallium (diss.filt)	µg/l			<2
Zinc (diss.filt)	µg/l	100	75	2.8
Sodium (Dis.Filt)	mg/l	150	150	36.5
Magnesium (Dis.Filt)	mg/l	50		9.74
Potassium (Dis.Filt)	mg/l	5		14
Calcium (Dis.Filt)	mg/l	200		135
Iron (Dis.Filt)	mg/l	0.2		0.355
Mineral Oil / Oils & Greases				
Mineral oil >C10 C40 (aq)	µg/l	10		<100
PCB's				
PCB congener 28	µg/l	0.01		<0.015
PCB congener 52	µg/l	0.01		<0.015
PCB congener 101	µg/l	0.01		<0.015
PCB congener 118	µg/l	0.01		<0.015
PCB congener 138	µg/l	0.01		<0.015
PCB congener 153	µg/l	0.01		<0.015
PCB congener 180	µg/l	0.01		<0.015
Sum of detected EC7 PCB's	µg/l	0.01		<0.105
Semi-Volatile Organic Compounds (SVOCs)				
1,2,4-Trichlorobenzene	µg/l	0.40		<1
1,2-Dichlorobenzene	µg/l	10		<1
2,4,6-Trichlorophenol	µg/l	200		<1
2-Chlorophenol	µg/l	200		<1
Anthracene	µg/l	10000		<1
Bis(2-Ethylhexyl) phthalate	µg/l	8	6	<2
Benzo(b)fluoranthene	µg/l	0.5		<1
Benzo(k)fluoranthene	µg/l	0.05		<1
Benzo(a)pyrene	µg/l	0.01	0.0075	<1
Benzo(g,h,i)perylene	µg/l	0.05		<1
n-Dibutyl phthalate	µg/l	2		<1

Parameter	Units	EPA IGV Standards ¹	S.I. No. 9 of 2016 Standards ²	BH01
Fluoranthene	µg/l	1		<1
Hexachlorobenzene	µg/l	0.03		<1
Hexachlorobutadiene	µg/l	0.1		<1
Nitrobenzene	µg/l	10		<1
Naphthalene	µg/l	1	0.075	<1
Pentachlorophenol	µg/l	2		<1
Phenol	µg/l	0.5		<1
Indeno(1,2,3-cd)pyrene	µg/l	0.05		<1
Volatile Organic Compounds (VOCs)				
Dichlorodifluoromethane	µg/l	15		<1
Vinyl chloride	µg/l		0.375	<1
Trichlorofluoromethane	µg/l	12		<1
1,1-Dichloroethene	µg/l		0.375	<1
Dichloromethane	µg/l	10	15	<3
Methyl tertiary butyl ether (MTBE)	µg/l	30	10	<1
1,1,1-Trichloroethane	µg/l	500		<1
Carbontetrachloride	µg/l	2		<1
1,2-Dichloroethane	µg/l	3	2.25	<1
Benzene	µg/l	1	0.75	<1
Trichloroethene	µg/l	70	7.5	<1
Toluene	µg/l	10	525	<1
Tetrachloroethene	µg/l	40	7.5	<1
Chlorobenzene	µg/l	1		<1
Ethylbenzene	µg/l	10		<1
m,p-Xylene	µg/l	10		<1
o-Xylene	µg/l	10		<1
4-iso-Propyltoluene	µg/l		0.75	<1
1,2-Dichlorobenzene	µg/l	10		<1
1,2,4-Trichlorobenzene	µg/l	0.4		<1
Hexachlorobutadiene	µg/l	0.1		<1
Combined Pesticides / Herbicides				
1,2,4-Trichlorobenzene	µg/l	0.4		<0.01
Aldrin	µg/l	0.01		<0.01
Alachlor	µg/l	20		<0.01
Atrazine	µg/l	1	0.075	<0.01
Chlorfenvinphos	µg/l	5		<0.01

Parameter	Units	EPA IGV Standards ¹	S.I. No. 9 of 2016 Standards ²	BH01
Chlorpyriphos	µg/l	90		<0.01
Dichlobenil	µg/l		0.075	<0.01
Dichlorvos	µg/l	0.001		<0.01
Dieldrin	µg/l	0.01	0.075	<0.01
Endosulphan I	µg/l	0.001		<0.01
Endosulphan II	µg/l	0.001		<0.02
Hexachlorobenzene	µg/l	0.03		<0.01
Hexachlorobutadiene	µg/l	0.1		<0.01
Malathion	µg/l	0.01		<0.01
Parathion	µg/l	0.01		<0.01
Pentachlorobenzene	µg/l	1		<0.01
Permethrin I	µg/l	20		<0.01
Permethrin II	µg/l	20		<0.01
Prometryn	µg/l	0.01		<0.01
Simazine	µg/l	1	0.075	<0.01
Trifluralin	µg/l	0.1		<0.01
4,4 – DDT	µg/l	0.075		<0.01
Miscellaneous Organics				
MCPA	µg/l		0.075	<0.05
Mecoprop	µg/l	10	0.075	<0.04
Dichlorprop	µg/l	100		<0.1
2,4-Dichlorophenoxyacetic acid	µg/l		0.075	<0.05
Bromoxynil	µg/l	5		<0.04
Pentachlorophenol	µg/l	2		<0.04

¹ IGV-Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland, 2003.

² OTV-Overall threshold value, European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) as amended in 2011, 2012, 2016.

* Items shaded in **bold** are in exceedance of the EPA IGV Standards

* Items shaded in **orange** are in exceedance of the Drinking Water Regulations

Table 4: Perimeter Well Monitoring Results October 2019

Date: 23-10-2019						
Sample Station	CH ₄	CO ₂	O ₂	Atmospheric Pressure	Staff Member	Weather
	(% v/v)	(% v/v)	(% v/v)	(mbar)		
BH01	1.2	1.3	21.8	1005	Emily Archer	Overcast, heavy rain, showers, 12°C
BH02	1.0	0.8	20.9			

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Table 5: Surface Water Sampling Results

Parameter	Units	MAC ¹	EQS ²	Upstream		Downstream	
				SW01	SW02	SW01	SW02
Inorganics							
Ammoniacal Nitrogen as N	mg/l	--	≤0.140 (95%ile)	<0.2	<0.2	<0.2	<0.2
Conductivity @ 20 deg.C	mS/cm	1	--	0.691	0.684	0.655	0.646
Fluoride	mg/l	0.5	--	<0.5	<0.5	<0.5	<0.5
Dissolved Oxygen	mg/l	--	95%ile>80% saturation, 95%ile<120% saturation	93.64	84.66	103.61	100.65
pH	pH Units	--	6.0-9.0	8.09	7.99	8.11	8.23
Phosphate (Ortho as PO4)	mg/l	0.5	--	<0.05	<0.05	0.08	0.064
Chloride	mg/l	40	--	45.7	45.8	48.7	48.8
COD, unfiltered	mg/l	250	--	19.8	<7	<7	<7
Total Cyanide	mg/l	0.01	--	<0.05	<0.05	<0.05	<0.05
BOD, unfiltered	mg/l	--	≤2.6 (95%ile)	1.9	--	--	--
Total Alkalinity as CaCO3	mg/l	--	--	288	298	291	292
Total Suspended Solids	mg/l	50	--	<2	3.6	14.3	15.9
Total Oxidised Nitrogen as N	mg/l	2	--	4.84	4.89	4.94	4.95
Sulphate (soluble) as S	mg/l	200	--	9.33	7.9	8.1	7.67

Parameter	Units	MAC ¹	EQS ²	Upstream		Downstream	
				SW01	SW02	SW01	SW02
Total Organic Carbon	mg/l	NAC**	--	<3	<3	<3	<3
Dissolved Metals (Filtered)							
Mercury (diss.filt)	µg/l	--	0.07	<0.01	<0.01	<0.01	<0.01
Arsenic (diss.filt)	µg/l	--	25	<0.5	<0.5	0.52	<0.5
Barium (diss.filt)	µg/l	1.0	--	6.41	6.61	5.62	5.71
Boron (diss.filt)	µg/l	2.0	--	18.7	25.8	21.6	22.2
Cadmium (diss.filt)	µg/l	0.45	0.08	<0.08	<0.08	<0.08	<0.08
Chromium (diss.filt)	µg/l	32	4.7	<1	<1	<1	<1
Copper (diss.filt)	µg/l	100	30	2.67	3.14	1.22	2.03
Lead (diss.filt)	µg/l	--	7.2	<0.2	<0.2	<0.2	0.29
Manganese (diss.filt)	µg/l	300	--	5.52	6.41	<3	4.78
Nickel (diss.filt)	µg/l	--	20	1.79	2.11	0.756	0.839
Phosphorus (diss.filt)	µg/l	--	0.075	<10	<10	16	28
Selenium (diss.filt)	µg/l	0.01	--	1.2	1.18	<1	<1
Thallium (diss.filt)	µg/l	--	--	<2	<2	<2	<2
Zinc (diss.filt)	µg/l	--	100	24.6	25.6	3.92	7.36
Sodium (Dis.Filt)	mg/l	200	--	25.2	25.4	24.3	25.9
Magnesium (Dis.Filt)	mg/l	--	--	8.76	8.91	8.05	7.48
Potassium (Dis.Filt)	mg/l	--	--	3.46	3.54	2.99	2.98
Calcium (Dis.Filt)	mg/l	--	--	126	124	118	112
Iron (Dis.Filt)	mg/l	0.2	--	<0.019	<0.019	<0.019	<0.019
Mineral Oil / Oils & Greases							
Mineral oil >C10 C40 (aq)	µg/l	--	--	<100	<100	<100	<100

Parameter	Units	MAC ¹	EQS ²	Upstream		Downstream		Downstream
				SW01	SW02	SW01	SW02	
				16.07.2019	16.07.2019	03.09.2019	03.09.2019	
PCB's								
PCB congener 28	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
PCB congener 52	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
PCB congener 101	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
PCB congener 118	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
PCB congener 138	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
PCB congener 153	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
PCB congener 180	µg/l	--		<0.015	<0.015	<0.015	<0.015	<0.015
Sum of detected EC7	µg/l	--		<0.105	<0.105	<0.105	<0.105	<0.105
PCB's								
Semi-Volatile Organic Compounds (SVOCs)								
1,2,4-Trichlorobenzene	µg/l	--	0.4	<1	<1	<1	<1	<1
1,2-Dichlorobenzene	µg/l	--	--	<1	<1	<1	<1	<1
2,4,6-Trichlorophenol	µg/l	--	--	<1	<1	<1	<1	<1
2-Chlorophenol	µg/l	--	--	<1	<1	<1	<1	<1
Anthracene	µg/l	0.4	0.1	<1	<1	<1	<1	<1
Bis(2-Ethylhexyl) phthalate	µg/l	--	--	<2	<4	<4	<4	<2
Benzo(b)fluoranthene	µg/l		0.03	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/l		0.03	<1	<1	<1	<1	<1
Benzo(a)pyrene	µg/l	0.1	0.05	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/l		0.002	<1	<1	<1	<1	<1
Indeno(1,2,3-cd)pyrene	µg/l		0.002	<1	<1	<1	<1	<1
n-Dibutyl phthalate	µg/l	--	--	<1	<1	<1	<1	<1

Parameter	Units	MAC ¹	EQS ²	Upstream		Downstream	
				SW01	SW02	SW01	SW02
				16.07.2019	16.07.2019	03.09.2019	03.09.2019
Fluoranthene	µg/l	--	--	<1	<1	<1	<1
Hexachlorobenzene	µg/l	0.05	0.01	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	0.6	0.1	<1	<1	<1	<1
Nitrobenzene	µg/l	--	--	<1	<1	<1	<1
Naphthalene	µg/l	--	2.4	<1	<1	<1	<1
Pentachlorophenol	µg/l	1	0.4	<1	<1	<1	<1
Phenol	µg/l	46	8	<1	<1	<1	<1
Volatiles Organic Compounds (VOCs)							
Dichlorodifluoromethane	µg/l	--	--	<1	<1	<1	<1
Vinyl chloride	µg/l	0.5	--	<1	<1	<1	<1
Trichlorofluoromethane	µg/l	--	--	<1	<1	<1	<1
1,1-Dichloroethene	µg/l	--	10	<1	<1	<1	<1
Dichloromethane	µg/l	--	20	12.8	9.78	<3	<3
Methyl tertiary butyl ether (MTBE)	µg/l	--	--	<1	<1	<1	<1
1,1,1-Trichloroethane	µg/l	--	10	<1	<1	<1	<1
Carbontetrachloride	µg/l	--	--	<1	<1	<1	<1
1,2-Dichloroethane	µg/l	--	10	<1	<1	<1	<1
Benzene	µg/l	50	10	<1	<1	<1	<1
Trichloroethene	µg/l	--	--	<1	<1	<1	<1
Toluene	µg/l	--	10	<1	<1	<1	<1
Tetrachloroethene	µg/l	--	10	<1	<1	<1	<1
Chlorobenzene	µg/l	--	--	<1	<1	<1	<1

Parameter	Units	MAC ¹	EQS ²	Upstream		Downstream	
				SW01	SW02	SW01	SW02
Ethylbenzene	µg/l	--	--	16.07.2019	16.07.2019	03.09.2019	03.09.2019
m,p-Xylene	µg/l	--	10	<1	<1	<1	<1
o-Xylene	µg/l	--	10	<1	<1	<1	<1
4-iso-Propyltoluene	µg/l	--	--	<1	<1	<1	<1
1,2-Dichlorobenzene	µg/l	--	--	<1	<1	<1	<1
1,2,4-Trichlorobenzene	µg/l	--	--	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	0.6	0.1	<1	<1	<1	<1
Combined Pesticides / Herbicides							
1,2,4-Trichlorobenzene	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Aldrin	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Alachlor	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Atrazine	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Chlorfenvinphos	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Chlorpyrifos	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Dichlobenil	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Dichlorvos	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Diethrin	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Endosulphan I	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Endosulphan II	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Hexachlorobutadiene	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Malathion	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Parathion	µg/l	--	--	<0.01	<0.01	<0.01	<0.01

Parameter	Units	MAC ¹	EQS ²	Upstream		Downstream	
				SW01	SW02	SW01	SW02
Pentachlorobenzene	µg/l	--	--	16.07.2019	16.07.2019	03.09.2019	03.09.2019
Permethrin I	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Permethrin II	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Prometryn	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Simazine	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
Trifluralin	µg/l	--	--	<0.01	<0.01	<0.01	<0.01
4,4 – DDT	µg/l	--	--	<0.01	<0.01	<0.01	<0.01

Notes:

¹ Maximum Admissible Concentration (MAC), as classified by European Communities (Quality of Surface Water intended for abstraction of drinking water) Regulations 1989 (S.I No. 294 of 1989)

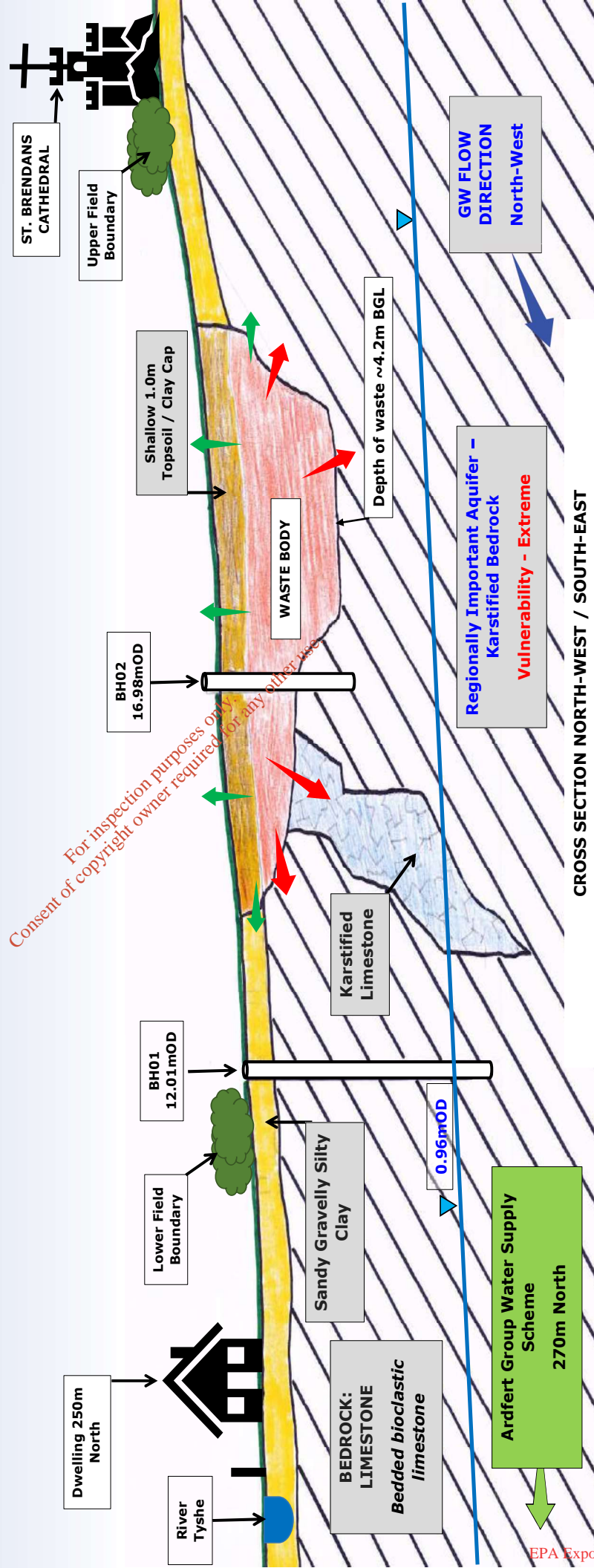
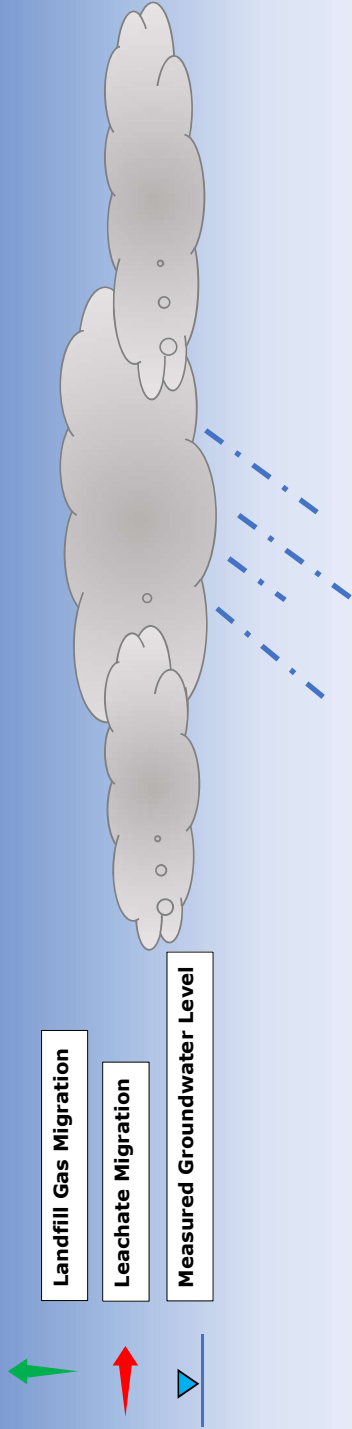
² Environmental Quality Standard (EQS), European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I No. 272 of 2009)

* Items shaded in **bold** are in exceedance of the European Communities MACs

** Items shaded in **orange** are in exceedance of the 2009 EQS Regulations

*** NAC – no abnormal change

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**FIGURE 5.1 ARDFERT HISTORIC LANDFILL
CONCEPTUAL SITE MODEL**