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Cyngor Sir Ynys Môn

Penhesgyn Landfill Site

2020 Annual Water Monitoring Report

May 2020

Prepared for

Cyngor Sir Ynys Môn

Prepared by

Egniol Environmental Ltd.
Llys Onnen
Ffordd y Llyn
Parc Menai
Bangor
Gwynedd
LL57 4DF

Document Review

Revision	Date of Review	Prepared By	Reviewed By	Approved By
-	14/05/2020	Anna Cole	Dave Wolstencroft	IoACC

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1.0 INTRODUCTION

1.1 Background

This report has been compiled in accordance with the Closure Report for the Site (Amec Report, May 2008) which requires that an annual review of the monitoring data collected at the site be carried out. The data reviewed in this report was collected from the 09th April 2019, in accordance with the Closure Report.

1.2 Site Location and Description

Penhesgyn Landfill Site (NGR SH 532 74) is located 2km northwest of Menai Bridge on Ynys Môn.

Site Address:

Penhesgyn Waste Transfer and Recycling Centre
Llansadwrn
Menai Bridge
Ynys Môn
LL59 5RY

The overall site covers an area of approximately 21ha, of which, approximately 12ha comprises a closed landfill with the remaining area utilized as a Waste Transfer Station (residual waste), an In-Vessel Composting (IVC) facility, and a Household Waste Recovery Centre (HWRC).

Access to the landfill is via the weighbridge and through a set of double agricultural type galvanized steel gates. An engineered track provides access across the site through the Valley Cell and along the perimeter of Landfill Area 3.

The site is bound to the east, west and north by farmland. The nearest residential properties are Cae Uchaf (320m East), Penhesgyn Isaf (340m East) and Penhesgyn Hall (220m South).

The local topography is gently undulating land which is dissected by the shallow valleys of the Afon Braint to the northeast and an unnamed stream to the southwest. A series of low hills lie in a general northeast to southwest orientation. Immediately to the southwest of the site is an area of lower lying wetland. This is fed by drainage from the surrounding area and in turn drains to the west into the Afon Braint.

1.3 Site History

Prior to the deposition of waste at the site the land use was likely to have been similar to the surrounding area i.e. rough grazing and wetland.

The landfill part of the site is divided into 3 main areas. Area 1 has been developed into the HWRC and site offices with an undeveloped section to the east which continues to be used as agricultural land. Area 2 and Area 3 are closed landfill areas.

Deposition of waste at the site predates 1968; however, there is no documentary information available before this date. Previous site investigations have indicated that both household and commercial waste was deposited.

Documented landfilling at Penhesgyn began in 1968 in Area 2 which was operated as a 'Dilute and Disperse' landfill. Area 2 was infilled and completed in 1998 and capped in 2000.

Area 3 has been operated on the principle of engineered containment. Waste has been disposed of within 4 engineered cells (known as Cell 1, Cell 2, Cell 3 and Valley Cell) with all cells having been restored and capped. Area 3, Cell 4 had been identified as a landfill cell but has not been developed as such and is currently utilized as a storage area for containers and plant.

1.4 Monitoring Issues

Water samples were collected from the following compliance monitoring points.

Table 1: Water monitoring points

Leachate	Groundwater	Surface water
L1	BH1	SW1
L4	BH2	SW2
L5	~~BH22~~	SW3
L6	BH96B	SW4
L7		SW5
~~LV~~		SW6
		SW7
		SW8
		SW9
		SW10

Leachate sampling point LV was not assessed as it would require opening the large leachate valves located on the leachate storage tanks; it was not considered safe to do so due to the high volume of leachate expressed by the valve when opened. These valves are intended only to be opened when leachate is being pumped into containers for transportation to a licensed leachate disposal facility.

Borehole BH22 is silted up and is situated within the wetland area where it cannot be readily accessible. This borehole is considered unsuitable for future water monitoring at this location.

Levels of Dissolved Oxygen in water samples were not reported by the laboratory. This is due to a delay in their collection of the samples from the site which in turn affected the test results.

2.0 ENVIRONMENTAL CONTEXT

2.1 Geology

The site is underlain by alluvium overlying glacial till, which is embedded with layers of sand and gravel, this in turn overlies Mica Schist of the Penmynydd Zone of metamorphism, which forms part of the Mona Complex. Prior to the land filling of Cell 3 most of the basal area is reported to have pockets of peat, overlying the glacial drift deposits, which was subsequently removed prior to construction works taking place. Schist bedrock was not encountered during the works.

2.2 Hydrogeology

The sand and gravel deposits beneath the site are classified by the Environment Agency as a Minor Aquifer. Beneath the western part of the site the aquifer is confined by the overlying clay. In the east of the site where the clay is absent the aquifer is confined.

2.3 Hydrology

The groundwater beneath the site discharges into the wetland to the southwest. In turn this wetland is drained by two surface ditches which then flow into the Afon Braint 800m downstream on the site.

3.0 LEACHATE

3.1 Introduction

Leachate monitoring data was collected from landfill Area 2, a 'Dilute and Disperse' landfill area. The leachate monitoring schedule is summarised below.

Table 2: Leachate Monitoring Schedule

Locations	Total	Frequency	Parameters*	Units
Leachate Wells: L1, L4, L5, L6, L7	5	Annually	pH Electrical Conductivity Ammoniacal Oxygen Chloride BOD COD Dissolved Oxygen	pH units µS/cm mg/l

*the regulated parameters are highlighted

Locations of the leachate wells are shown on drawing reference. 5379.RSURF/D03.

Leachate monitoring data is presented in Appendix 1.

Site Specific control and trigger levels are set out in Table 4.4 of the Hydrological Risk Assessment (Amec, 2007), and are summarised below.

Table 3: Site Specific Trigger Levels

Parameters	Control Levels (mg/l)	Trigger Levels (mg/l)
Chloride	4,440	4,884
Ammoniacal Nitrogen	1,710	1,800

3.2 Leachate Quality

During the 2020 review period, **Ammoniacal Nitrogen** in leachate wells in Area 2 was detected at concentrations ranging from 0.07mg/l (L7) to 39mg/l (L1). These concentrations were low and considerably below the control and trigger levels which indicates that leachate in Area 2 is weak and/or diluted with groundwater.

Chloride was detected in the leachate samples in concentrations varying between 18mg/l (L5) to 160mg/l (L1). These concentrations are considerably below the assessment levels and correspond with the levels of ammoniacal nitrogen.

Other tested parameters were detected as follows:

- pH levels of leachate were near neutral at between 6.6 and 7.2.
- Electrical Conductivity levels varied between 800µs/cm to 1,600µs/cm and indicate a weak leachate.
- BOD ranged from 7.7mg O_2/l to 23mg O_2/l.
- COD levels varied between 22mg O_2/l and 61mg O_2/l.
- Dissolved Oxygen was not tested.

These parameters are not regulated by the site permit.

4.0 GROUNDWATER

4.1 Introduction

Groundwater monitoring was carried out at three monitoring points (BH1, BH2, BH96) which are located down gradient from the landfill. They were monitored for the following parameters:

Table 4: Groundwater Monitoring Schedule

Borehole ID	Total	Frequency	Parameters	Units
BH1, BH2, BH22, BH96B	4	Annually	pH Electrical Conductivity Ammoniacal Oxygen Chloride Dissolved Oxygen	pH units µS/cm mg/l

Borehole locations are shown on drawing reference 5379.SURV.D03 (enclosed).

Groundwater monitoring data is presented in Appendix 1.

Site specific control and trigger levels are set out in Table 4.5 of the Hydrogeological Risk Assessment (Amec, 2007), as follows:

Table 5: Groundwater Control and Trigger Levels

Parameters	Control Level (mg/l)				Trigger Levels (mg/l)			
	BH2	BH8*	BH22	BH96B	BH2	BH8*	BH22	BH96B
Chloride	225	225	225	225	250	250	250	250
Ammoniacal Nitrogen	3.6	8.5	23	3.8	4.8	9.5	31	5.1

*BH8 location is unknown

4.2 Groundwater Quality

Ammoniacal Nitrogen was detected at all groundwater monitoring points in low concentrations: 1.8mg/l (BH1), 0.04mg/l (BH2) and 0.52mg/l (BH96B). Concentration in borehole BH1, if compared with the assessment levels for BH2 were also low.

No water sample was collected in BH22. This borehole is situated in the wetland area and is not readily accessible. When last accessed in 2018 the borehole was found to be silted up to the level of surrounding surface water.

Chloride was detected in all boreholes in low concentrations: 10mg/l (BH1), 38mg/l (BH2) and 11mg/l (BH96B) which did not breach groundwater assessment levels.

Other tested parameters were detected as follows:

- pH levels of groundwater were near neutral at between 6.8 and 7.5.
- Electrical Conductivity levels varied between 170 µs/cm and 770 µs/cm.
- BOD ranged from 21 mgO_2/l to 32 mgO_2/l.

- COD concentrations varied between 23 mgO_2/l (BH2) and 470 mgO_2/l (BH96B). All results were elevated but markedly higher in a downgradient monitoring point BH96B.
- Dissolved Oxygen levels in the groundwater boreholes were not tested.

The latest results are generally consistent with those in 2019 but were higher than those during the earlier aftercare period.

5.0 SURFACE WATER

5.1 Introduction

Surface water monitoring was carried out at 10 monitoring points:

- SW1 Drain and tributary of Afon Braint, upstream of the site;
- SW2 Water entering Afon Braint from the drain (SW1);
- SW3 Afon Braint to the west and upstream of the site;
- SW4 Drain from wetland to Afon Braint, downgradient of the site;
- SW5 A wetland area downstream from the site (Area 2);
- SW6 A drain entering the site from east; an upstream monitoring point;
- SW7 A stream entering the site from drain SW6; an upstream monitoring point (sampled in the sump before entering the culvert beneath Area 2);
- SW8 At the culvert exit, downstream of the site (Area 2);
- SW9 A drainage ditch draining from wetland towards Afon Braint, a downstream monitoring point;
- SW10 Afon Braint at the point of entry from drainage ditch (SW9); a downstream monitoring point.

Monitoring points SW3 and SW6 represent background water quality.

The monitoring location plan and the direction of the surface water drainage are enclosed in Appendix 2.

Table 6: Surface Water Monitoring Schedule

Monitoring Point ID	Total	Frequency	Parameters	Units
SW1 SW2 SW3 SW4 SW5 SW6 SW7 SW8 SW9 SW10	10	Annually	pH Electrical Conductivity Ammoniacal Oxygen Chloride Dissolved Oxygen	pH units µS/cm mg/l

Site specific control and trigger levels are set out in Table 4.6 of the Hydrogeological Risk Assessment (Amec, 2007) for downstream monitoring points SW9 and SW10. These levels are calculated as increases over upstream concentrations at SW6 and SW3, respectively, to account for the presence of other potential contaminated sources, as follows:

Table 7: Surface Water Control and Trigger Levels

Parameter	Control Level, mg/l		Trigger Level, mg/l	
	SW9	SW10	SW9	SW10
Chloride	SW6+75	SW3+75	SW6+150	SW3+100
Ammoniacal Nitrogen	SW6+1.0	SW3+0.4	SW6+3.0	SW3+1.0

There are no regulated levels set out for monitoring points SW1, SW2, SW3, SW6 and SW7 situated upstream to the landfill site. Surface water in these locations drains from the surrounding agricultural land. SW8 is situated at the exit from the surface water culvert which drains surface water from the upstream area however this monitoring point is situated downstream and close to landfill Area 2.

Table 8: Surface Water Control and Trigger Levels 2020

Parameter	Control Level, mg/l		Trigger Level, mg/l	
	SW9	SW10	SW9	SW10
Chloride	99	97	174	124
Ammoniacal Nitrogen	1.1	0.6	3.1	1.2

Note: based on concentrations of Cl and NH_3-N in SW6 at 24mg/l and 0.091mg/l, respectively, and in SW3 at 24mg/l and 0.16mg/l, respectively.

5.2 Surface Water Quality

Ammoniacal Nitrogen was detected in all surface water monitoring points. In downstream monitoring points SW9 and SW10 the concentrations were 0.01mg/l in both locations; these are below the relevant assessment levels in Table 8. The concentration of NH_3-N in SW5 was slightly elevated at 0.87mg/l. As mentioned earlier, this monitoring point represents upstream water quality but can be influenced by ingress of groundwater and/or leachate from landfill Area 2.

Ammoniacal nitrogen in upstream monitoring points SW1, SW2, SW3, SW6 and SW7 (surface water sump), was detected in variable concentrations of 0.04mg/l, 0.27mg/l, 0.16mg/l, 0.09mg/l and 0.69mg/l, respectively. Surface water sample from SW8 (the exit from the culvert) contained 5.6mg/l of NH_3-N, which was the overall highest concentration among surface water samples.

These results indicate a) ammoniacal nitrogen continues to be present in surface water albeit in generally low and variable concentrations, b) landfill leachate leaches from 'Dilute & Disperse' Area 2 into surface water, and c) there are external sources of this contaminant upstream of the landfill site. Overall similar results were observed during water monitoring survey in 2019.

Chloride concentrations in control points SW9 and SW10 were 99mg/l in both locations. This concentration is at and above the relevant control levels for Cl, albeit below the trigger levels. The samples taken at upstream monitoring points SW1, SW2, SW3, SW6 and SW7 contained chloride in concentrations of 25mg/l, 23mg/l, 24mg/l, 24mg/l and 30mg/l, respectively. The samples from downstream monitoring points SW4, SW5 and SW8 contained chloride in concentrations of 100mg/l, 54mg/l and 54mg/l, respectively. These results provide an indication of weak chloride loading on the local surface water resource from mainly the landfill site and potentially the local agricultural activities.

Other parameters were tested for and assessed below; these are not regulated by the site permit.

pH levels of surface water samples neutral to slightly alkaline (7.7 to 8.3).

Electrical Conductivity levels varied between 330µs/cm, which is normal for surface water sources, to 850µs/cm (SW4) which indicates a presence of dissolved salts and other inorganic chemicals. These levels are considered insignificant.

BOD ranged from 2.0mg O_2/l to 20mg O_2/l (SW5). BOD levels in water of 3-5mg/l is considered moderately clean. BOD levels of 6-9mg/l, organic matter is present. Levels of BOD in the latest set of results were generally lower in the upstream monitoring points (SW1, SW2, SW3) and two most downstream monitoring points (SW9 and SW10). BOD levels were higher in downstream monitoring points (SW4 and SW5) which are adjacent to the landfill. The upstream point SW6 showed somewhat elevated level of BOD at 6.6mg/l.

These results indicate the effects of landfill leachate and external source(s) of organic pollution, on surface water quality. These latest results correspond with the findings of earlier monitoring surveys.

COD levels varied between 7.6mg O_2/l (SW10) and 370mg O_2/l (SW5). Chemical Oxygen Demand is an 'umbrella' indicator of organic pollution in water. The latest monitoring results showed a marked increase of COD levels in the downstream water samples. The results also indicate that local agricultural activities contribute to pollution of surface water with organic matter Overall the results of COD testing corresponded with the BOD results in surface water samples.

6.0 SUMMARY

The annual monitoring of leachate, groundwater and surface water was carried out at Penhesgyn (closed) non-hazardous landfill site to assess compliance with the site permit in terms of impact on the surrounding water environment.

Leachate

Concentrations of Ammoniacal Nitrogen and Chloride did not breach the control and trigger levels in leachate wells in the Dilute and Disperse Area 2. Other tested parameters were also low compared with leachate quality of a typical operational non-hazardous landfill site. Overall, the latest monitoring results indicate that leachate in Area 2 is of weaker strength and/or diluted with groundwater. Levels of many tested parameters in leachate were comparative with those observed in the groundwater samples. In the context of the earlier monitoring results, leachate quality continues to be consistently weak.

Groundwater

There were no breaches of the site-specific control and trigger levels for Ammoniacal Nitrogen and Chloride. At the same time, in all samples levels of COD were elevated but markedly higher in a downgradient monitoring point BH96B. Other tested parameters were detected in stable and low concentrations.

Overall, groundwater quality during the review period was consistent with the results of 2019 monitoring survey as well as the earlier monitoring data collected during the aftercare period.

Surface water

Ammoniacal Nitrogen was detected in all surface water samples in variable concentrations. The regulated monitoring points SW9 and SW10 contained relatively low concentrations of NH_3-N and were compliant with the assessment levels. Higher concentrations were detected in other downstream locations which are situated closer to the landfill. Ammoniacal Nitrogen was also detected in the upstream monitoring points, albeit in low concentrations.

Chloride was also detected in all monitoring locations, including the two regulated monitoring points (SW9 and SW10) where it was present in concentrations close to the control levels. Water samples from other downstream monitoring points also contained chloride in concentrations higher than those observed in water samples in the upstream monitoring points.

Other tested parameters Electrical Conductivity, Chemical Oxygen Demand and Biological Oxygen Demand were generally higher in downstream surface water samples.

Overall, the latest water quality monitoring results show that the local groundwater and surface water continue to be affected by landfill leachate from Area 2 however the leachate quality is weakened. The quality of groundwater in the regulated monitoring points was compliant with the relevant assessment levels. The quality of surface water in the two regulated monitoring points was compliant for ammoniacal nitrogen but slightly above the control levels for chloride.

There monitoring results continue to indicate that local agricultural activities also contribute organic and inorganic pollution loading on the local water resource. These latest results accord with the findings of earlier monitoring surveys.

Appendix 1 Data Summary Tables (2014-2020)

Appendix 1 Data Summary Table (2014-2020)

Sample ID	Date Sampled	pH	Electrical Conductivity	Chloride, as Cl	Ammoniacal Nitrogen, as N	Chemical Oxygen Demand	Biochemical Oxygen Demand	Dissolved Oxygen
		pH units	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
BH1	14/03/2014	6.7	169	14.4	<0.2			5.44
BH2	14/03/2014	7.35	709	43	<0.2			5.84
BH22	14/03/2014	no access						
BH96B	14/03/2014	7.41	692	7.6	<0.2			1.6
L1	14/03/2014	7.01	3340		117		6.49	<0.3
L4	14/03/2014	7.47	1850		54.8		3.35	<0.3
L5	14/03/2014	7.63	537		0.629		17.4	10.1
L6	14/03/2014	7.19	688		0.239		5.55	7.9
L7	14/03/2014	7.53	630		<0.2		20.3	<0.3
SW1	14/03/2014	8.02	440	28.9	<0.2		<1	11.2
SW2	14/03/2014	7.59	263	28.1	<0.2		<1	8.87
SW3	14/03/2014	7.59	278	28.2	<0.2		<1	10.8
SW4	14/03/2014	7.16	439	48.8	<0.2		7.55	7.51
SW5	14/03/2014	no access						
SW6	14/03/2014	7.72	501	31.7	<0.2		7.03	9.39
SW7	14/03/2014	7.77	520	31.9	<0.2		<1	9.65
SW8	14/03/2014	7.67	573	38.7	0.863		<1	4.38
SW9	14/03/2014	7.72	580	45.1	0.571		<1	10
SW10	14/03/2014	7.68	277	27.8	<0.2		<1	9.82

Sample ID	Date Sampled	pH	Electrical Conductivity	Chloride, as Cl	Ammoniacal Nitrogen, as N	Chemical Oxygen Demand	Biochemical Oxygen Demand	Dissolved Oxygen
		pH units	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
BH1	14/04/2015	7.98	148	13.2	<0.2			1.32
BH2	14/04/2015	8.11	764	40.9	0.433			3.97
BH22	14/03/2015	no access						
BH96	14/04/2015	7.77	688	13.1	0.352			2.14
L1	14/04/2015	7.93	4700		151		6.92	<0.3
L4	14/04/2015	8.16	3580		133		10	<0.3
L5	14/04/2015	no access						
L6	14/04/2015	7.84	667		<0.2		<1	4.57
L7	14/04/2015	7.4	661		2.04		3.94	<0.3
SW1	14/04/2015	8.21	469	30.7	0.229	<7	<1	11.9
SW2	14/04/2015	7.95	275	26.4	0.22	14.4	<1	11.4
SW3	14/04/2015	7.86	293	27.2	0.204	<7	<1	11.3
SW4	14/04/2015	7.7	564	48.4	<0.2	46.4	3.24	6.29
SW5	14/04/2015	no access						
SW6	14/04/2015	7.98	393	25.3	<0.2	8.04	<1	12.1
SW8	14/04/2015	7.89	611	38.3	0.72	<7	<1	9.62
SW9	14/04/2015	8.16	652	49.5	0.556	16	2.66	11.8
SW10	14/04/2015	7.85	287	26.8	0.227	7.33	<1	10.5

Sample ID	Date Sampled	pH units	Electrical Conductivity	Chloride, as Cl	Ammoniacal Nitrogen, as N	Chemical Oxygen Demand	Biochemical Oxygen Demand	Dissolved Oxygen
		pH	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
BH1	26/04/2016	6.8	166	13	0.02	10	<2.9	5.6
BH2	26/04/2016	8	956	45	0.07	<5	<2.9	7.3
BH22	26/04/2016	no access						
BH96B	26/04/2016	7.1	787	25	0.5	8	<2.9	3.8
L1	26/04/2016	7.2	3450	442	73.4	110	6.6	1.9
L4	26/04/2016	7.3	2960	479	86.9	164	11.1	2.1
L5	26/04/2016	7.4	367	27	0.05	11	<2.9	9.4
L6	26/04/2016	7	800	30	0.04	12	<2.0	4.8
L7	26/04/2016	6.9	758	25	0.02	12	<2.0	6
SW1	26/04/2016	7.5	350	27	0.09	12	<2.9	8.9
SW2	26/04/2016	7.5	322	26	0.07	12	<2.9	10.4
SW3	26/04/2016	7.5	369	26	0.06	10	<2.9	10.2
SW4	26/04/2016	6.8	735	71	0.5	55	29.4	0.8
SW5	26/04/2016	no access						
SW6	26/04/2016	7.7	626	16	0.01	62	<2.9	9.2
SW7	26/04/2016	7.3	476	23	0.05	23	6.8	7.2
SW8	26/04/2016	7.6	642	33	0.02	28	4.1	10.1
SW9	26/04/2016	7.3	749	41	0.5	10	<2.9	4
SW10	26/04/2016	7.3	727	52	0.3	11	7.2	6.9

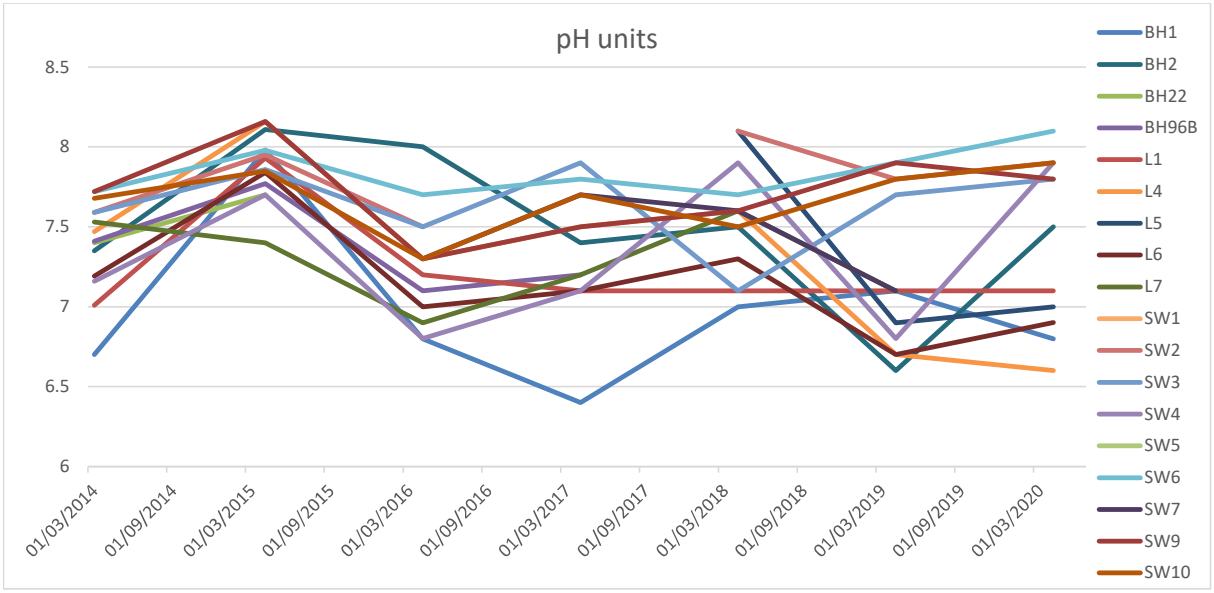
Sample ID	Date Sampled	pH pH units	Electrical Conductivity µS/cm	Chloride, as Cl mg/l	Ammoniacal Nitrogen, as N mg/l	Chemical Oxygen Demand mg/l	Biochemical Oxygen Demand mg/l	Dissolved Oxygen mg/l
BH1	26/04/2017	6.4	127	8.2	0.044	1.6	26	11.1
BH2	26/04/2017	7.4	909	50	0.052	1.7	<10	10.1
BH22	26/04/2017	7.4	1240	88	7.3	8.6	34	10.8
BH96B	26/04/2017	7.2	850	18	1.7	1.8	<10	7
L1	26/04/2017	7.1	3710	460	96	6.2	92	8.8
L4	26/04/2017	7.5	1540	190	14	2.6	42	7.8
L5	26/04/2017	no access						
L6	26/04/2017	7.1	995	24	0.12	1.4	<10	10.5
L7	26/04/2017	7.2	994	21	0.056	1.1	10	11.2
SW1	26/04/2017	8.1	493	26	<0.0015	2.5	<10	11.3
SW2	26/04/2017	no access						
SW3	26/04/2017	7.9	332	18	0.089	2.4	13	10.7
SW4	26/04/2017	7.1	736	26	0.12	<1	34	8.2
SW5	26/04/2017	no access						
SW6	26/04/2017	7.8	461	18	0.093	2	<10	7.8
SW7	26/04/2017	7.7	721	31	1.2	1.9	<10	11
SW8	26/04/2017	7.5	754	54	1.5	2.7	<10	10.5
SW9	26/04/2017	7.5	750	42	0.28	2.8	12	8.6
SW10	26/04/2017	7.7	338	21	0.18	1.5	<10	11

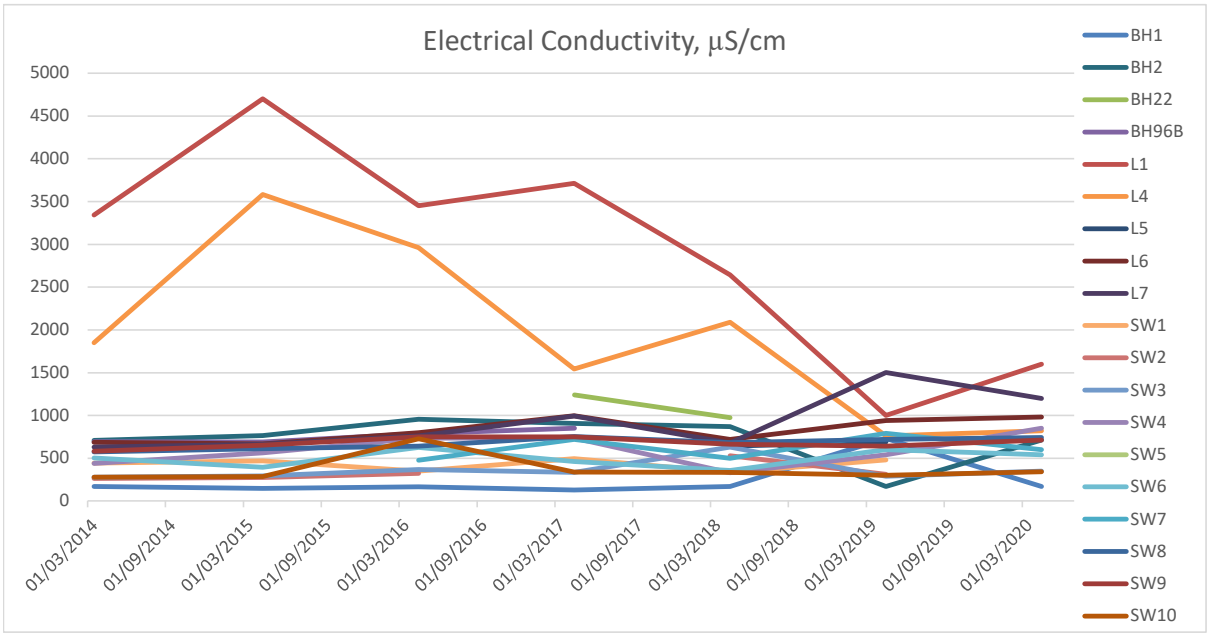
Sample ID	Date Sampled	pH pH units	Electrical Conductivity µS/cm	Chloride, as Cl mg/l	Ammoniacal Nitrogen, as N mg/l	Chemical Oxygen Demand mg/l	Biochemical Oxygen Demand mg/l	Dissolved Oxygen mg/l
BH1	09/04/2018	7	168	10	0.093	140	25	4.8
BH2	09/04/2018	7.5	807	41	0.043	11	5.1	9
BH22	09/04/2018	7.7	974	85	7.6	28	49	10
BH96B	09/04/2018	no access						
L1	09/04/2018	7.1	2640	120	68	22	16	8.8
L4	09/04/2018	7.6	2090	140	47	86	14	6.1
L5	09/04/2018	8.1	642	19	1.5	<10	17	9.4
L6	09/04/2018	7.3	719	29	0.21	<10	14	8.2
L7	09/04/2018	7.6	679	17	0.063	<10	15	7.2
SW1	09/04/2018	7.4	332	24	0.34	19	7.3	10.2
SW2	09/04/2018	8.1	530	26	3.6	<10	6.9	10
SW3	09/04/2018	7.1	630	34	0.44	140	71	3.4
SW4	09/04/2018	7.9	331	24	0.35	18	7.3	9.8
SW5	09/04/2018	no access						
SW6	09/04/2018	7.7	357	14	0.082	19	6.4	5.5
SW7	09/04/2018	7.6	500	21	0.27	81	70	10.2
SW8	09/04/2018	7.5	681	34	1.6	<10	8.5	9.9
SW9	09/04/2018	7.6	663	41	0.27	10	5.3	9.4
SW10	09/04/2018	7.5	333	24	0.34	21	7.3	10

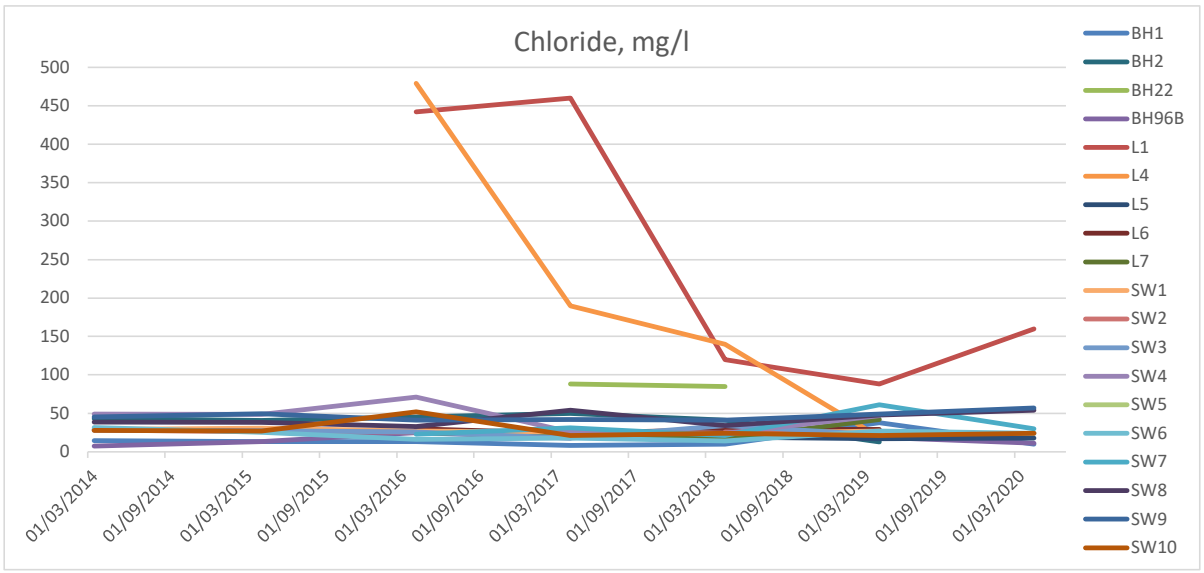
Sample ID	Date Sampled	pH pH units	Electrical Conductivity µS/cm	Chloride, as Cl mg/l	Ammoniacal Nitrogen, as N mg/l	Chemical Oxygen Demand mg/l	Biochemical Oxygen Demand mg/l	Dissolved Oxygen mg/l
BH1	09/04/2019	7.1	730	38	<0.015	440	<1.0	8.2
BH2	09/04/2019	6.6	170	13	0.099	690	28	1.4
BH22	09/04/2019	no access						
BH96B	09/04/2019	7.1	640	19	1.8	590	<1.0	2.3
L1	09/04/2019	7.1	1000	88	17	40	2.5	3.2
L4	09/04/2019	6.7	760	19	0.79	34	3.6	2
L5	09/04/2019	6.9	690	17	1.3	170	6.6	2.4
L6	09/04/2019	6.7	940	29	0.072	16	2.5	2.7
L7	09/04/2019	7.1	1500	42	1.2	2900	11	2.1
SW1	09/04/2019	8.2	480	27	<0.015	13	1.7	11
SW2	09/04/2019	7.8	310	23	0.037	32	1.9	11
SW3	09/04/2019	7.7	290	22	0.062	19	1.7	10
SW4	09/04/2019	6.8	540	47	0.1	51	1.6	2.6
SW5	09/04/2019	7.3	980	41	7.2	3700	17	<1.0
SW6	09/04/2019	7.9	600	27	0.035	9	1	11
SW7	09/04/2019	7.1	790	61	10	2100	20	<1.0
SW8	09/04/2019	7.5	720	48	4.3	8.8	2.4	6.6
SW9	09/04/2019	7.9	640	49	0.97	8.7	2.9	11
SW10	09/04/2019	7.8	300	21	0.047	17	<1.0	10

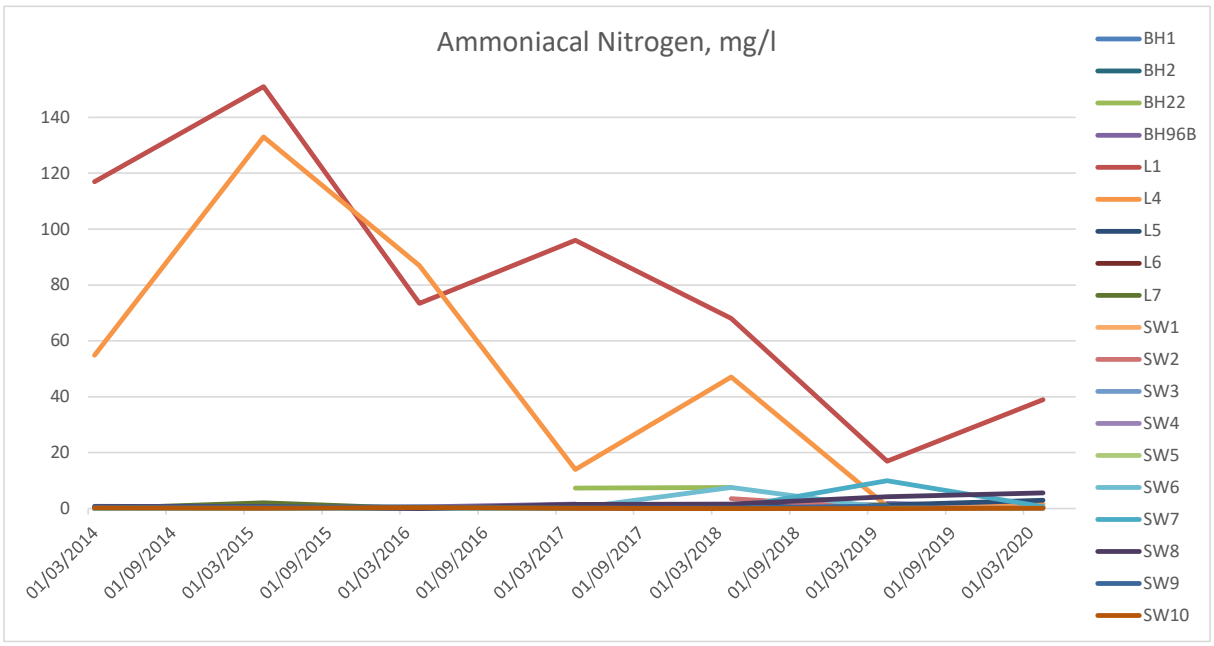
Sample ID	Date Sampled	pH pH units	Electrical Conductivity µS/cm	Chloride, Cl mg/l	Ammoniacal Nitrogen, NH_3-N mg/l	Chemical Oxygen Demand mg/l	Biochemical Oxygen Demand mg/l	Dissolved Oxygen mg/l
BH1	30/04/2020	6.8	170	10	1.80	160	31	n/a
BH2	30/04/2020	7.5	710	38	0.04	23	32	n/a
BH22	30/04/2020				no access			
BH96B	30/04/2020	7.2	770	11	0.52	470	21	n/a
L1	30/04/2020	7.1	1600	160	39.00	61	23	n/a
L4	30/04/2020	6.6	820	24	1.50	29	17	n/a
L5	30/04/2020	7	800	18	3.00	43	17	n/a
L6	30/04/2020	6.9	980	22	0.39	31	17	n/a
L7	30/04/2020	7.2	1200	28	0.07	22	7.7	n/a
SW1	30/04/2020	8.3	510	25	0.04	13	2.2	n/a
SW2	30/04/2020	7.9	330	23	0.27	19	2	n/a
SW3	30/04/2020	7.8	350	24	0.16	22	3.8	n/a
SW4	30/04/2020	7.9	850	100	0.16	55	11	n/a
SW5	30/04/2020	7.6	710	54	0.87	370	20	n/a
SW6	30/04/2020	8.1	540	24	0.09	29	6.6	n/a
SW7	30/04/2020	7.7	600	30	0.69	48	n/a	n/a
SW8	30/04/2020	7.7	740	54	5.60	29	n/a	n/a
SW9	30/04/2020	7.8	710	57	0.01	31	4.5	n/a
SW10	30/04/2020	7.9	340	24	0.01	7.6	4.5	n/a

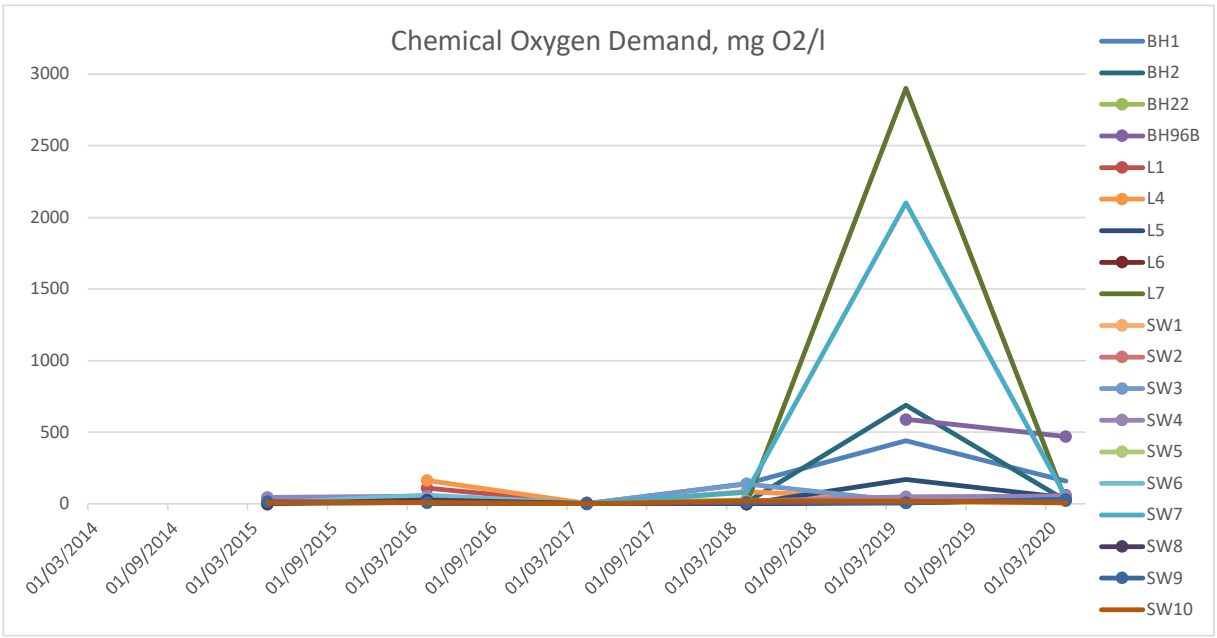
n/a test not carried out

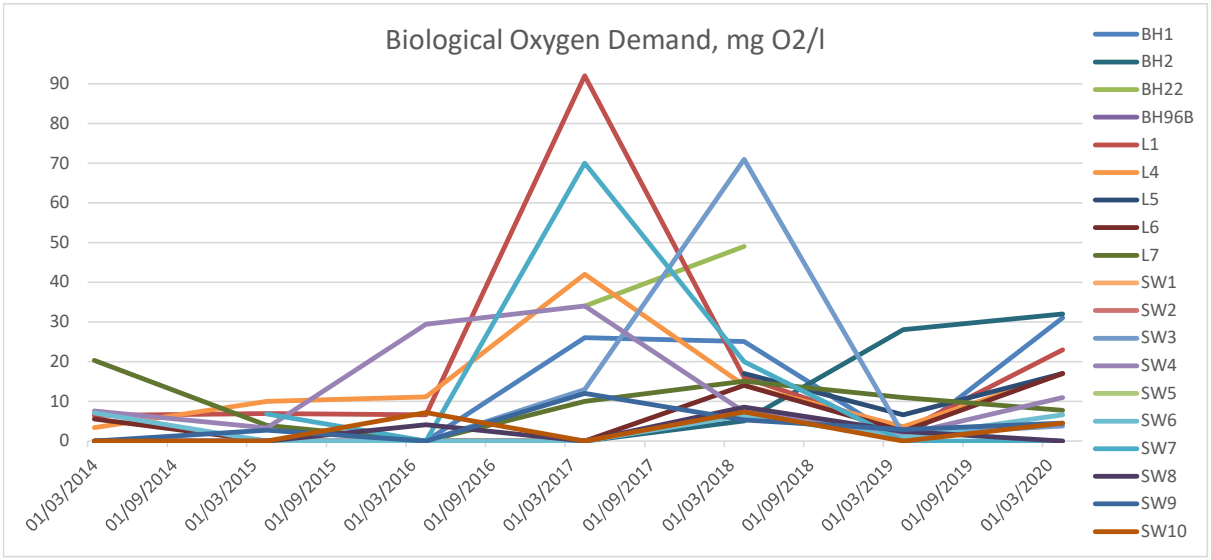

pH units
8.5
8
7.5
7
6.5
6
01/03/2014
01/09/2014
01/03/2015
01/09/2015
01/03/2016
01/09/2016
01/03/2017
01/09/2017
01/03/2018
01/09/2018
01/03/2019
01/09/2019
01/03/2020
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW9
SW10

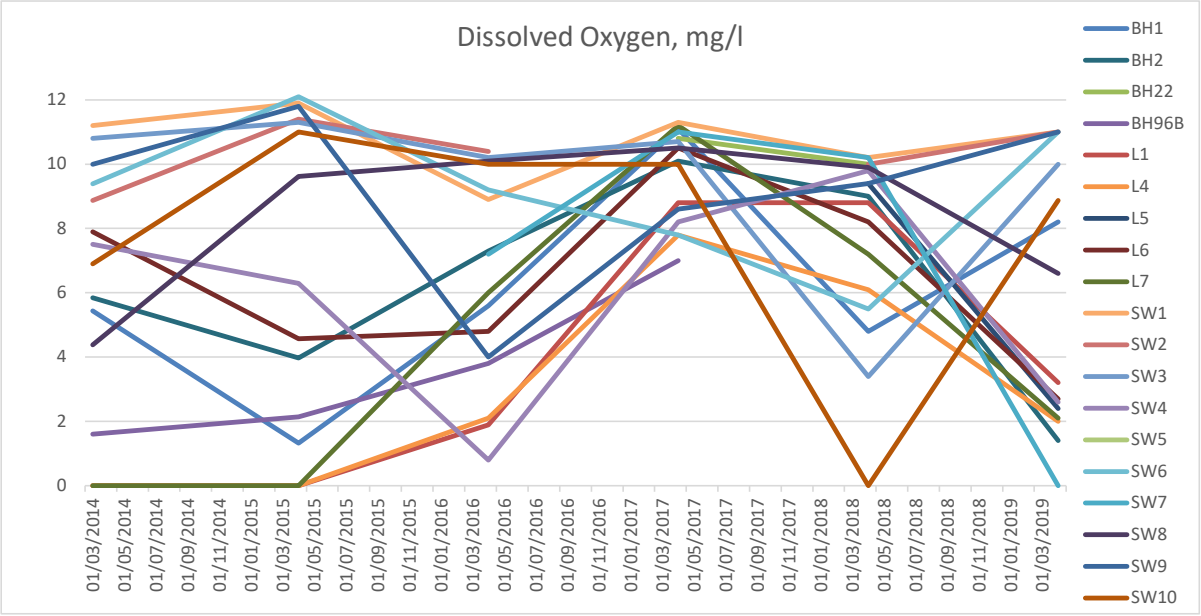

Electrical Conductivity, µS/cm
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/03/2014
01/09/2014
01/03/2015
01/09/2015
01/03/2016
01/09/2016
01/03/2017
01/09/2017
01/03/2018
01/09/2018
01/03/2019
01/09/2019
01/03/2020
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10


Chloride, mg/l
500
450
400
350
300
250
200
150
100
50
0
01/03/2014
01/09/2014
01/03/2015
01/09/2015
01/03/2016
01/09/2016
01/03/2017
01/09/2017
01/03/2018
01/09/2018
01/03/2019
01/09/2019
01/03/2020
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10


Ammoniacal Nitrogen, mg/l
140
120
100
80
60
40
20
0
01/03/2014
01/09/2014
01/03/2015
01/09/2015
01/03/2016
01/09/2016
01/03/2017
01/09/2017
01/03/2018
01/09/2018
01/03/2019
01/09/2019
01/03/2020
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10


Chemical Oxygen Demand, mg O2/l
3000
2500
2000
1500
1000
500
0
01/03/2014
01/09/2014
01/03/2015
01/09/2015
01/03/2016
01/09/2016
01/03/2017
01/09/2017
01/03/2018
01/09/2018
01/03/2019
01/09/2019
01/03/2020
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10


Biological Oxygen Demand, mg O2/l
90
80
70
60
50
40
30
20
10
0
01/03/2014
01/09/2014
01/03/2015
01/09/2015
01/03/2016
01/09/2016
01/03/2017
01/09/2017
01/03/2018
01/09/2018
01/03/2019
01/09/2019
01/03/2020
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10


Dissolved Oxygen, mg/l
12
10
8
6
4
2
0
01/03/2014
01/05/2014
01/07/2014
01/09/2014
01/11/2014
01/01/2015
01/03/2015
01/05/2015
01/07/2015
01/09/2015
01/11/2015
01/01/2016
01/03/2016
01/05/2016
01/07/2016
01/09/2016
01/11/2016
01/01/2017
01/03/2017
01/05/2017
01/07/2017
01/09/2017
01/11/2017
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
BH1
BH2
BH22
BH96B
L1
L4
L5
L6
L7
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10

Appendix 2 Surface Water Drainage System and Surface Water Management Plan (copied from the Site Closure Plan, 2007)

N

Area 3

Area 2

IL 56.1m

Tributary of Afon Braint

Afon Braint

Tributary of Afon Rhyd-Eilian

Drain

Issues

Spr

Track

Maes Llwyn

Penhesgyn Gors

Penhesg Isaf

Pen-hesgyn Hall

Curlew Cottage

Pump House

Marchynys

CG

55m

60m

65m

70m

74m

61m

Key

- Watercourse
- Direction of flow
- Drainage path from culvert to Afon Braint
- Existing culvert
- Open drain
- Land drain
- Open ditch
- CGMAC Leasehold boundary
- Landfill area

0 m 250 m

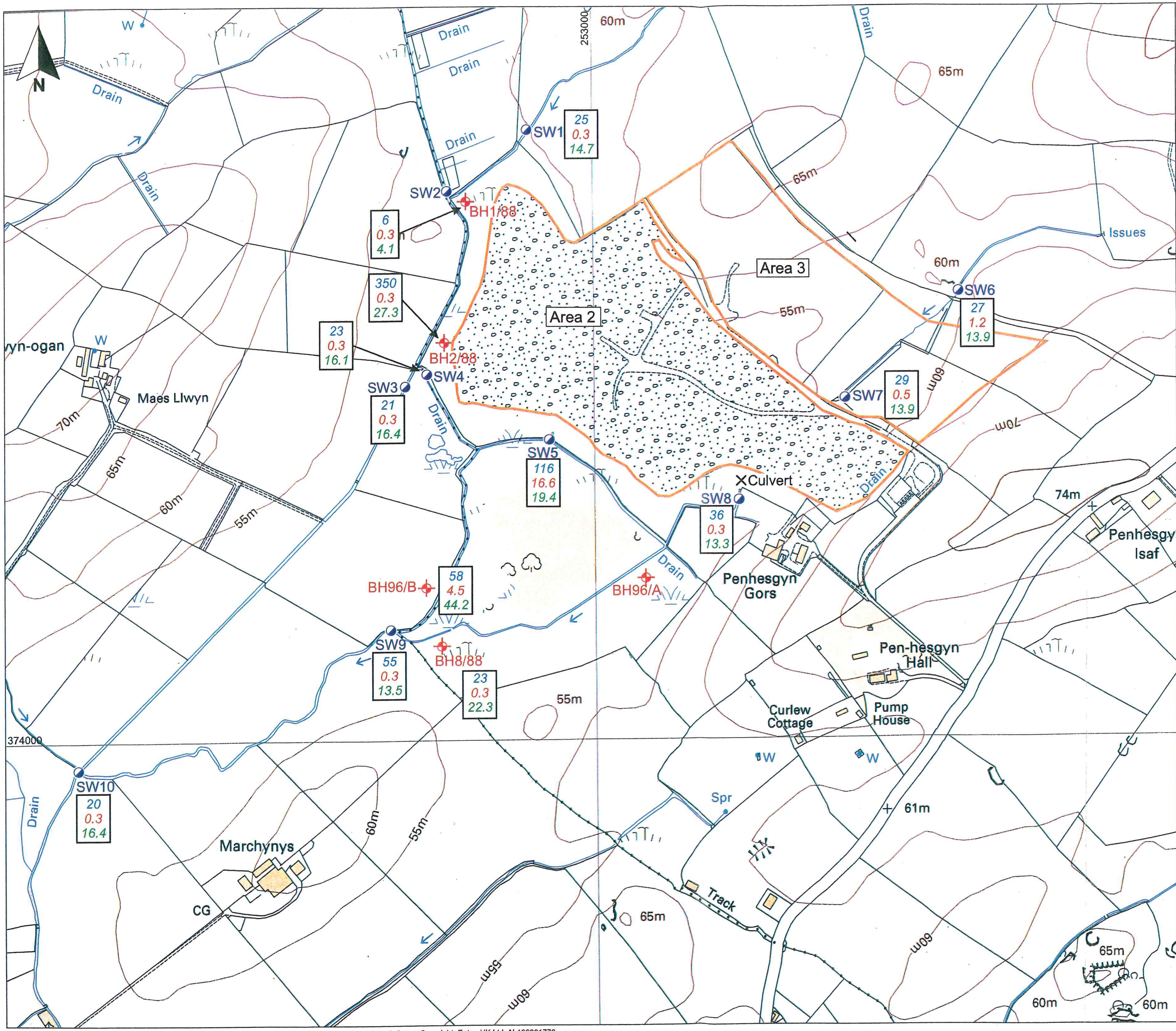
Scale 1:5,000 @ A3

Penhesgyn Landfill
Surface Water Management Plan

Figure 1
River and Stream System

May 2007
00264-S355.cdr holfs

Entec



Key

(symbol)	Borehole
(symbol)	Surface water sampling points
27	Chloride concentrations (mg/l)
1.2	Ammonia-as-N concentrations (mg/l)
13.9	TOC concentrations (mg/l)

0 m 300 m

Scale 1:5000 @ A3

Penhesgyn Landfill Site
Groundwater Risk Assessment

Figure 2.7
Monitoring Results for November 2001

December 2003
00264-S198.cdr drewc

Entec