NANT Y CAWS
PHASE 1
CLOSED LANDFILL

ENVIRONMENTAL PERMIT EA WML 34183

2019 Annual Environmental Monitoring Report

Report Number 1981r1v1d0120

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1 INTRODUCTION

Carmarthenshire County Council (CCC) maintains Nant y Caws (NYC) Phase I Landfill which is located east of Carmarthen and west of Cross Hands (see Figure 1). The landfill is in Aftercare and has not accepted waste since March 1997. The landfill has been partially restored, with a full FML (Flexible Membrane Liner) placed over the capped area. The site is regulated by Natural Resources Wales (NRW) through Permit No. EA WML 34183.

The Permit requires routine environmental monitoring to be undertaken. Geotechnology Ltd (Geotechnology) has been commissioned by CCC to undertake the monitoring since April 2013 and to report the results. This annual review of the monitoring data is based on the available data gathered up to December 2019.

This report includes data provided to Geotechnology by third parties.

2 OVERVIEW OF SITE ACTIVITY

Key dates relating to the operation, closure, capping and regulatory control of the landfill are provided in Table 2-1. A detailed site plan showing surface topography and monitoring infrastructure is provided in Figure 2.

Table 2-1 Summary of Key Dates

Date	Activity
1984	Phase 1 Landfill designed
12 Dec 1985	Waste Disposal Plan (WDP) issued by Carmarthen District Council
1 May 1994	WDP converted to a Waste Management Licence (WML)
1997	Cessation of landfilling operations
1998	Installation of gas and groundwater monitoring infrastructure
Dec 1999	Final FML capping completed
1 Jan 2002	Modification to WML by Environment Agency
2002/2003	Geotechnology undertakes hydrogeological risk assessment and prepare monitoring action plans based on limited data set
2009	Leachate Breakout on Southern Bund – Remedial measures implemented
6 April 2010	WML automatically became an Environmental Permit in accordance with the Environmental Permitting Regulations (England and Wales) 2010
2010	Leachate treatment system undergoing improvements
20 Jan 2015	Landfill formally taken into Aftercare by NRW
2016	Permit Variation issued to operator of leachate treatment system (EPR/PP3338CQ) CWM Environmental placed soils over central part of aimed at restoring surface drainage patterns

Key features of the site are highlighted on Figures 2 and 3. The latter figure is a conceptual site model previously developed for a Hydrogeological Risk Assessment by Geotechnology.

2.1 Landfilling

The landfill was designed in 1984 by W.S. Atkins and Partners and was based on a containment principle. However, there are no details available to demonstrate that any form of engineered containment was adopted. Instead, the design is considered to rely on the in-situ glacial till to provide an impermeable base. A series of leachate interceptor drains are shown on the original site plans. The design drawings also show that Phase 1 was divided into a series of working cells with a total of 25 shown on the plan.

This original plan also describes the working method, which involved vertical layering with working faces of 2 to 2.5m which are then capped with 300mm of inert fill. Subsequent working faces were pushed over each completed layer to form four layers, giving a total landfill thickness of between approximately 8 and 10m. This data was broadly confirmed in subsequent drilling for internal gas wells in 1998, though a maximum waste thickness of 14m was obtained. It is known that over-tipping and further waste layering was undertaken at the site in late 1994 and early 1995 which may account for the increased thickness observed. The original design also shows that at the site boundary a cut-off ditch was constructed which is further isolated from the refuse by a clay bund.

Landfilling ceased in March 1997 and the landfill has not received any wastes since then.

2.2 Capping

During the operational period, measures were undertaken to reduce the leachate yield from the site in the form of FML applications to the flanks. Initially, a 0.5mm polypropylene membrane was used on the southwestern flank though this has been replaced by a 2mm

double textured HDPE. All the flanks of the landfill now have a 2mm textured HDPE cover, which in turn is welded to a 1mm smooth HDPE liner on the plateau cap. Prior to the final capping work being completed in December 1999, an intermediate layer of 0.5m of clay soil cover was placed, though it is locally thicker in hollows.

The Phase 1 landfill has therefore been capped since December 1999.

2.3 Restoration

The agricultural restoration of the Phase 1 landfill continued from 1999 up until 2003, although there are no precise records. The restoration process involved the importation of sub-soils from many extraneous sources. Geotechnology undertook a soil audit of the areas completed up till November 2002. This is documented in Geotechnology report 237/0/1102 issued in November 2002. Geotechnology was not involved in the final stages of restoration at the landfill.

Agricultural post and wire fencing was placed and the surface was seeded to encourage surface soil stabilisation on the restored cap. The fields created by the fences are present today. The vegetation within the fields is, however, overgrown and does not appear to be being grazed or managed in accordance with the intention of the Post Closure Working Plan.

Following the removal of several stockpiles, CWM Environmental placed materials over the central part of the site during 2016. These works were aimed at reinstating the landfill landform and protection of the capping systems. Plates 1 and 2 illustrate the current site conditions.

2.4 Leachate Management

The leachate at the site is collected by a gravity fed under waste drainage system comprising a 225mm diameter spine drain receiving inflows from 150mm diameter spur drains. The drainage system is accessed from the landfill surface by leachate inspection chambers, which rise through the waste. The chambers allow inspection of the leachate system and permit access for routine maintenance, leachate level measurement and cleaning. The position of each chamber has been re-surveyed by Geotechnology and is shown on Figure 2. Leachate inspection chambers 9 and 16 could not be found during the survey.

In addition to the under drainage works undertaken during the infilling, further leachate drains were installed at the toe of the flanks to intercept perched leachate which was historically observed to break out along the flanks. This work was completed during the capping period of the restoration in 1999. Both the toe drains and under drain system flow under gravity to the pumping sump from where the leachate is pumped, either to the nearby concrete lined leachate lagoon or the treatment plant. Following treatment, the leachate is discharged to the Afon Bantwen under discharge consent. An application to vary the Permit was prepared by Geotechnology, at the request of CCC in 2015, and this was accepted by NRW in 2016.

3 REGULATORY FRAMEWORK

The Aftercare Management Plan sets out the relevant regulatory framework against which the environmental protection measures should be evaluated. These criteria are summarised in the following sections.

3.1 Leachate Level Limit

The maximum level of leachate that should be observed from a leachate inspection chamber is 0.5m as measured from the base of the chamber.

3.2 Leachate Chemistry Control Levels

Control levels for assessing leachate chemistry are provided in Table 3-1.

Table 3-1 Leachate Control Levels

	Ammoniacal Nitrogen	Chloride	Potassium
	mg l^{-1}	mg l^{-1}	mg l^{-1}
Current Discharge Consent from Effluent Treatment Plant	**4**		
Leachate Quarterly Control Level for L1	70	250	140
Daily Leachate Control Levels	4		

3.3 Groundwater Compliance Levels

Current groundwater trigger and control levels are summarised in Table 3-2.

Table 3-2 Trigger Levels for Emissions to Groundwater

	Ammoniacal Nitrogen	Chloride	Potassium
	mg l^{-1}	mg l^{-1}	mg l^{-1}
Groundwater Trigger Level BH101, 103, 104, 105 and 117	10	250	40
Groundwater Control level BH101, 103, 104, 105 and 117	4	150	30

3.4 Surface Water Control Levels

Current surface water control levels are summarised in Table 3-3.

Table 3-3 Control Levels for Emissions to Surface Water

	Ammoniacal Nitrogen	Chloride	Suspended Solids
Location	mg l^{-1}	mg l^{-1}	mg l^{-1}
SW1	0.6	150	
Cap run-off discharge			50 mg/l
French Drain Discharge	4		

3.5 Perimeter Gas Compliance Levels

Currently applicable emission limits for the perimeter gas wells are summarised in Table 3-4.

Table 3-4 Landfill Gas in External Monitoring Boreholes Emission Limits

Perimeter gas position	Carbon Dioxide Action Level (% v/v)	Methane Compliance Limit (% v/v)
All positions	3	1

Action levels are for internal use by CCC while methane compliance limits are a Permit requirement.

4 MONITORING NETWORK PERFORMANCE

To demonstrate that the site is functioning as designed, a monitoring programme is being implemented. The current programme is managed by CCC with the monitoring of leachate, downgradient groundwater, surface water and external landfill gas currently undertaken by Geotechnology. Upgradient groundwater wells are sampled by the current operators of the adjacent operational landfill, CWM Environmental. The available monitoring infrastructure is shown on Figure 2.

A summary of the current monitoring programme is provided in Table 4-1.

Table 4-1 Current Monitoring Programme

Item	Monitoring Point	Type of Monitoring	Monitoring Frequency	Relevant Working Plan	Party Responsible
A	Landfill leachate level	Level and Conditional Observations	Monthly for 12 months starting 2014 and then quarterly	See WP10	Needs to be clarified*
B	Landfill leachate – L1	Composition	Six monthly	See WP10	Geo (access required))
C	Leachate Breakout - Phase 1 flanks (including toe drain)	Visual	Quarterly	See WP10	Geo
D	Upgradient Groundwater – BH203, BH205	Composition		Data provided by CWM Environmental	CCC/CWM
E	Downgradient Groundwater – BH101, 103, 104, 105, 117	Level	Quarterly	See WP11	Geo
F	Downgradient Surface Water – SW1, SW4	Composition	Quarterly	See WP12	Geo
G	Internal landfill gas	Composition	Monthly	See WP13	Infinis
H	French Drain	On-site measurement of composition	When observed to be flowing during inspections by WEBS	See WP12	Needs to be clarified *
I	Run-off Discharge	Composition	Quarterly	See WP12	Geo
J	Leachate Discharge	Composition	Monthly	See WP10	Needs to be clarified *
K	Contingency Surface Water Sample Points	Composition		See WP12	Geo
L	Perimeter landfill gas - BH102, 106, 107, 109, 110, 111, 113, 114, 115, 118, 119, 120	Composition	Quarterly	See WP14	Geo
M	Monitoring infrastructure integrity	Observational	Inspect each point when sampling	See WP10 – WP14	Geo
N	Topographic Survey and Settlement Assessment	Topographic Survey	Every 5 years starting 2015	See WP15	Geo

Note: * Geotechnology understands that CCS has appointed a new contractor to manage the leachate treatment system. It is unknown if the new contractor has been requested to undertake the monitoring identified

4.1 Monitoring Network

Each time Geotechnology undertakes the monitoring, an inspection of the monitoring infrastructure is also completed. Since 2013, clearance of vegetation along the northwestern edge of the landfill has taken place. Routine control of the vegetation significantly aids the safe collection of samples.

Other minor repairs have been undertaken as required to headworks of several wells. Several headworks still require improvement.

4.2 Sample Analysis & Laboratory Performance

Samples collected for laboratory testing were submitted to UKAS registered Chemtest laboratories in cooler boxes. The results from the laboratory analysis have been compiled as follows:

- Appendix 1: Laboratory Certificates
- Appendix 2: Leachate Chemistry
- Appendix 3: Groundwater Chemistry
- Appendix 4: Surface water Chemistry

In previous years, the operators of the leachate treatment plant undertook more frequent monitoring of the leachate prior to and following treatment. They also monitored the quality of a French drain along the southern perimeter of the site that was previously installed to collect leachate outbreaks. It is unclear if this data is still being gathered by the new contractor.

4.3 Site Observations

During the first round of sampling in April 2013, an oil sheen was noticed on the surface of the sample taken from BH104. This has not been observed since.

The restored landfill cap is largely covered by good vegetative cover and appears largely visibly stable. On the eastern flanks and most of the plateau, the landfill is parcelled into grassed fields. In some areas, drainage appears to be poor with reeds developing.

The western and northern portions of the landfill have recently been reprofiled by CWM Environmental. Most of the flanks in the northern and western boundary of the landfill have self-seeded, resulting in the proliferation of many dwarf trees (mainly willow), gorse, broom and other flora. Whilst this is not in accordance with the species proposed in the Post Closure Working Plan, they have had the desired effect of stabilising the slopes, especially the near surface restoration soils. No evidence of instability, failure or leachate breakout was observed in the walkovers undertaken during the latter part of 2019.

Leachate breakout has previously occurred on the southern bund of the landfill. Measures to collect and treat excess leachate have been implemented by CCC. In the same corner, the capping membrane HDPE is exposed and damaged over an area of approximately 1m^2. Based on visible vehicle tracks, Geotechnology suspects that trafficking has primarily caused the damage rather than any failure of the soil cover. In the southeastern corner of the landfill, Geotechnology suspects perching of leachate within the waste as the ground surface is soft and fully saturated.

The access road down to the leachate treatment plant is tarmacadam and is in good condition.

4.4 Topographic Survey

The landform at Phase 1 has been surveyed on many occasions, the most recent of which was in 2019 by Geotechnology, at the request of CWM environmental. Given this recent survey, the next topographic survey should be scheduled for 2024. An isopachyte comparing the 2019 land surface with the 2015 land surface is provided in Appendix 5.

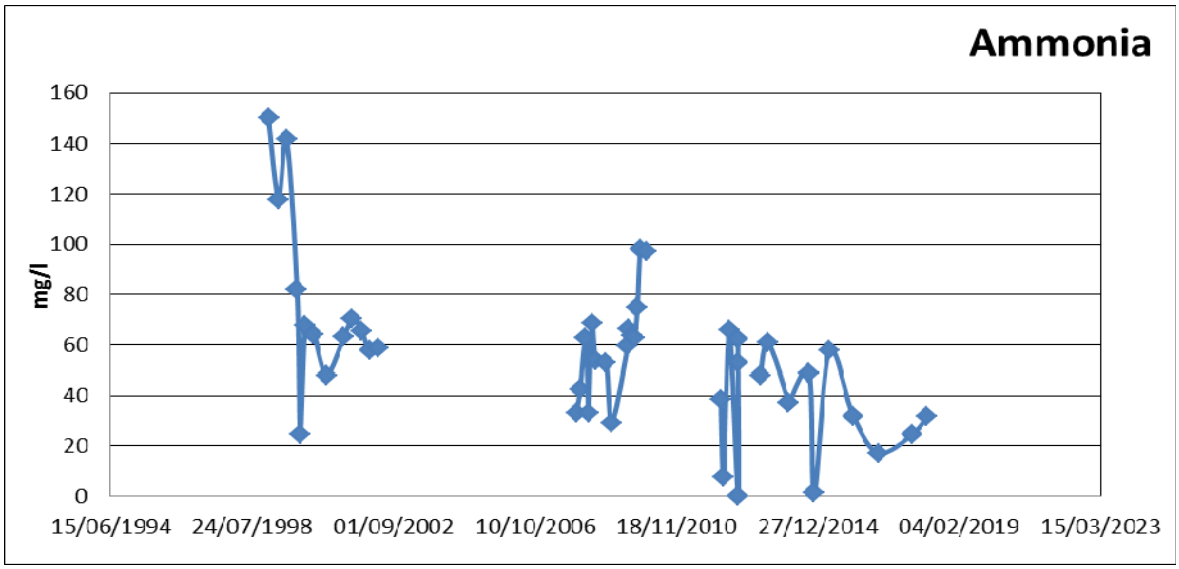
5 LEACHATE

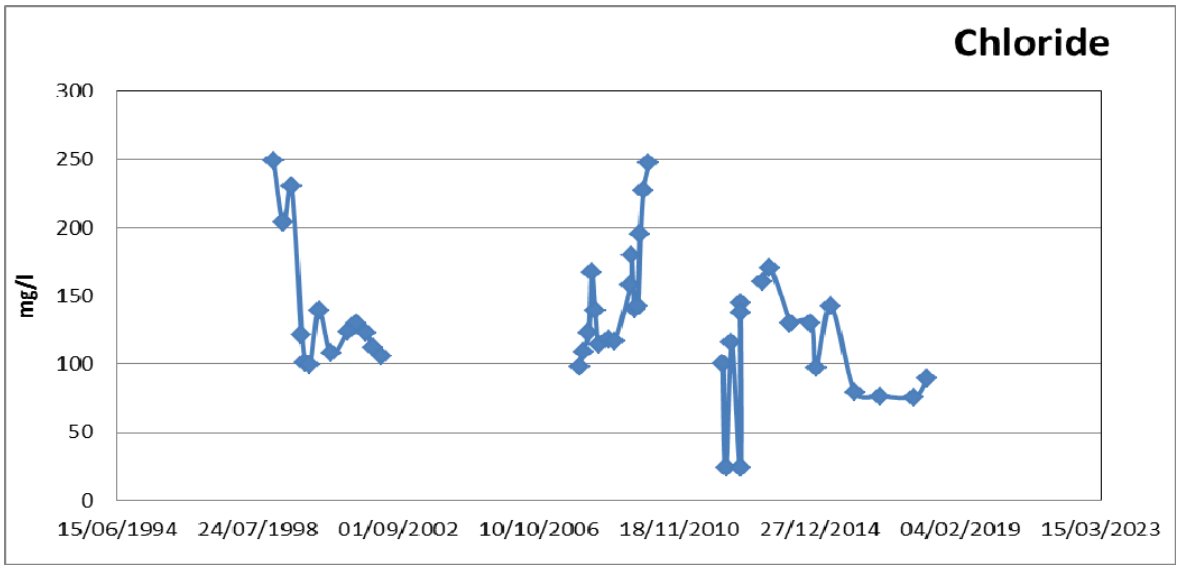
5.1 Leachate Quality

Leachate chemistry has been monitored between 1998 and 2002 and from December 2007 to 2018. The results are graphically illustrated in Appendix 2. The data presented includes data gathered by Geotechnology and more frequent monitoring undertaken by WEBS who previously operated the leachate treatment plant. It is unclear if this monitoring has continued under the direction of the new contractor. Geotechnology also requires access to the leachate sampling chamber to enable continued monitoring.

Leachate has typically been moderately mineralised with electrical conductivity of approximately 1000 microS/cm. The dominant contaminants within the leachate are ammonia and potassium. The concentration of these parameters and others is variable but appears to be declining with time. The variation in ammonia and chloride is shown below.

Trace metals within the leachate are at very low concentrations, with several non-detectable. Low level trace organics have also been detected in recent years. In 2017, these included speciated polyaromatic hydrocarbons (<0.001 mg/l total PAH) and 0.0012 mg/l mecoprop. In 2018, polyaromatic hydrocarbons were not detected and 0.00255 mg/l mecoprop was found.





The leachate is characterised by BOD values of <20 mg/l and total organic carbon (TOC) content of <50 mg/l suggesting that the biodegradable component is now low.

Given the potentially declining source concentrations, Geotechnology suggests that CCC maintains scrutiny of the leachate treatment requirements to ensure resources are being effectively used. The treatment goals and operation of the leachate treatment plant and the potential for cost savings using alternate techniques should be regularly considered at least every 5 years. The source term is clearly declining which may present opportunities for rationalising treatment management.

5.2 Assessment against Control Levels

The spot samples collected by Geotechnology to date indicate that leachate quality falls below the control levels (see Table 5-1). The more detailed routine monitoring undertaken by the leachate treatment operator should also be scrutinised.

Table 5-1 Evaluation of Leachate Chemistry

	Ammoniacal Nitrogen	Chloride	Potassium
	mg l^{-1}	mg l^{-1}	mg l^{-1}
Leachate Quarterly Control Level for L1	**70**	**250**	**140**
2016 Maximum value from spot sampling at L1	31.9	79.4	37.6
2017 Maximum value from spot sampling at L1	24.8	75.8	31.1
2018 Maximum value from spot sampling at L1	31.6	89.4	30.7

6 GROUNDWATER

6.1 Groundwater Quality

All the groundwater results are provided in Appendix 3.

To assist with describing the hydrochemistry of groundwater within the vicinity of Phase I, several borehole groupings have been created. The groupings are summarised below and are based on the position of each monitoring position relative to Phase I (see Figure 2).

- BH203 and BH205 – Up-gradient of Phase 1
- BH117 – across gradient from Phase 1 on Eastern side
- BH108 – across gradient from Phase 1 on Western side
- BH101, BH103, BH104 and BH105 – Down-gradient of Phase 1

Results for BH108 and BH117 are only available since 2008, whereas downgradient monitoring records are available since 1998.

The relatively low electrical conductivity of downgradient groundwater indicates that groundwater is of relatively good quality despite the proximity of the monitoring positions to the unlined landfill. Groundwater is less mineralised than leachate but does become locally, slightly more mineralised in the wells along the southern edge of the landfill. Since 2017, the concentration of ammonia has not exceeded 0.4 mg/l in any samples collected and potassium has been below 1.1mg/l.

Trace elements and oxidised species of nitrogen, such as nitrate, have been detected in groundwater around the edge of the landfill but at relatively low concentrations. The data suggests that either the landfill is not releasing such potential pollutants or that natural attenuation is occurring. Increased COD at BH117 and BH104 noted previously has not persisted.

Hazardous substance cadmium has previously been detected in groundwater upgradient and downgradient of the landfill but at a concentration lower than the freshwater EQS. Cadmium was not detected during the last year of monitoring. Mercury was detected at 0.00006 mg/l at BH105 in November 2016 but not above the analytical detection limit in 2017 or 2018. The monitoring completed in 2019 revealed 0.00001 mg/l at BH104. Low level Lead was also detected at BH101 at 0.000359 mg/l.

Given the low TOC content of leachate, all groundwater samples have previously been found to contain <25 mg/l TOC, suggesting that the landfill is not a significant source of organic contaminants. During 2016, trace levels of polyaromatic hydrocarbons (PAHs) were only detected at BH104 (0.3 microg/l total PAH). In 2018, similar hydrocarbons were found but at concentrations never exceeding 0.0000532 mg/l. In 2019, the maximum concentration of PAHs detected was 0.000363 mg/l. BTEX and mecoprop were also not found above the detection limit in any samples tested in 2019

6.2 Assessment against Compliance Levels

The groundwater chemistry observed in 2018 and 2019 was like that observed previously and no breaches of the control and trigger levels occurred, as shown by the summary in Table 6-1.

Table 6-1 Comparison of Groundwater Chemistry with Compliance Levels

	Potassium	Ammoniacal Nitrogen	Chloride
	mg/l	mg/l	mg/l
Trigger Levels (BH101, 103, 104, 105 and 117)	40	10	250
Control Levels (BH101, 103, 104, 105 and 117)	30	4	150
Maximum Value in Groundwater (2016)	4.39	0.631	26.8
Maximum Value in Groundwater (2017)	1.21	0.39	25.6
Maximum Value in Groundwater (2018)	0.966	0.261	25.3
Maximum Value in Groundwater (2019)	1.13	<0.2	25.3

7 SURFACE WATER

All the surface water results are presented in Appendix 4.

7.1 Contributions

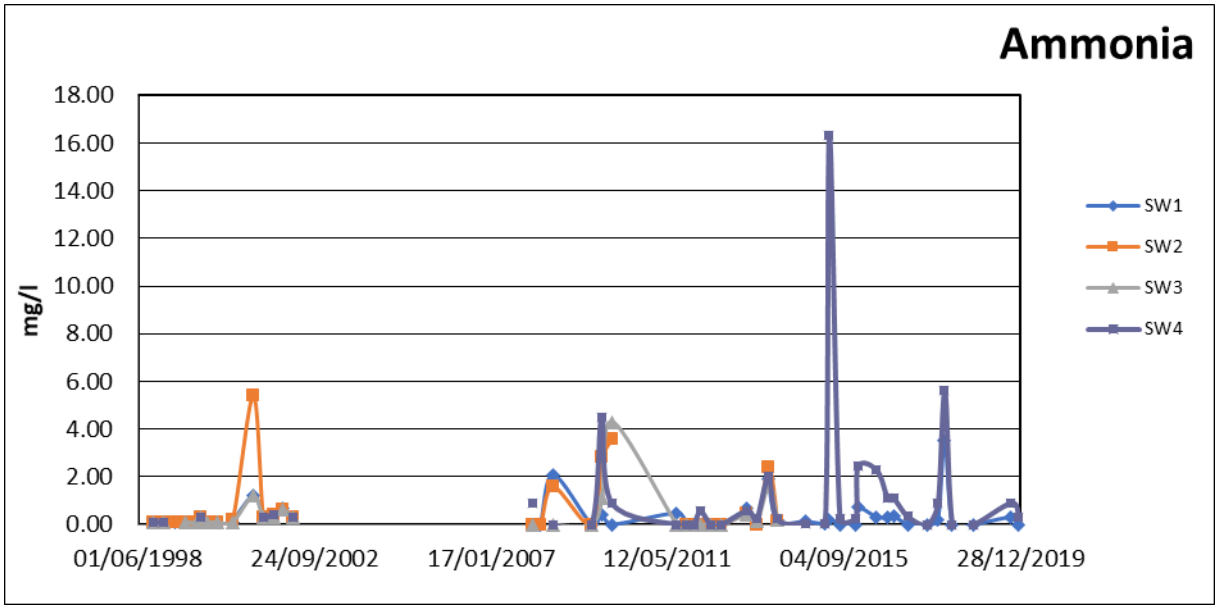
Sample points SW1, SW2, SW3 and SW4 monitor the stream that runs west to east along the southern boundary of the landfill. The location of the surface water sample points is shown on Figure 2.

Surface water quality is primarily influenced by input from the CWM treatment lagoons west of the site, the level of leachate treatment achieved at the Phase I treatment plant and surface run-off containing elevated suspended solids from the landfill upgradient of Phase I.

7.2 Quality

Surface water quality observed during 2018 and 2019 is like that observed previously. The quality of surface water leaving the site at SW1 (the furthest point monitored downgradient of the site) is improved (more dilute) than the quality issuing into the stream just upstream of SW4 from the settlement lagoons to the west. As highlighted by the graphs reproduced below and further graphs in Appendix 4, this is best observed by comparing the higher concentration of several parameters observed at SW4 with the lower concentrations at SW1. This evaluation demonstrates that water quality at SW1 is dominated by the water quality at SW4 which in-turn is directly downgradient of the CWM settlement lagoons and not related to the Phase I closed landfill or leachate treatment.

Increased suspended solids at SW1 is, however, due to input from run-off that enters the stream just above the sample point. This run-off enters from the north and can be traced back to sources upgradient of the Phase I landfill – primarily mobilisation of sediment from access tracks / open areas. This input can be clearly seen in Plate 1.



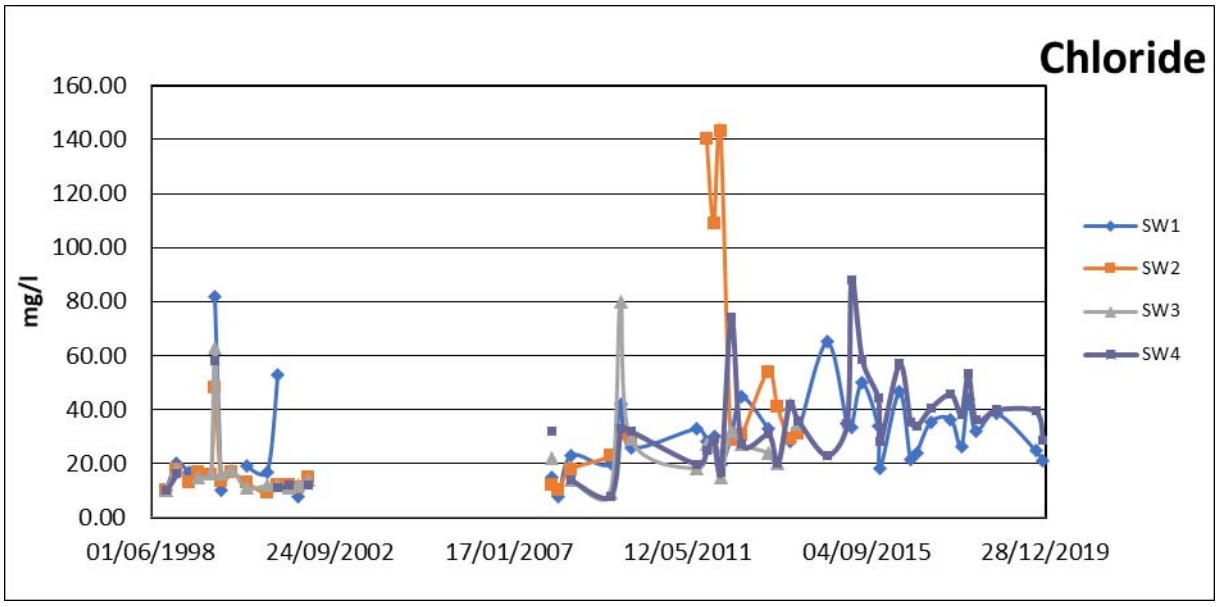


Plate 1. View north over confluence just above sample point SW1

7.3 Assessment against Control Levels

All surface water quality was below the emission limits in 2018 and 2019, as summarised in Table 7-1, apart from elevated ammonia. As can be seen by reviewing the graph above, the cause of the increased ammonia at SW1 is due to elevated ammonia upstream of the landfill at SW4. Again, this is linked to the discharge from the lagoons to the west of the site.

Table 7-1 Comparison of Surface Water Data with Emission Levels

	Ammoniacal Nitrogen as N	Chloride	Suspended solids
	mg/l	mg/l	mg/l
	Ammoniacal Nitrogen	Chloride	Suspended Solids
Location	**mg l-¹**	**mg l-¹**	**mg l-¹**
Control Levels			
SW1	0.6	150	
Cap run-off discharge			50
Max values in 2017			
SW1	0.2	26.1	
Max value in cap runoff			5.95
Max values in 2018			
SW1	3.51	44	
Max values in 2019			
SW1	0.299	24.9	25.9
Cap run-off	-	-	12

8 PERIMETER GROUND GAS

During the quarterly monitoring undertaken since April 2013, all methane concentrations have been below the Permit threshold. Methane has been below 0.3% at all monitoring positions since 2014.

Carbon dioxide (CO_2) has been detected at several positions along the eastern boundary (BH114, BH115, BH116 & BH118). Throughout 2014 and 2015, the concentration of carbon dioxide rarely exceeded 1%. In 2016, 3.3% was detected at BH115 in January and 6.8% at BH116 in June. At all other times, less than 2.1% was detected at either position. In 2017, 4.1% was found at BH116 but less than 0.5% was detected at other positions. In 2018, less than 2.2% was the maximum concentration of carbon dioxide detected. This was found at monitoring position BH118 on the eastern perimeter. Gas flow was 0.1 l/h at the time. The latest monitoring is broadly similar to the previous results with all wells found to contain ground gas with less than 0.4% carbon dioxide apart from BH116. At this position, 2.4% was detected at the end of Q3 and 4.8% in Q4. Gas flow was measured to be <0.1 l/h.

9 SUMMARY AND RECOMMENDATIONS

9.1 Environmental Protection

The available data reveals a declining leachate source term. Consequently, the risk to the environment is reducing. With this in mind, CCC should regularly review the operation of the leachate treatment plant to ensure it is an efficient use of resources.

Groundwater and surface water monitoring completed in support of the Permit at Phase I has shown that the landfill is currently having limited impact. The available information shows that the quality of groundwater has not significantly deteriorated since the start of monitoring in 1998.

Upgradient groundwater already contains a series of low level trace elements including hazardous substances. Passage of this water below the landfill reveals that the landfill is not significantly impacting groundwater, as several trace elements remain at the levels observed upgradient. Potassium is a key contaminant within leachate and despite the mobility of this element it is not significantly elevated in downgradient groundwater. The reason that the landfill is not having a significant impact on groundwater is suspected to be because groundwater has a higher piezometric surface than the basal drainage system of the landfill. The basal drainage system, therefore, intercepts any leachate and groundwater. Consequently, the landfill is largely considered to be hydraulically isolated. The inward groundwater flow may not, however, prevent some outward diffusive transport, as contaminants move from an area of higher concentration to a lower one i.e. from the leachate to the aquifer. This process does not appear to be having a significant impact.

This model is further confirmed by the surrounding groundwater quality which shows little obvious impact from the landfill.

The quality of surface water within the vicinity of the landfill appears to be variable but generally good and is governed by inputs from the surface water treatment lagoons to the west and run-off from the north.

Along the southern flank of the landfill, leachate breakout is known to have previously occurred, but this situation is now being actively managed and controlled by CCC.

9.2 Monitoring Programme

Now that the site has been formally taken into Aftercare, the monitoring programme agreed in the Aftercare Management Plan has started to be implemented. As part of this Plan, an increased range of chemical parameters were analysed in leachate and groundwater samples as these media had not previously been assessed for the presence of hazardous substances and trace organics. Based on the data gathered during the last 24 months, where most of these substances were not found above detection limits, Geotechnology suggests that the monitoring programme should continue to be implemented as summarised in Table 4-1 but that the analytical suites should be reduced to those summarised in Table 9-1. The reduction reflects the declining leachate source term and is aimed at ensuring efficient use of resources.

Table 9-1 Analytical Testing Schedule

Media	Groundwater		Surface Water	Leachate	Runoff Discharge	Perimeter Gas	Leachate Discharge	French Drain
Suite ID	NYC1	NYC2	NYC3	NYC4	NYC5			
Time of Year	Q1, Q3	Q2, Q4	Q1, Q2, Q3, Q4	Q2, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Monthly	When flowing
Sampling locations	BH101, 103, 104, 105, 117		SW1 and SW4	L1	End of pipe discharge point	BH102, 106, 107, 109, 110, 111, 113, 114, 115, 117, 118, 119, 120	End of pipe discharge point	
No. of samples/ year	15	5	8	2	4	-	12	
ON-SITE TESTING								
Carbon dioxide, methane, hydrogen sulphide, carbon monoxide, differential pressure, air temperature, atmospheric pressure, balance gas						✓		
Ammonia, pH, temperature (at treatment plant by operator)							✓	✓
LAB TESTING								
pH	✓	✓	✓	✓	✓			
Electrical Conductivity	✓	✓	✓	✓	✓			
Dissolved Oxygen	✓	✓	✓	✓				
Alkalinity	✓	✓	✓	✓				
Hardness		✓		✓				
Calcium		✓		✓				
Magnesium		✓		✓				
Chloride	✓	✓	✓	✓				
Potassium	✓	✓	✓	✓				
Sodium	✓	✓		✓				
Sulphate		✓		✓				
Phosphate		✓		✓				
Phosphorous		✓		✓				
Ammoniacal Nitrogen	✓	✓	✓	✓				
Arsenic		✓		✓				
Barium		✓		✓				
Beryllium		✓		✓				
Boron		✓		✓				
Cadmium		✓		✓				
Chromium		✓		✓				
Copper		✓		✓				
Iron		✓		✓				
Lead		✓		✓				
Manganese		✓		✓				
Mercury		✓		✓				
Nickel		✓		✓				
Zinc		✓		✓				
Mecoprop		✓		✓				
Total PAH		✓		✓	✓			
Suspended Solids			✓		✓			

9.3 Decommissioning and Surrender

Ahead of the development of the site for the disposal of waste, CCC leased the land from a Mr D Davies as part of a 50-year lease, starting in 1983. Since this time, CWM has purchased the land and is now the landlord. Geotechnology understands that the long-term plan of CCC is to start the process of handing the land lease back to CWM once the materials being stored on the surface have been removed and any remedial works completed. Now that this work has been undertaken Geotechnology suggests that this next stage should be initiated.

During the next phase of site management, Geotechnology understands that CCC will continue to monitor the site and treat leachate and that CWM will continue to be responsible for landfill gas collection and management. Monitoring will continue to be coordinated by CCC until there is no risk to the environment. At that point, a Permit Surrender application will be submitted to NRW bringing together the lines of evidence that demonstrate the site no longer poses a risk to the environment and the infrastructure can be decommissioned. During this period, regular consideration should be given to the performance and suitability of the leachate treatment plant.

Figure 1 Site Location Plan

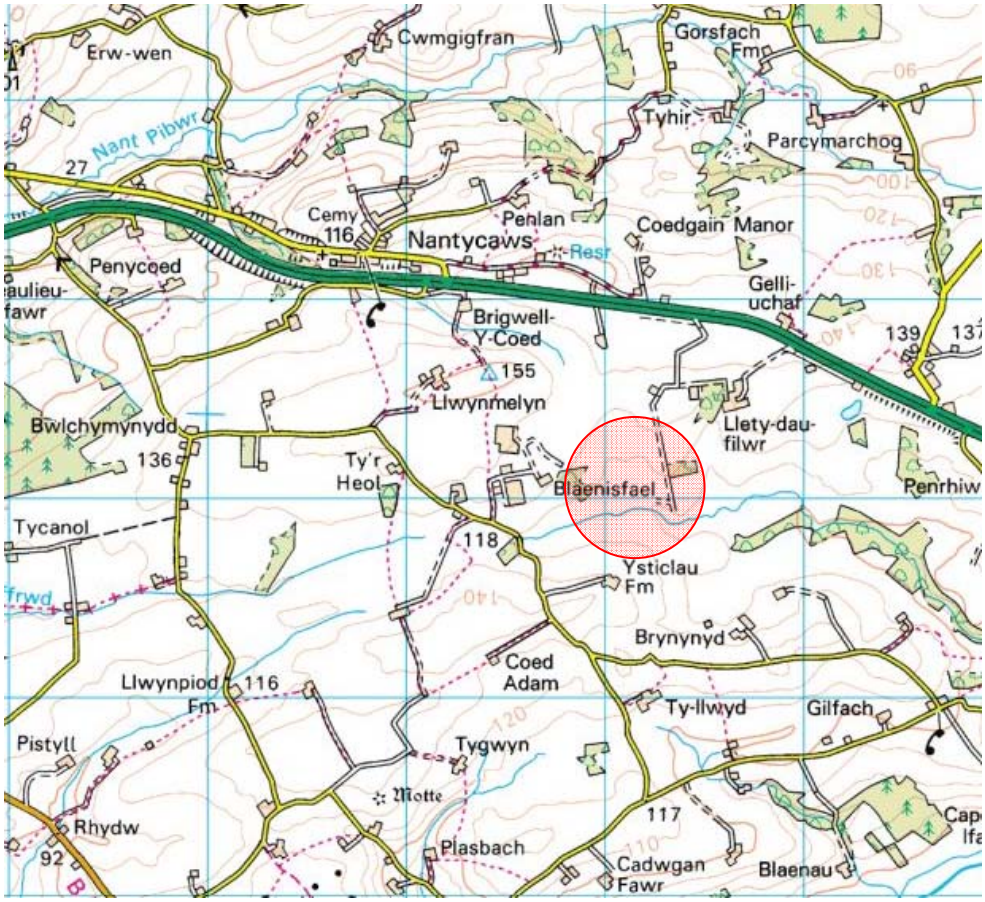


Figure 2 Available Monitoring Network

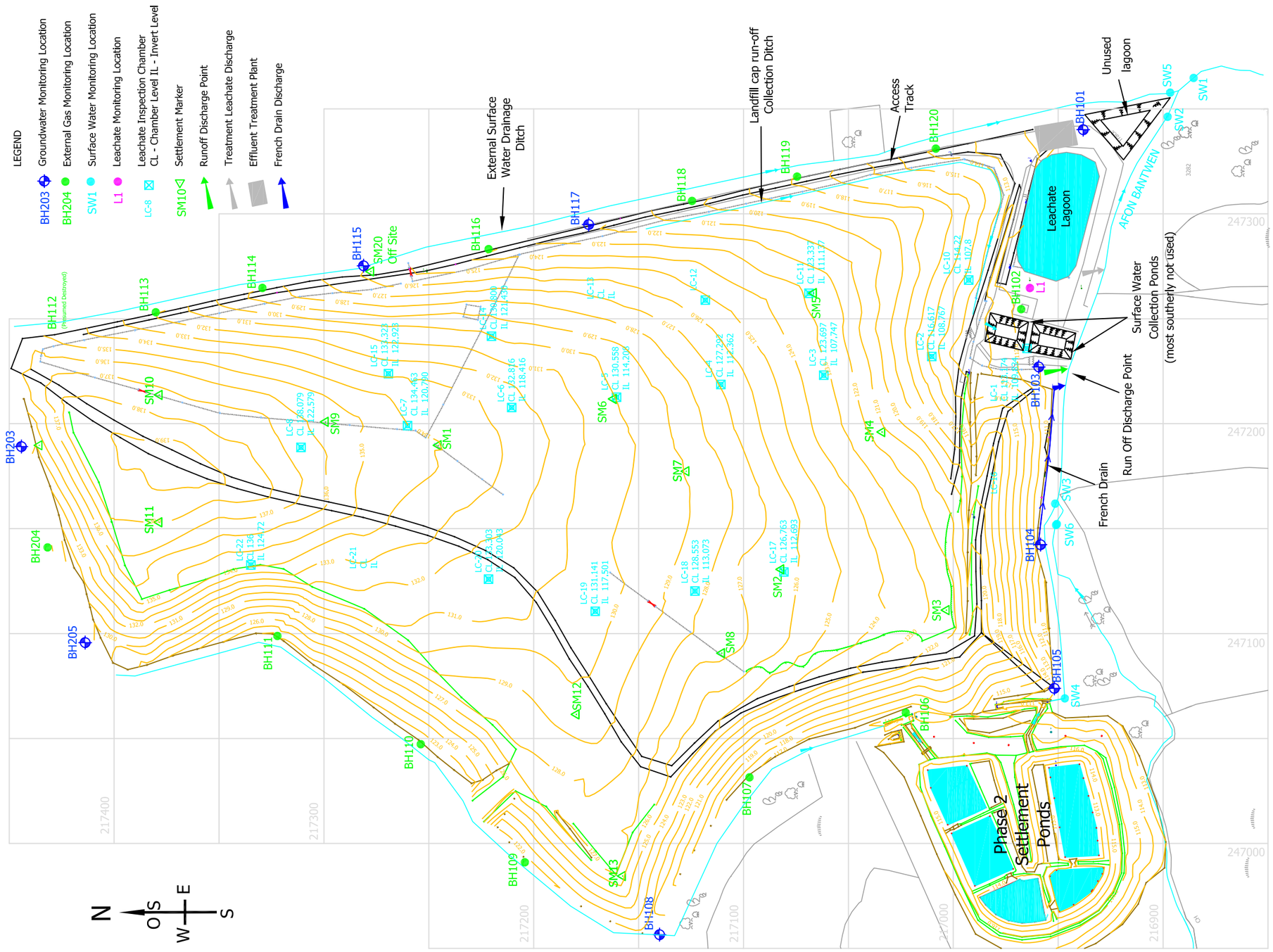
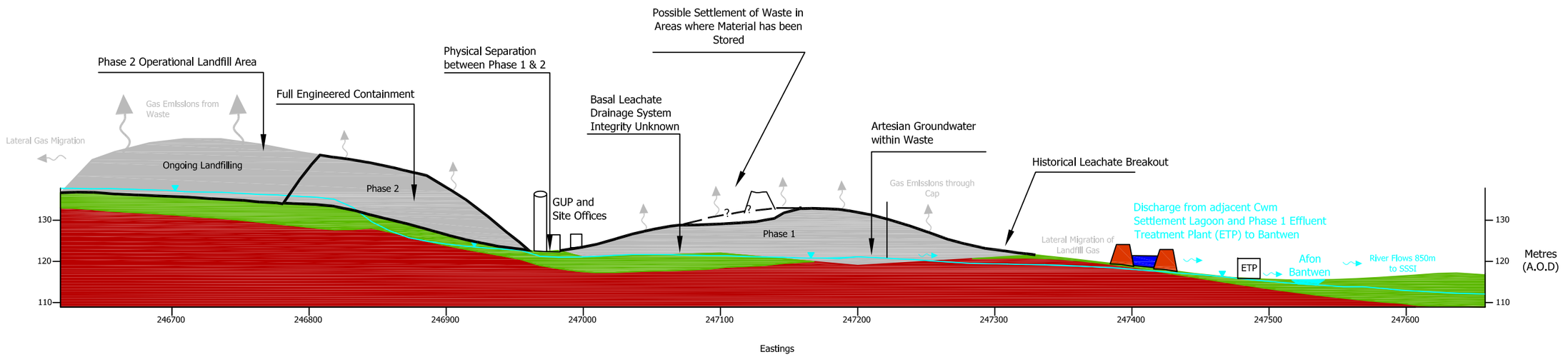


Figure 3 Conceptual Site Model



Legend

- Waste
- Glacial Drift
- Devonian Bedrock
- Potential Landfill Gas Emission
- Potential Seepage to Controlled Water

GUP Gas Utilisation Plant
ETP Effluent Treatment Plant

Note:
Landfill gas can give rise to odour and migrate laterally

NANT Y CAWS
PHASE 1
CLOSED LANDFILL

ENVIRONMENTAL
PERMIT EA WML 34183

2019 Annual Environmental Monitoring Report

Appendix 1
Laboratory Certificates

Report Number 1981r1v1d0120

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Geotechnology
5 Cefn-yr-Allt
Aberdulais
Neath
West Glamorgan
SA10 8HE

Attention: Ben Rees

CERTIFICATE OF ANALYSIS

Date of report Generation:	22 October 2019
Customer:	Geotechnology
Sample Delivery Group (SDG):	191009-33
Your Reference:	
Location:	Carmarthen
Report No:	526485

This report has been revised and directly supersedes 526103 in its entirety.

We received 13 samples on Wednesday October 09, 2019 and 13 of these samples were scheduled for analysis which was completed on Tuesday October 22, 2019. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan
Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
20899318	BH14			07/10/2019
20899308	BH 101			07/10/2019
20899306	BH 103			07/10/2019
20899305	BH 104			07/10/2019
20899303	BH 105			07/10/2019
20899311	BH117			07/10/2019
20899385	LAGOON IN			07/10/2019
20899314	LAGOON OUT			07/10/2019
20899309	NYCSW1			07/10/2019
20899310	NYCSW4			07/10/2019
20899319	RUNOFF			07/10/2019
20899312	WSW2			07/10/2019
20899317	WSW4			07/10/2019

Maximum Sample/Coolbox Temperature (°C) : **9.8**

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			20899318	20899308			20899306			20899305			20899303			20899311			20899385	20899314	
Customer Sample Reference			BH14	BH 101			BH 103			BH 104			BH 105			BH117			LAGOON IN	LAGOON OUT	
AGS Reference																						
Depth (m)																						
Container			1plastic (ALE221)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1plastic (ALE221)	1plastic (ALE221)	H2SO4 (ALE244)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	SW	SW	SW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 12	X	X			X			X			X			X			X	X	
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 12	X		X			X			X			X			X		X		X
Anions by Kone (w)	All	NDPs: 0 Tests: 12	X	X			X			X			X			X			X	X	
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 12	X	X			X			X			X			X			X	X	
Dissolved Metals by ICP-MS	All	NDPs: 1 Tests: 11	X			X			X			N			X			X	X	X	
Mercury Dissolved	All	NDPs: 0 Tests: 1	X																		
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 1	X																		
pH Value	All	NDPs: 0 Tests: 12	X	X			X			X			X			X			X	X	
Suspended Solids	All	NDPs: 0 Tests: 7																	X	X	
VOC MS (W)	All	NDPs: 0 Tests: 1	X																		

20899317	WSW4			HNO3 Filtered (ALE204)	SW										X										
				H2SO4 (ALE244)	SW				X																
				1lplastic (ALE221)	SW		X				X		X								X		X		
20899312	WSW2			HNO3 Filtered (ALE204)	SW										X										
				H2SO4 (ALE244)	SW				X																
				1000ml glass bottle (ALE220)	SW		X				X		X								X		X		
20899319	RUNOFF			500ml Plastic (ALE208)	SW																		X		
20899310	NYCSW4			HNO3 Filtered (ALE204)	SW										X										
				H2SO4 (ALE244)	SW				X																
				500ml Plastic (ALE208)	SW		X				X		X								X		X		
20899309	NYCSW1			HNO3 Filtered (ALE204)	SW										X										
				H2SO4 (ALE244)	SW				X																
				500ml Plastic (ALE208)	SW		X				X		X								X		X		

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH14	BH 101	BH 103	BH 104	BH 105	BH117
			Depth (m)	.	.	.	.	.	.
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	07/10/2019	07/10/2019	07/10/2019	07/10/2019	07/10/2019	07/10/2019
			Sample Time	12:40:00	10:30:00	10:28:00	10:10:00	09:45:00	11:20:00
			Date Received	09/10/2019	09/10/2019	09/10/2019	09/10/2019	09/10/2019	09/10/2019
			SDG Ref	191009-33	191009-33	191009-33	191009-33	191009-33	191009-33
			Lab Sample No.(s)	20899318	20899308	20899306	20899305	20899303	20899311
			AGS Reference						
Alkalinity, Total as CaCO3	<2 mg/l	TM043		470 #	235 #	220 #	315 #	275 #	270 #
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		13.3 2 #	<0.2 #	<0.2 #	<0.2 #	<0.2 #	<0.2 #
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120		0.907 #	0.424 #	0.435 #	0.573 #	0.445 #	0.522 #
Arsenic (diss.filt)	<0.5 µg/l	TM152		0.63 2 #					
Barium (diss.filt)	<0.2 µg/l	TM152		189 2 #					
Beryllium (diss.filt)	<0.1 µg/l	TM152		<0.1 2 #					
Boron (diss.filt)	<10 µg/l	TM152		131 2 #					
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 2 #					
Chromium (diss.filt)	<1 µg/l	TM152		<1 2 #					
Copper (diss.filt)	<0.3 µg/l	TM152		<0.3 2 #					
Lead (diss.filt)	<0.2 µg/l	TM152		<0.2 2 #					
Manganese (diss.filt)	<3 µg/l	TM152		705 2 #					
Nickel (diss.filt)	<0.4 µg/l	TM152		3.38 2 #					
Zinc (diss.filt)	<1 µg/l	TM152		2.92 2 #					
Sodium (Dis.Filt)	<0.076 mg/l	TM152		8.29 2 #	14.6 #	13.3 #		10.7 #	11.6 #
Magnesium (Dis.Filt)	<0.036 mg/l	TM152		9.11 2 #					
Potassium (Dis.Filt)	<0.2 mg/l	TM152		9.7 2 #	0.996 #	0.963 #		0.934 #	0.787 #
Calcium (Dis.Filt)	<0.2 mg/l	TM152		168 2 #					
Iron (Dis.Filt)	<0.019 mg/l	TM152		1.7 2 #					
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 2 #					
Sulphate	<2 mg/l	TM184		42.8 #					
Chloride	<2 mg/l	TM184		11.1 #	15.3 #	14.6 #	7.6 #	11.3 #	25.3 #
pH	<1 pH Units	TM256		7.13 @ #	8.13 #	8.09 #	8.21 #	7.79 #	7.86 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	LAGOON IN	LAGOON OUT	NYCSW1	NYCSW4	RUNOFF	WSW2
			Depth (m)	.	.	.	.	.	.
			Sample Type	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
			Date Sampled	07/10/2019	07/10/2019	07/10/2019	07/10/2019	07/10/2019	07/10/2019
			Sample Time	13:50:00	13:40:00	10:50:00	11:10:00	00:00:00	13:20:00
			Date Received	09/10/2019	09/10/2019	09/10/2019	09/10/2019	09/10/2019	09/10/2019
			SDG Ref	191009-33	191009-33	191009-33	191009-33	191009-33	191009-33
			Lab Sample No.(s)	20899385	20899314	20899309	20899310	20899319	20899312
			AGS Reference						
Suspended solids, Total	<2 mg/l	TM022		24.5 #	20.6 #	25.9 #	5.35 #	<2 #	<2 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043		610 #	530 #	140 #	200 #		345 #
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099				0.299 #	0.912 #		<0.2 #
Ammoniacal Nitrogen as NH4	<0.3 mg/l	TM099		37.5 2 #	31.5 #				
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120		1.14 #	1.13 #	0.42 #	0.577 #		0.626 #
Potassium (Dis.Filt)	<0.2 mg/l	TM152		20.8 2 #	18.5 2 #	14.6 #	31.2 #		6.26 #
Chloride	<2 mg/l	TM184		86 #	72.8 #	24.9 #	39.5 #		13.5 #
pH	<1 pH Units	TM256		7.69 #	7.7 @ #	8.04 #	7.91 #		8.2 @ #

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Customer Sample Ref.	WSW4							
Depth (m)	.							
Sample Type	Surface Water (SW)							
Date Sampled	07/10/2019							
Sample Time	13:05:00							
Date Received	09/10/2019							
SDG Ref	191009-33							
Lab Sample No.(s)	20899317							
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	3.15 #					
Alkalinity, Total as CaCO3	<2 mg/l	TM043	65 #					
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	0.724 #					
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120	0.147 #					
Potassium (Dis.Filt)	<0.2 mg/l	TM152	2.71 #					
Chloride	<2 mg/l	TM184	10.8 #					
pH	<1 pH Units	TM256	7.77 @ #					

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

PAH Spec MS - Aqueous (W)

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	BH14
		Depth (m)	.
		Sample Type	Ground Water (GW)
		Date Sampled	07/10/2019
		Sample Time	12:40:00
		Date Received	09/10/2019
		SDG Ref	191009-33
		Lab Sample No.(s)	20899318
		AGS Reference	
Component	**LOD/Units**	**Method**	
Naphthalene (aq)	<0.01 µg/l	TM178	0.023 #
Acenaphthene (aq)	<0.005 µg/l	TM178	<0.005 #
Acenaphthylene (aq)	<0.005 µg/l	TM178	<0.005 #
Fluoranthene (aq)	<0.005 µg/l	TM178	0.0334 #
Anthracene (aq)	<0.005 µg/l	TM178	<0.005 #
Phenanthrene (aq)	<0.005 µg/l	TM178	0.022 #
Fluorene (aq)	<0.005 µg/l	TM178	0.00833 #
Chrysene (aq)	<0.005 µg/l	TM178	0.0174 #
Pyrene (aq)	<0.005 µg/l	TM178	0.0285 #
Benzo(a)anthracene (aq)	<0.005 µg/l	TM178	0.00686 #
Benzo(b)fluoranthene (aq)	<0.005 µg/l	TM178	0.0361 #
Benzo(k)fluoranthene (aq)	<0.005 µg/l	TM178	0.0131 #
Benzo(a)pyrene (aq)	<0.002 µg/l	TM178	0.0221 #
Dibenzo(a,h)anthracene (aq)	<0.005 µg/l	TM178	<0.005 #
Benzo(g,h,i)perylene (aq)	<0.005 µg/l	TM178	0.0165 #
Indeno(1,2,3-cd)pyrene (aq)	<0.005 µg/l	TM178	0.013 #
PAH, Total Detected USEPA 16 (aq)	<0.082 µg/l	TM178	0.24 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

VOC MS (W)

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	**LOD/Units**	**Method**	
Customer Sample Ref.			BH14
Depth (m)			.
Sample Type			Ground Water (GW)
Date Sampled			07/10/2019
Sample Time			12:40:00
Date Received			09/10/2019
SDG Ref			191009-33
Lab Sample No.(s)			20899318
AGS Reference			
Benzene	<1 µg/l	TM208	<1 1 #
Toluene	<1 µg/l	TM208	<1 1 #
Ethylbenzene	<1 µg/l	TM208	<1 1 #
m,p-Xylene	<1 µg/l	TM208	<1 1 #
o-Xylene	<1 µg/l	TM208	<1 1 #
Sum of detected Xylenes	<2 µg/l	TM208	<2 1

Validated

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Notification of NDPs (No determination possible)

Date Received : 09/10/2019 05:29:26

Sample No	Customer Sample Ref.	Depth (m)	Test	Comment
20899305	BH 104		Dissolved Metals by ICP-MS	Container Received Empty

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Table of Results - Appendix

Method No	Reference	Description
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

CERTIFICATE OF ANALYSIS

SDG:	191009-33	**Client Reference:**		**Report Number:**	526485
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	526103

Test Completion Dates

Lab Sample No(s)	20899318	20899311	20899308	20899306	20899305	20899303	20899385	20899314	20899309	20899310
Customer Sample Ref.	BH14	BH117	BH 101	BH 103	BH 104	BH 105	LAGOON IN	LAGOON OUT	NYCSW1	NYCSW4
AGS Ref.										
Depth										
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water
Alkalinity as CaCO3	21-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	21-Oct-2019	21-Oct-2019	18-Oct-2019	18-Oct-2019
Ammoniacal Nitrogen	16-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019
Anions by Kone (w)	19-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	19-Oct-2019	19-Oct-2019	18-Oct-2019	18-Oct-2019
Conductivity (at 20 deg.C)	18-Oct-2019	17-Oct-2019	17-Oct-2019	18-Oct-2019	18-Oct-2019	17-Oct-2019	18-Oct-2019	18-Oct-2019	17-Oct-2019	18-Oct-2019
Dissolved Metals by ICP-MS	21-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019		18-Oct-2019	21-Oct-2019	21-Oct-2019	18-Oct-2019	18-Oct-2019
Mercury Dissolved	15-Oct-2019									
PAH Spec MS - Aqueous (W)	18-Oct-2019									
pH Value	21-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	18-Oct-2019	16-Oct-2019	18-Oct-2019	21-Oct-2019	17-Oct-2019	18-Oct-2019
Suspended Solids							22-Oct-2019	22-Oct-2019	18-Oct-2019	16-Oct-2019
VOC MS (W)	21-Oct-2019									

Lab Sample No(s)	20899319	20899312	20899317
Customer Sample Ref.	RUNOFF	WSW2	WSW4
AGS Ref.			
Depth			
Type	Surface Water	Surface Water	Surface Water
Alkalinity as CaCO3		21-Oct-2019	21-Oct-2019
Ammoniacal Nitrogen		15-Oct-2019	15-Oct-2019
Anions by Kone (w)		19-Oct-2019	19-Oct-2019
Conductivity (at 20 deg.C)		18-Oct-2019	18-Oct-2019
Dissolved Metals by ICP-MS		21-Oct-2019	21-Oct-2019
pH Value		21-Oct-2019	21-Oct-2019
Suspended Solids	22-Oct-2019	22-Oct-2019	22-Oct-2019

Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2107).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

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Geotechnology
5 Cefn-yr-Allt
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Attention: Ben Rees

CERTIFICATE OF ANALYSIS

Date of report Generation:	06 January 2020
Customer:	Geotechnology
Sample Delivery Group (SDG):	191211-69
Your Reference:	
Location:	Carmarthen
Report No:	536292

This report has been revised and directly supersedes 535124 in its entirety.

We received 12 samples on Wednesday December 11, 2019 and 12 of these samples were scheduled for analysis which was completed on Monday January 06, 2020. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan
Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
21336457	BH101			10/12/2019
21336458	BH103			10/12/2019
21336459	BH104			10/12/2019
21336460	BH105			10/12/2019
21336461	BH117			10/12/2019
21336452	LAGOON IN			10/12/2019
21336454	LAGOON OUT			10/12/2019
21336462	RUN OFF			10/12/2019
21336456	SW1			10/12/2019
21336455	SW4			10/12/2019
21336450	WERN SW2			10/12/2019
21336451	WERN SW4			10/12/2019

Maximum Sample/Coolbox Temperature (°C) : **6.2**

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)					21336457					21336458					21336459					21336460	21336461
Customer Sample Reference					BH101					BH103					BH104					BH105	BH117
AGS Reference																					
Depth (m)																					
Container					0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	250ml Amber Gl. PTFE/PE (ALE219)
Sample Type					GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Acid Herbicides by LCMS (W)*	All	NDPs: 0 Tests: 5			X					X					X				X				X
Alkalinity as CaCO3	All	NDPs: 0 Tests: 9					X					X					X				X		
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 11						X					X					X					X
Anions by Kone (w)	All	NDPs: 0 Tests: 11					X					X					X				X		
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 12					X					X					X				X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 11							X					X			X				X		
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 2																					
Mercury Dissolved	All	NDPs: 0 Tests: 5							X					X			X				X		
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 5				X					X					X				X			X
pH Value	All	NDPs: 0 Tests: 12					X					X					X				X		
Phosphate by Kone (w)	All	NDPs: 0 Tests: 5					X					X					X				X		
Suspended Solids	All	NDPs: 0 Tests: 7																					

21336451	WERN SW4			HNO3 Filtered (ALE204)	SW							x									
				H2SO4 (ALE244)	SW				x												
				500ml Plastic (ALE208)	SW		x			x	x		x				x			x	
21336450	WERN SW2			HNO3 Filtered (ALE204)	SW							x									
				H2SO4 (ALE244)	SW				x												
				500ml Plastic (ALE208)	SW		x			x	x		x				x			x	
21336455	SW4			HNO3 Filtered (ALE204)	SW							x									
				H2SO4 (ALE244)	SW				x												
				500ml Plastic (ALE208)	SW		x			x	x						x				
				0.5l glass bottle (ALE227)	SW															x	
21336456	SW1			HNO3 Filtered (ALE204)	SW							x									
				H2SO4 (ALE244)	SW				x												
				500ml Plastic (ALE208)	SW		x			x	x						x			x	
21336462	RUN OFF			500ml Plastic (ALE208)	SW						x						x			x	
21336454	LAGOON OUT			H2SO4 (ALE244)	SW				x												
				500ml Plastic (ALE208)	SW					x	x	x					x			x	
21336452	LAGOON IN			H2SO4 (ALE244)	SW				x												
				500ml Plastic (ALE208)	SW					x	x	x					x			x	
21336461	BH117			H2SO4 (ALE244)	GW				x												
				500ml Plastic (ALE208)	GW		x			x	x	x		x			x		x		

Validated

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH103	BH104	BH105	BH117	LAGOON IN
			Depth (m)	.	.	.	.	.	.
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)
			Date Sampled	10/12/2019	10/12/2019	10/12/2019	10/12/2019	10/12/2019	10/12/2019
			Sample Time	12:05:00	11:50:00	11:35:00	11:20:00	12:30:00	08:35:00
			Date Received	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019
			SDG Ref	191211-69	191211-69	191211-69	191211-69	191211-69	191211-69
			Lab Sample No.(s)	21336457	21336458	21336459	21336460	21336461	21336452
			AGS Reference						
MCPP (isomers)*	<0.01 µg/l	SUB		<0.01	<0.01	<0.01	<0.01	<0.01	
Suspended solids, Total	<2 mg/l	TM022							11.5 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043		230 #	210 #	270 #	280 #	260 #	
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		<0.2 #	<0.2 #	<0.2 #	<0.2 #	<0.2 #	42.6 #
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120		0.421 #	0.393 #	0.48 #	0.449 #	0.49 #	1.21 #
Arsenic (diss.filt)	<0.5 µg/l	TM152		<0.5 #	<0.5 #	0.987 2 #	<0.5 2 #	<0.5 2 #	
Barium (diss.filt)	<0.2 µg/l	TM152		124 #	60.6 #	19 2 #	57.9 2 #	80.3 2 #	
Beryllium (diss.filt)	<0.1 µg/l	TM152		<0.1 #	<0.1 #	<0.1 2 #	<0.1 2 #	<0.1 2 #	
Boron (diss.filt)	<10 µg/l	TM152		<10 #	<10 #	<10 2 #	<10 2 #	<10 2 #	
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	<0.08 #	<0.08 2 #	<0.08 2 #	<0.08 2 #	
Chromium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 2 #	<1 2 #	<1 2 #	
Copper (diss.filt)	<0.3 µg/l	TM152		0.411 #	<0.3 #	0.929 2 #	<0.3 2 #	<0.3 2 #	
Lead (diss.filt)	<0.2 µg/l	TM152		0.359 #	<0.2 #	<0.2 2 #	<0.2 2 #	<0.2 2 #	
Manganese (diss.filt)	<3 µg/l	TM152		<3 #	<3 #	362 2 #	3.22 2 #	<3 2 #	
Nickel (diss.filt)	<0.4 µg/l	TM152		<0.4 #	<0.4 #	0.919 2 #	<0.4 2 #	<0.4 2 #	
Phosphorus (diss.filt)	<10 µg/l	TM152		10.4 #	20.9 #	<10 2 #	13.6 2 #	14.4 2 #	
Zinc (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	1.02 2 #	<1 2 #	<1 2 #	
Sodium (Dis.Filt)	<0.076 mg/l	TM152		15.9 #	13.4 #	7.27 2 #	11.1 2 #	12.2 2 #	
Magnesium (Dis.Filt)	<0.036 mg/l	TM152		12.4 #	7.91 #	9.05 2 #	9.32 2 #	7.31 2 #	
Potassium (Dis.Filt)	<0.2 mg/l	TM152		1.07 #	0.984 #	0.792 2 #	1.13 2 #	0.696 2 #	25.7 2 #
Calcium (Dis.Filt)	<0.2 mg/l	TM152		71.2 #	74.5 #	103 2 #	92.7 2 #	105 2 #	
Iron (Dis.Filt)	<0.019 mg/l	TM152		0.0228 #	<0.019 #	<0.019 2 #	<0.019 2 #	<0.019 2 #	
Hardness, Total as CaCO3	<0.65 mg/l	TM152		229	219	296 2	270 2	292 2	
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #	<0.01 #	0.0107 2 #	<0.01 2 #	<0.01 2 #	
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184		<0.05 #	0.057 #	<0.05 #	<0.05 #	0.057 #	
Sulphate	<2 mg/l	TM184		8.6 #	6.7 #	14.4 #	5.5 #	12.1 #	
Chloride	<2 mg/l	TM184		14.4 #	13.6 #	6.7 #	9.7 #	22.7 #	102 #
pH	<1 pH Units	TM256		8.24 #	8.17 #	8.48 #	7.75 #	7.91 #	7.8 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	LAGOON OUT	RUN OFF	SW1	SW4	WERN SW2	WERN SW4
			Depth (m)	.	.	.	.	.	.
			Sample Type	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
			Date Sampled	10/12/2019	10/12/2019	10/12/2019	10/12/2019	10/12/2019	10/12/2019
			Sample Time	08:40:00	11:55:00	12:15:00	11:10:00	08:10:00	08:20:00
			Date Received	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019
			SDG Ref	191211-69	191211-69	191211-69	191211-69	191211-69	191211-69
			Lab Sample No.(s)	21336454	21336462	21336456	21336455	21336450	21336451
			AGS Reference						
Suspended solids, Total	<2 mg/l	TM022		7.3 #	12 #	17.1 #	21.2 #	2.6 #	2.4 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043				95 #	160 #	340 #	70 #
Oxygen, dissolved	<0.3 mg/l	TM046						9.41	9.7
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		37.2 #		<0.2 #	0.312 #	<0.2 #	0.418 #
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120		1.16 #	0.618 #	0.247 #	0.411 #	0.673 #	0.15 #
Potassium (Dis.Filt)	<0.2 mg/l	TM152		23.6 2 #		11.4 #	21.9 #	7.32 #	1.53 #
Chloride	<2 mg/l	TM184		92.9 #		21.2 #	28.6 #	12.3 #	9.5 #
pH	<1 pH Units	TM256		7.83 #	8.35 #	7.8 #	7.92 #	8.41 #	7.86 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

PAH Spec MS - Aqueous (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH103	BH104	BH105	BH117
			Depth (m)	.	.	.	.	.
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	10/12/2019	10/12/2019	10/12/2019	10/12/2019	10/12/2019
			Sample Time	12:05:00	11:50:00	11:35:00	11:20:00	12:30:00
			Date Received	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019
			SDG Ref	191211-69	191211-69	191211-69	191211-69	191211-69
			Lab Sample No.(s)	21336457	21336458	21336459	21336460	21336461
			AGS Reference					
Naphthalene (aq)	<0.01 µg/l	TM178		0.0111 #	<0.01 #	0.0103 #	<0.01 #	<0.01 #
Acenaphthene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	<0.005 #	<0.005 #	<0.005 #
Acenaphthylene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0326 #	<0.005 #	<0.005 #
Fluoranthene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0263 #	<0.005 #	0.00572 #
Anthracene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.00812 #	<0.005 #	<0.005 #
Phenanthrene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0131 #	<0.005 #	<0.005 #
Fluorene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.00657 #	<0.005 #	<0.005 #
Chrysene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0192 #	<0.005 #	<0.005 #
Pyrene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0298 #	<0.005 #	0.00629 #
Benzo(a)anthracene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	<0.005 #	<0.005 #	<0.005 #
Benzo(b)fluoranthene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0363 #	<0.005 #	0.00648 #
Benzo(k)fluoranthene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0242 #	<0.005 #	<0.005 #
Benzo(a)pyrene (aq)	<0.002 µg/l	TM178		<0.002 #	<0.002 #	0.027 #	<0.002 #	0.00582 #
Dibenzo(a,h)anthracene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.00707 #	<0.005 #	<0.005 #
Benzo(g,h,i)perylene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.00971 #	<0.005 #	<0.005 #
Indeno(1,2,3-cd)pyrene (aq)	<0.005 µg/l	TM178		<0.005 #	<0.005 #	0.0273 #	<0.005 #	0.00817 #
PAH, Total Detected USEPA 16 (aq)	<0.082 µg/l	TM178		<0.082 #	<0.082 #	0.278 #	<0.082 #	<0.082 #

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

Table of Results - Appendix

Method No	Reference	Description
SUB		Subcontracted Test
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM046	Method 4500G, AWWA/APHA, 20th Ed., 1999	Measurement of Dissolved Oxygen by Oxygen Meter
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

Validated

CERTIFICATE OF ANALYSIS

SDG:	191211-69	**Client Reference:**		**Report Number:**	536292
Location:	Carmarthen	**Order Number:**	1430/1981	**Superseded Report:**	535124

Test Completion Dates

Lab Sample No(s)	21336457	21336458	21336459	21336460	21336461	21336452	21336454	21336462	21336456	21336455
Customer Sample Ref.	BH101	BH103	BH104	BH105	BH117	LAGOON IN	LAGOON OUT	RUN OFF	SW1	SW4
AGS Ref.										
Depth										
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Acid Herbicides by LCMS (W)*	06-Jan-2020	06-Jan-2020	06-Jan-2020	06-Jan-2020	06-Jan-2020					
Alkalinity as CaCO3	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019				18-Dec-2019	18-Dec-2019
Ammoniacal Nitrogen	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019		18-Dec-2019	18-Dec-2019
Anions by Kone (w)	14-Dec-2019	14-Dec-2019	14-Dec-2019	14-Dec-2019	14-Dec-2019	14-Dec-2019	14-Dec-2019		14-Dec-2019	18-Dec-2019
Conductivity (at 20 deg.C)	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019
Dissolved Metals by ICP-MS	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019		18-Dec-2019	18-Dec-2019
Mercury Dissolved	18-Dec-2019	18-Dec-2019	17-Dec-2019	17-Dec-2019	17-Dec-2019					
PAH Spec MS - Aqueous (W)	23-Dec-2019	23-Dec-2019	23-Dec-2019	23-Dec-2019	23-Dec-2019					
pH Value	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019
Phosphate by Kone (w)	13-Dec-2019	13-Dec-2019	13-Dec-2019	13-Dec-2019	13-Dec-2019					
Suspended Solids						18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019	18-Dec-2019

Lab Sample No(s)	21336450	21336451
Customer Sample Ref.	WERN SW2	WERN SW4
AGS Ref.		
Depth		
Type	Surface Water	Surface Water
Alkalinity as CaCO3	18-Dec-2019	18-Dec-2019
Ammoniacal Nitrogen	18-Dec-2019	18-Dec-2019
Anions by Kone (w)	14-Dec-2019	14-Dec-2019
Conductivity (at 20 deg.C)	17-Dec-2019	17-Dec-2019
Dissolved Metals by ICP-MS	18-Dec-2019	18-Dec-2019
Dissolved Oxygen by Probe	18-Dec-2019	16-Dec-2019
pH Value	18-Dec-2019	18-Dec-2019
Suspended Solids	18-Dec-2019	18-Dec-2019

CERTIFICATE OF ANALYSIS

Work Order	: **PR19D6443**	Issue Date	: 02-Jan-2020
Customer	: **ALS Life Sciences Ltd**	Laboratory	: ALS Czech Republic, s.r.o.
Contact	: ALS Hawarden Reporting	Contact	: Client Service
Address	: Unit 7-8 Hawarden Business Park Manor Road, Hawarden CH5 3US Deeside United Kingdom	Address	: Na Harfe 336/9 Prague 9 - Vysocany 190 00 Czech Republic
E-mail	: euhdnsubconresults@ALSGlobal.com	E-mail	: customer.support@alsglobal.com
Telephone	: ----	Telephone	: +420 226 226 228
Project	: 191211-69	Page	: 1 of 2
Order number	: ----	Date Samples Received	: 13-Dec-2019
		Quote number	: PR2018ALSAL-GB0004 (CZ-256-18-0022)
Site	: ----	Date of test	: 19-Dec-2019 - 02-Jan-2020
Sampled by	: client	QC Level	: ALS CR Standard Quality Control Schedule

General Comments

This report shall not be reproduced except in full, without prior written approval from the laboratory.

The laboratory declares that the test results relate only to the listed samples. If the section "Sampled by" of the Certificate of analysis states: "Sampled by Customer" then the results relate to the sample as received.

Responsible for accuracy

Testing Laboratory No. 1163
Accredited by CAI according to
CSN EN ISO/IEC 17025:2018

Signatories		*Position*
Zdeněk Jirák		Environmental Business Unit Manager

Analytical Results

Sub-Matrix: **GROUNDWATER**				Client sample ID	**21343607 BH101**		**21343611 BH103**		**21343617 BH104**	
				Laboratory sample ID	PR19D6443-001		PR19D6443-002		PR19D6443-003	
				Client sampling date / time	12-Dec-2019 00:00		12-Dec-2019 00:00		12-Dec-2019 00:00	
Parameter	*Method*	*LOR*	*Unit*		**Result**	**MU**	**Result**	**MU**	**Result**	**MU**
Pesticides										
MCPP (isomers)	W-PESLMS04	0.010	µg/L		<0.010	----	<0.010	----	<0.010	----

Sub-Matrix: **GROUNDWATER**				Client sample ID	**21343621 BH105**		**21343651 BH117**		**----**	
				Laboratory sample ID	PR19D6443-004		PR19D6443-005		----	
				Client sampling date / time	12-Dec-2019 00:00		12-Dec-2019 00:00		----	
Parameter	*Method*	*LOR*	*Unit*		**Result**	**MU**	**Result**	**MU**	**Result**	**MU**
Pesticides										
MCPP (isomers)	W-PESLMS04	0.010	µg/L		<0.010	----	<0.010	----	**----**	----

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, delivery date in brackets without a time component will be displayed instead. Measurement uncertainty is expressed as expanded measurement uncertainty with coverage factor k = 2, representing 95% confidence level.
Key: LOR = Limit of reporting; MU = Measurement Uncertainty. The MU does not include sampling uncertainty.

The end of result part of the certificate of analysis

Brief Method Summaries

Analytical Methods	*Method Descriptions*
Location of test performance: Na Harfe 336/9 Prague 9 - Vysocany Czech Republic 190 00	
W-PESLMS04	CZ_SOP_D06_03_182.A (DIN 38407-35) Determination of acidic herbicides, drug residues and other pollutants by liquid chromatography method with MS/MS detection and calculation of acidic herbicides, drug residues and other pollutants sums from measured values.

A `*` symbol preceding any method indicates laboratory or subcontractor non-accredited test. In the case when a procedure belonging to an accredited method was used for non-accredited matrix, would apply that the reported results are non-accredited. Please refer to General Comment section on front page for information. If the report contains subcontracted analysis, those are made in a subcontracted laboratory outside the laboratories ALS Czech Republic, s.r.o.
The calculation methods of summation parameters are available on request in the client service.

Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2107).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

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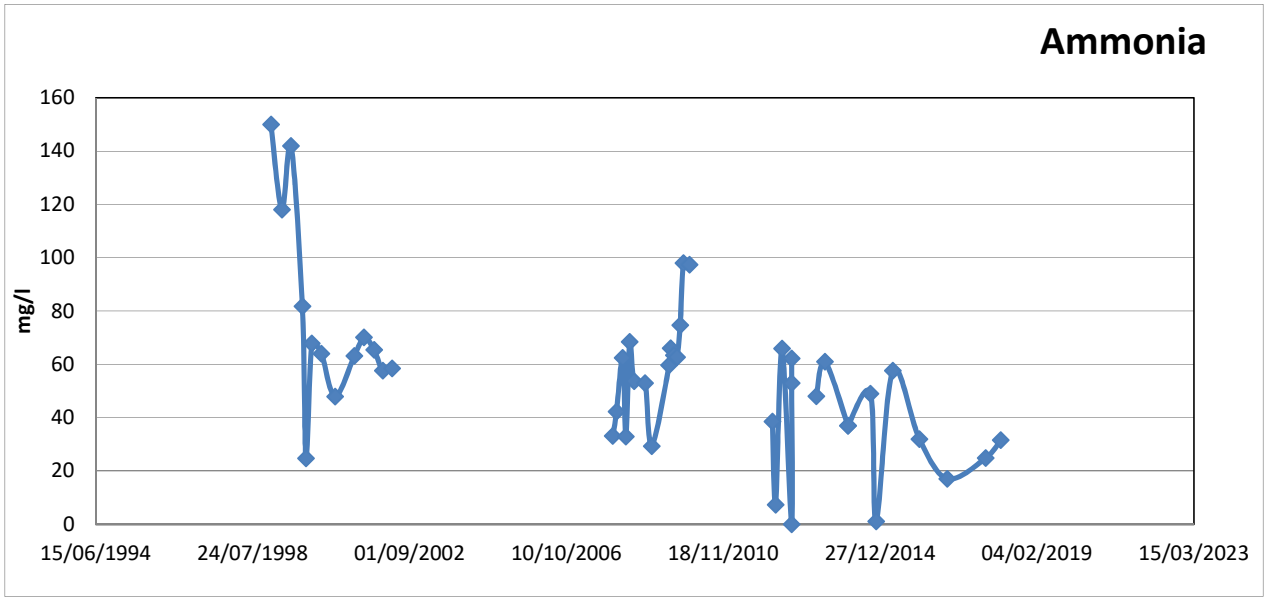
2019 Annual Environmental Monitoring Report

Appendix 2
Leachate Chemistry

Report Number 1981r1v1d0120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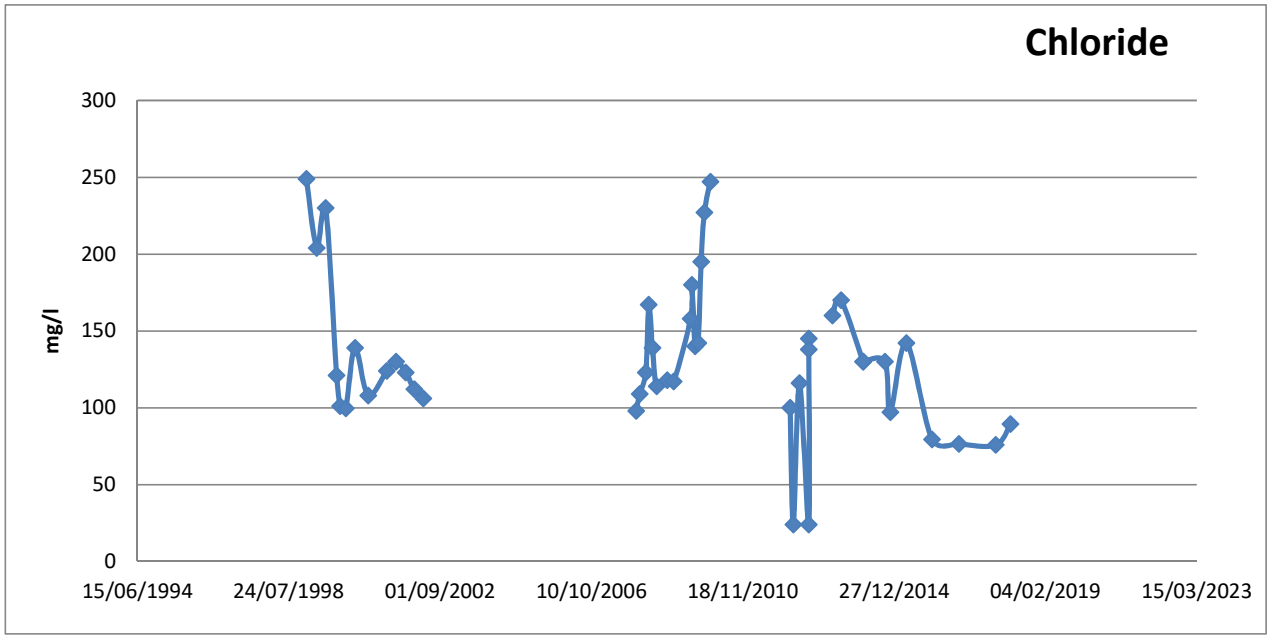
24/07/1998
01/09/2002
10/10/2006
18/11/2010
27/12/2014
04/02/2019
15/03/2023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mg/l
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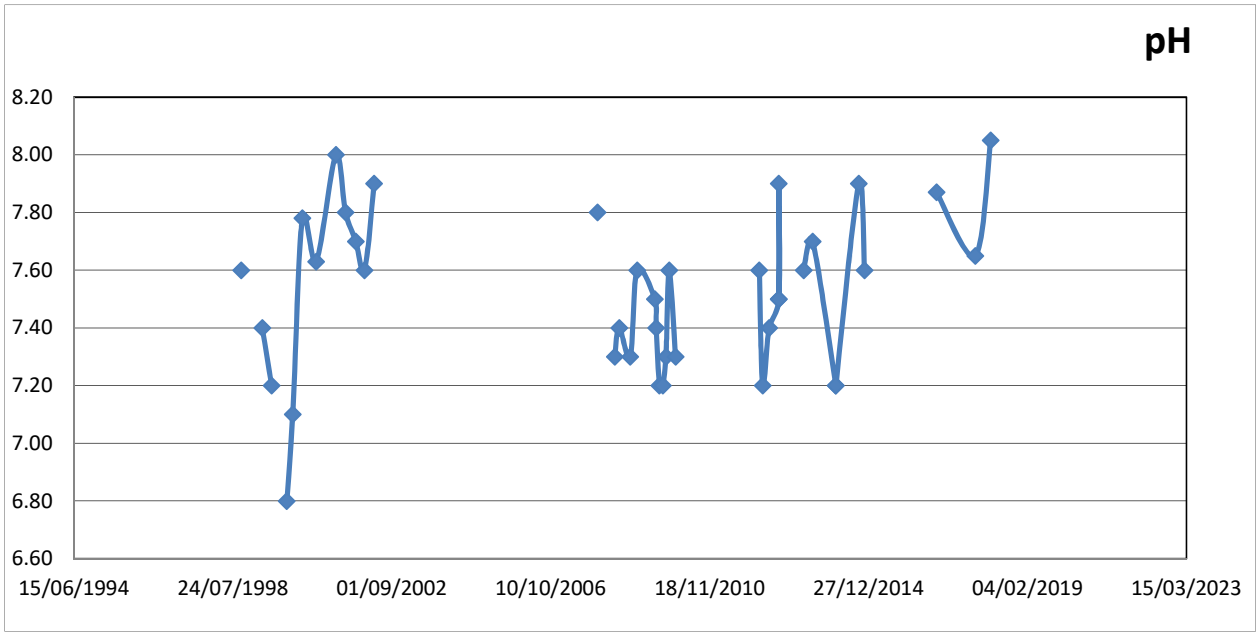
27/12/2014
04/02/2019
15/03/2023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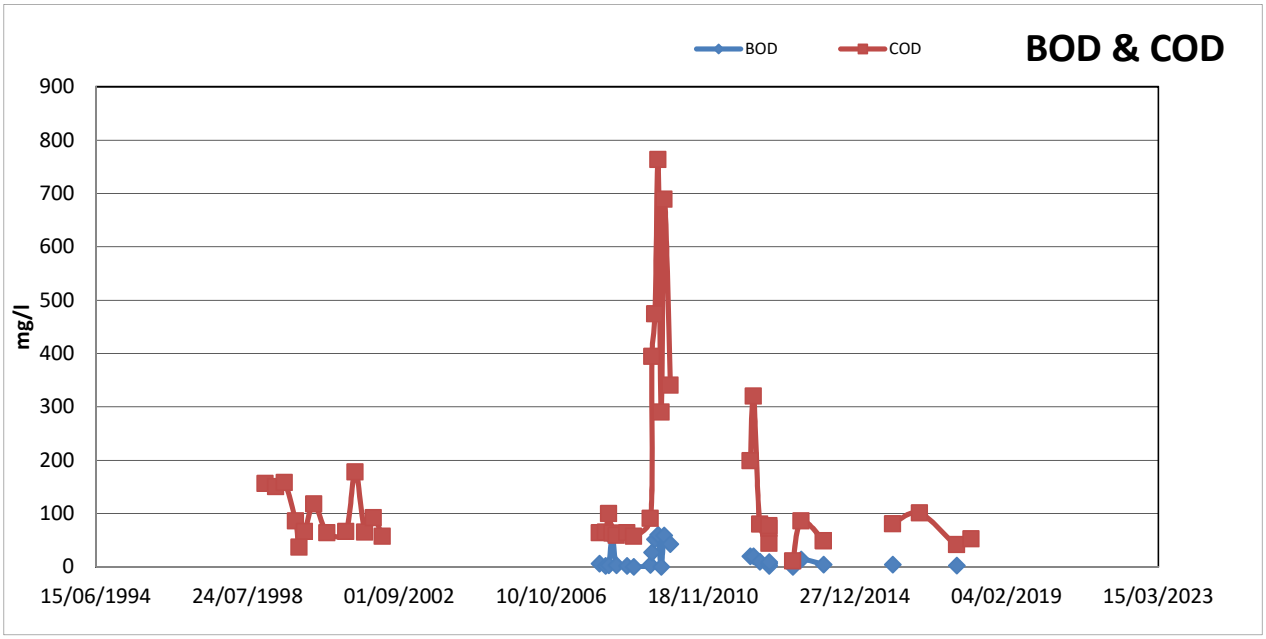
01/09/2002
10/10/2006
18/11/2010
27/12/2014
04/02/2019
15/03/2023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COD
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700
600
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400
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01/09/2002
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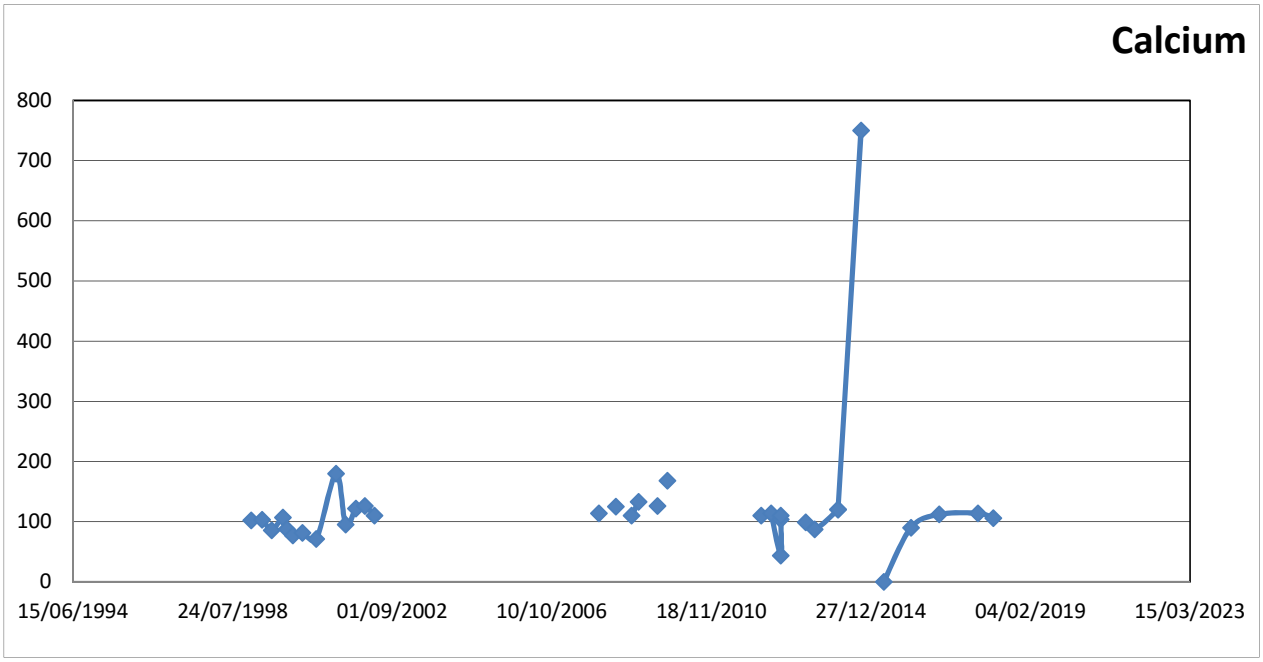
27/12/2014
04/02/2019
15/03/2023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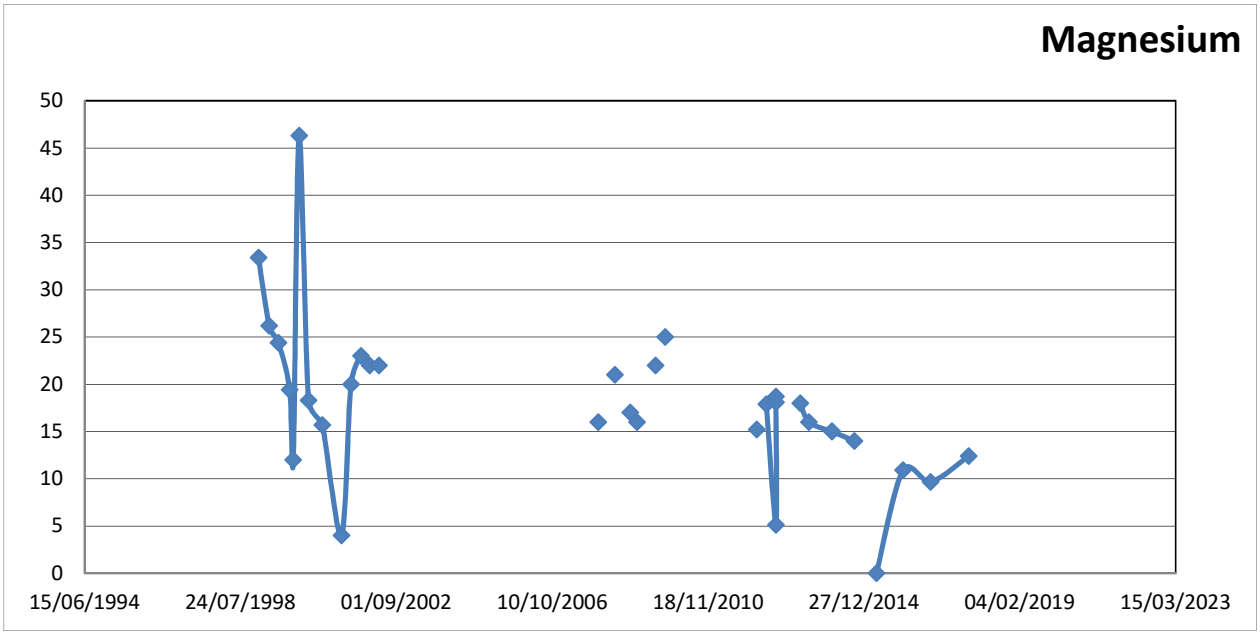
01/09/2002
10/10/2006
18/11/2010
27/12/2014
04/02/2019
15/03/2023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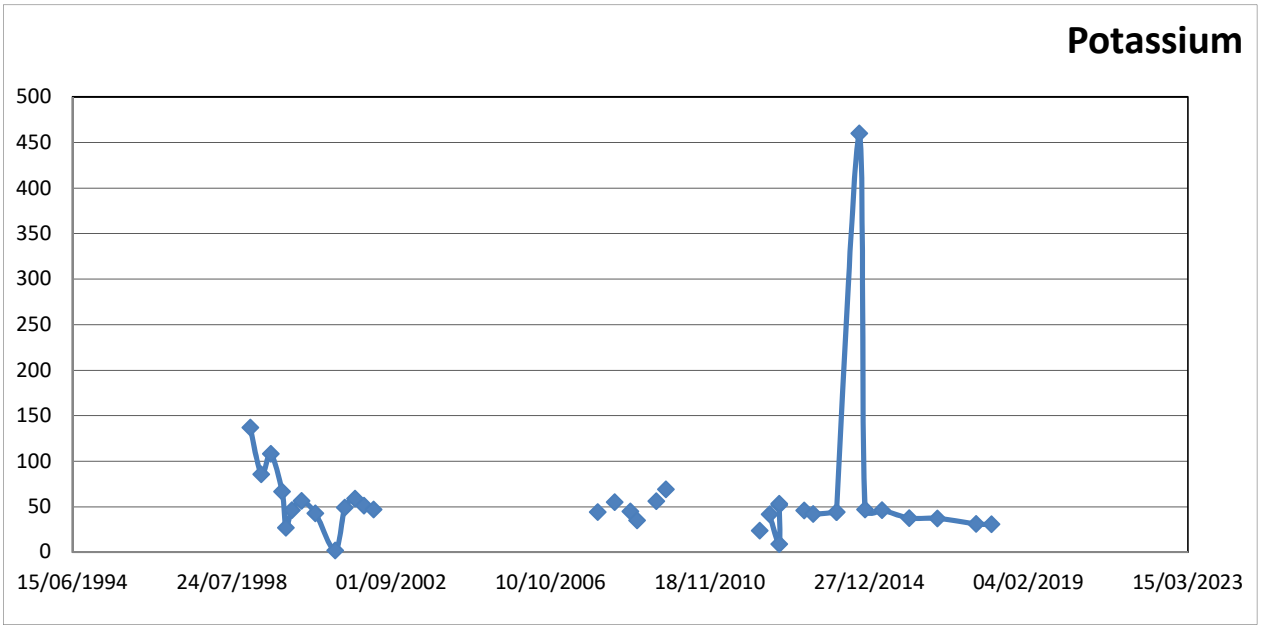
10/10/2006
18/11/2010
27/12/2014
04/02/2019
15/03/2023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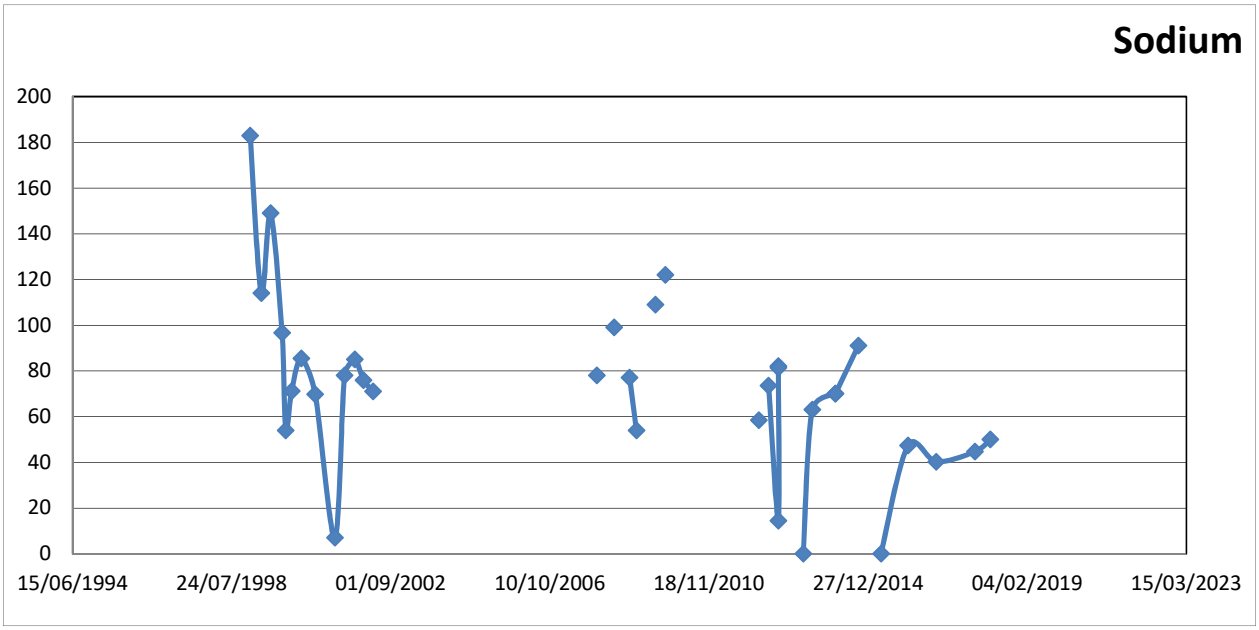
27/12/2014
04/02/2019
15/03/2023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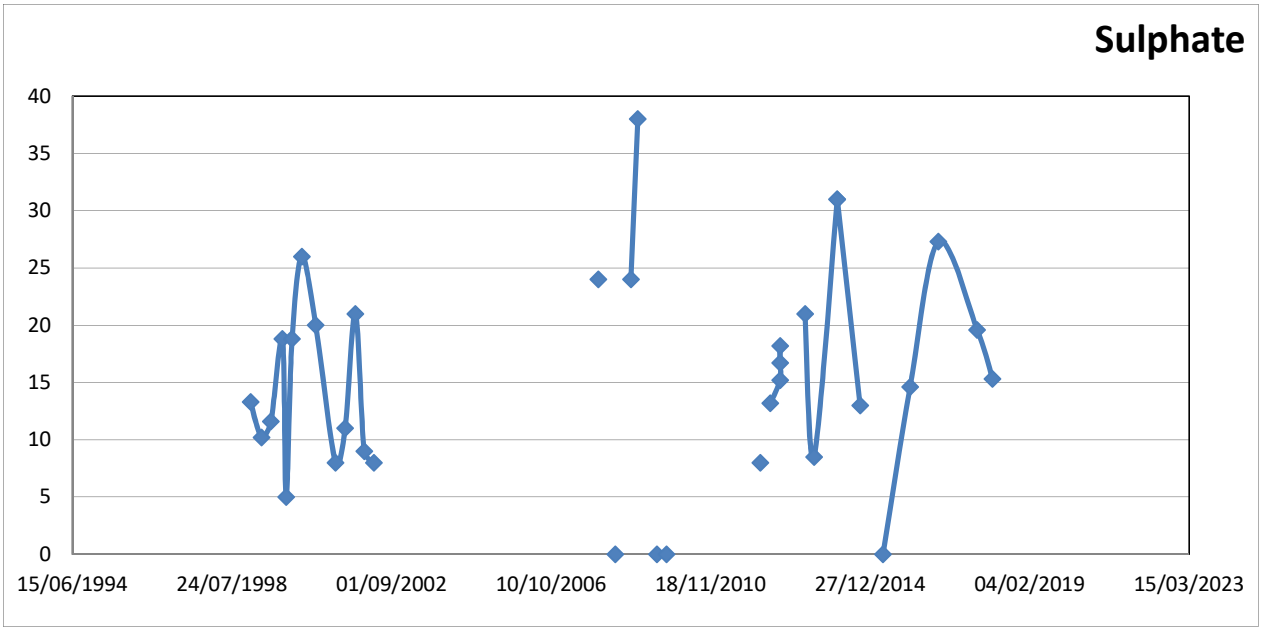
27/12/2014
04/02/2019
15/03/2023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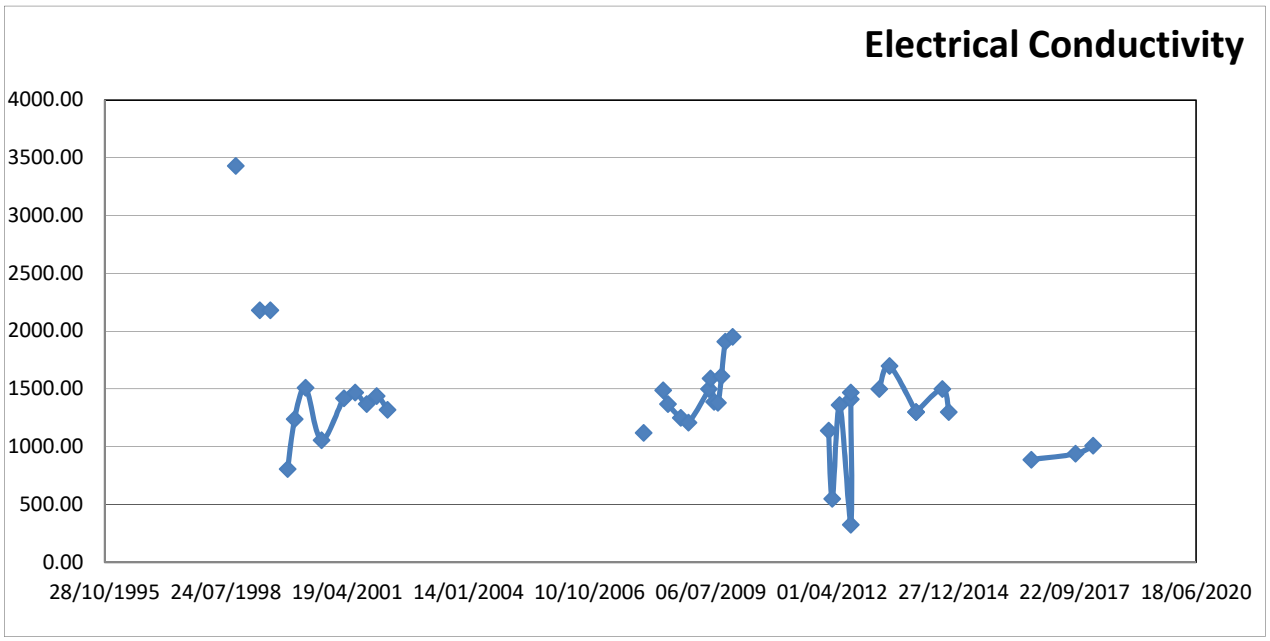
04/02/2019
15/03/2023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500.00
0.00
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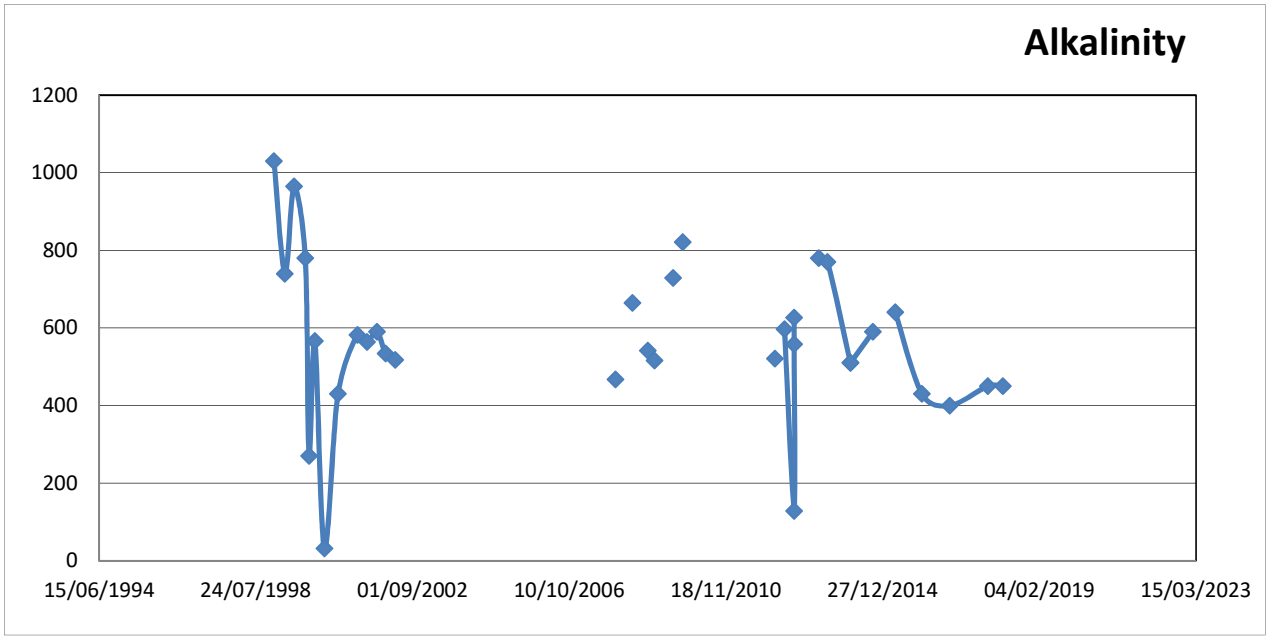
18/06/2020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400
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24/07/1998
01/09/2002
10/10/2006
18/11/2010
27/12/2014
04/02/2019
15/03/2023

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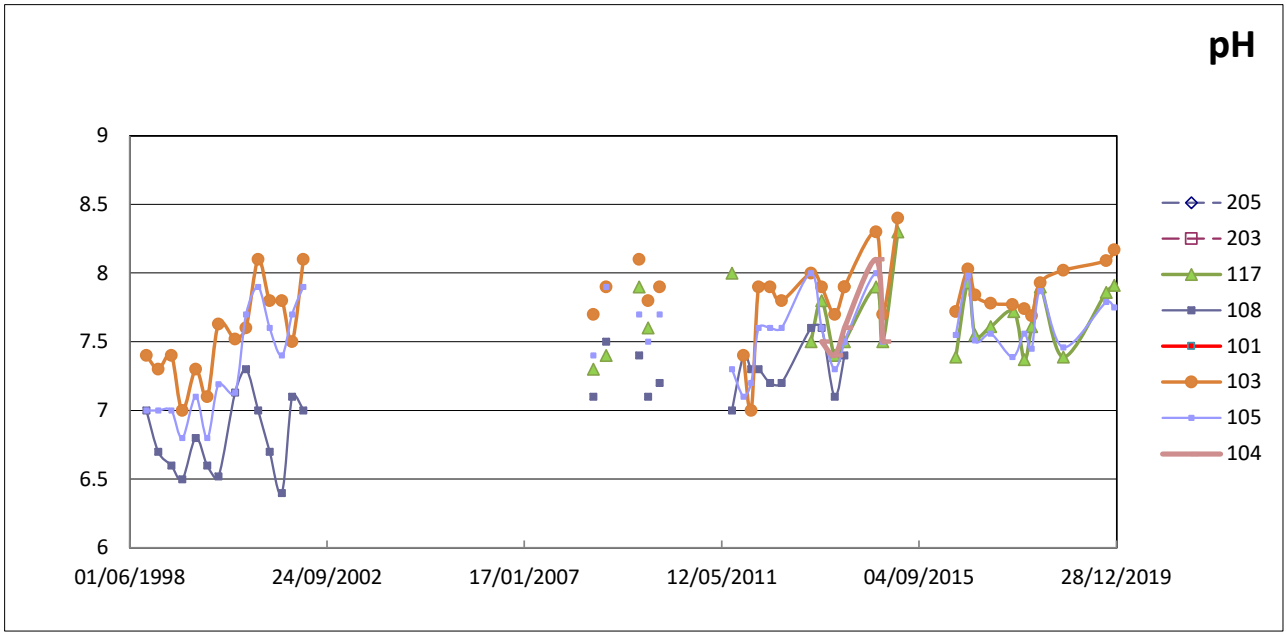
Appendix 3
Groundwater Chemistry

Report Number 1981r1v1d0120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8
7.5
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6.5
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12/05/2011
04/09/2015
28/12/2019
205
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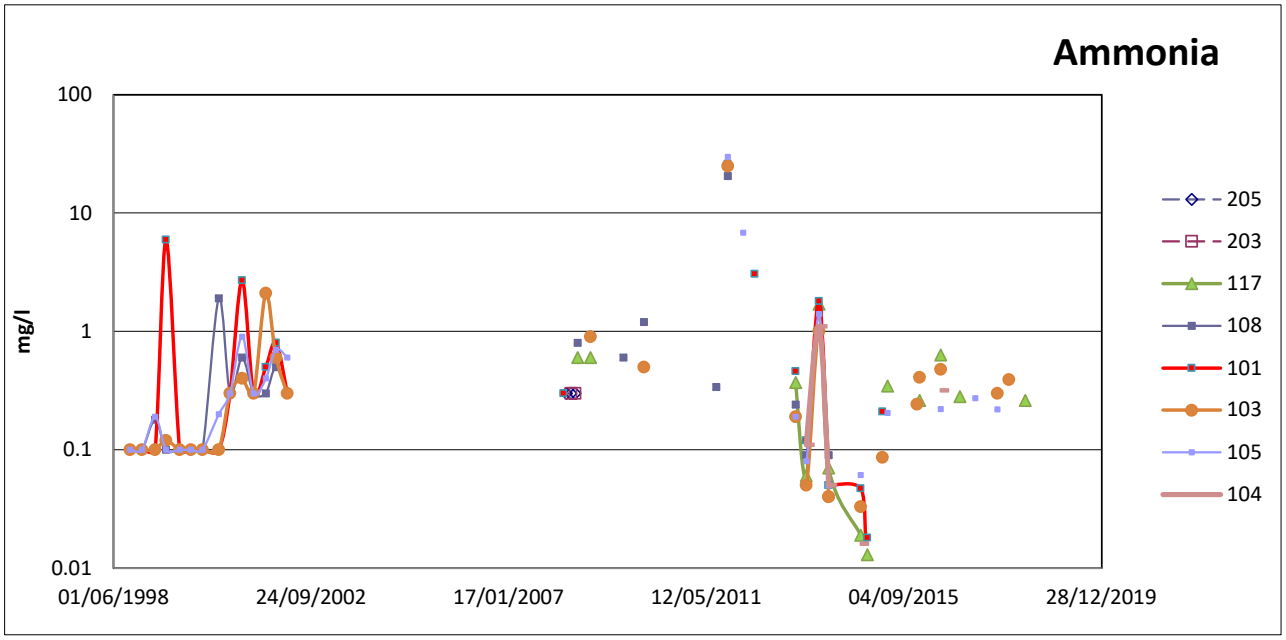
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mg/l
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0.1
0.01
01/06/1998
24/09/2002
17/01/2007
12/05/2011
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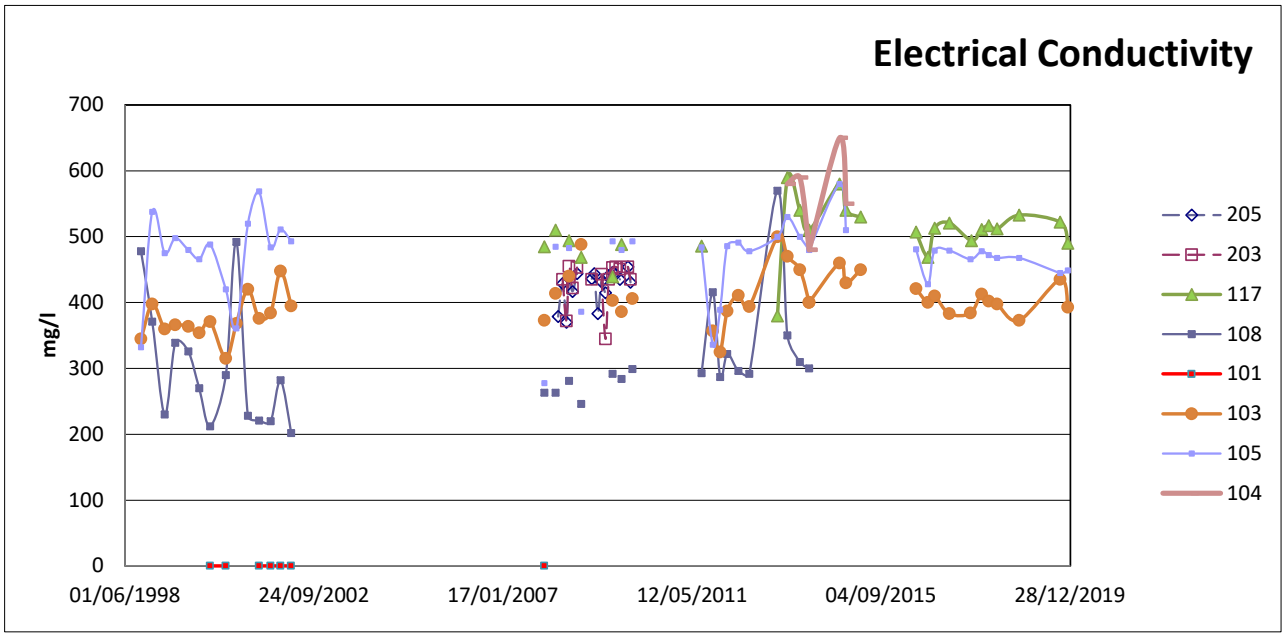
205
203
117
108
101
103
105
104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mg/l
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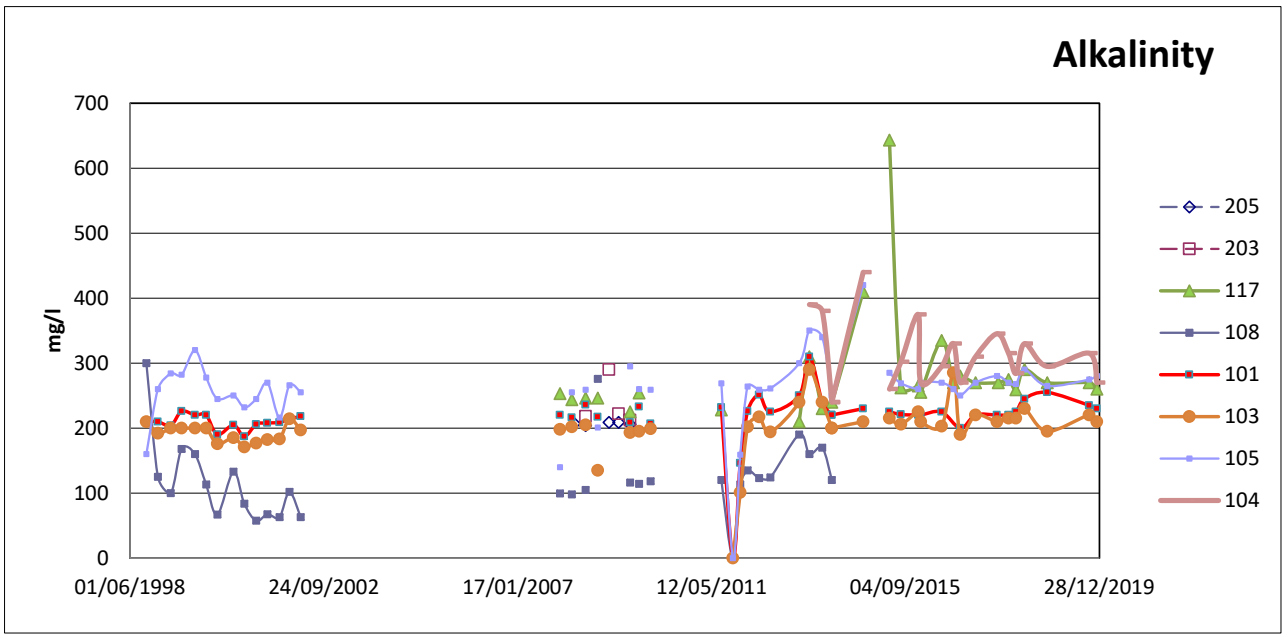
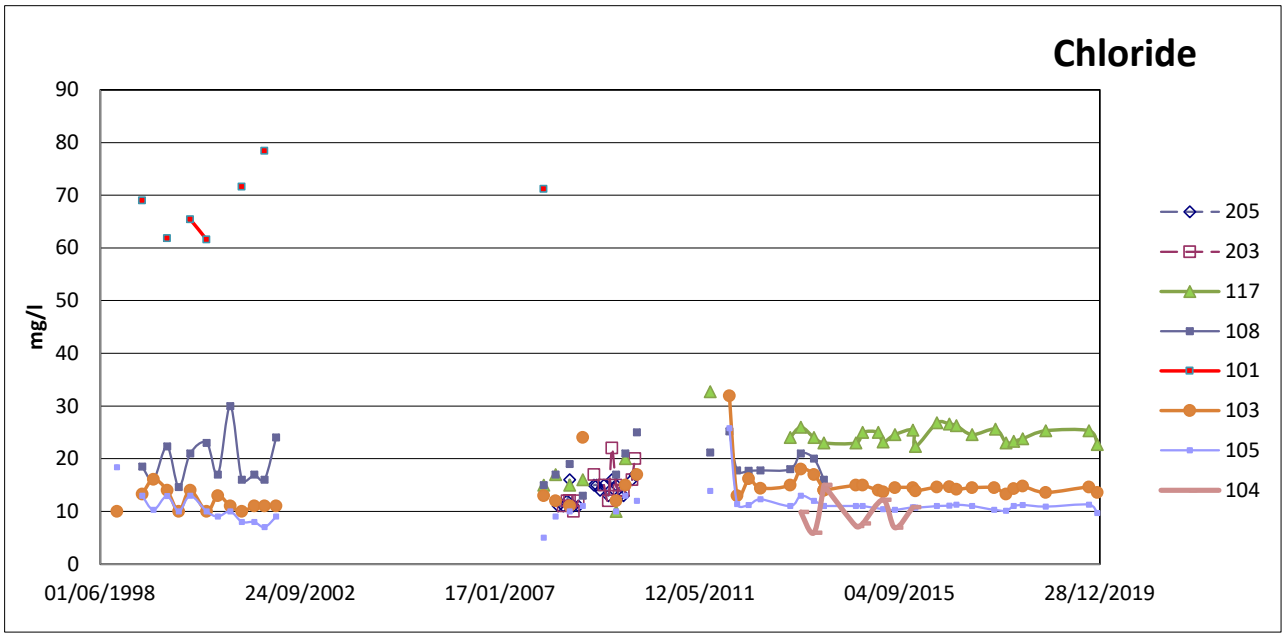
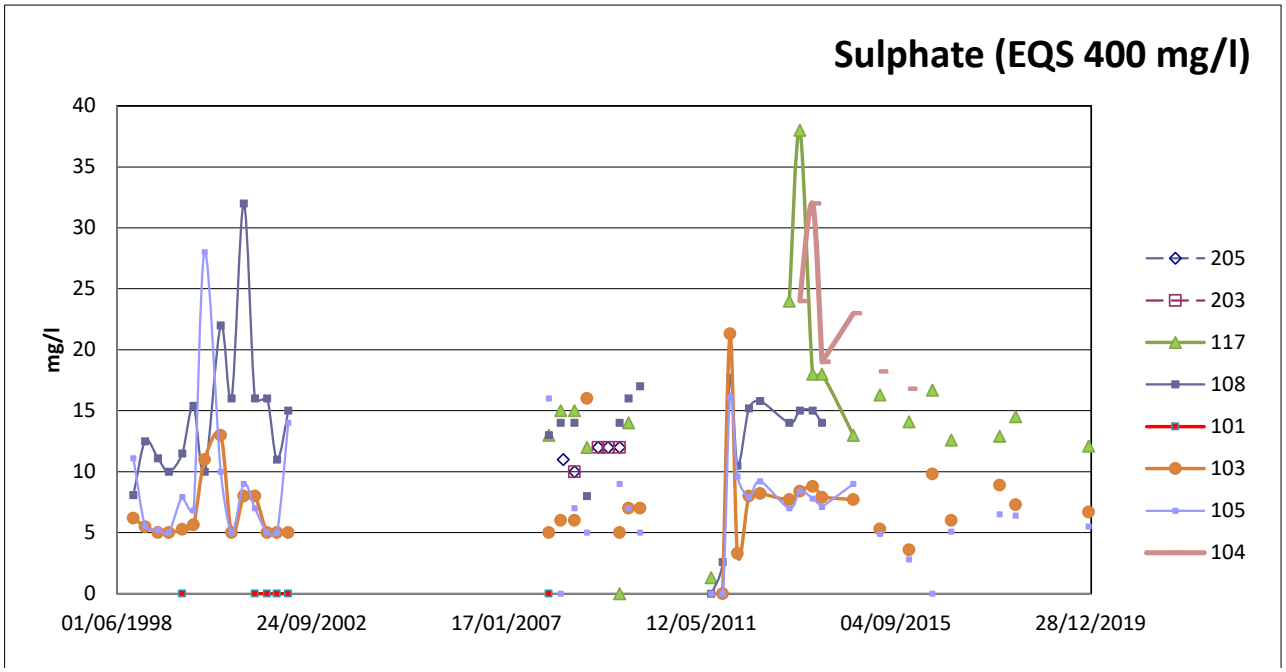
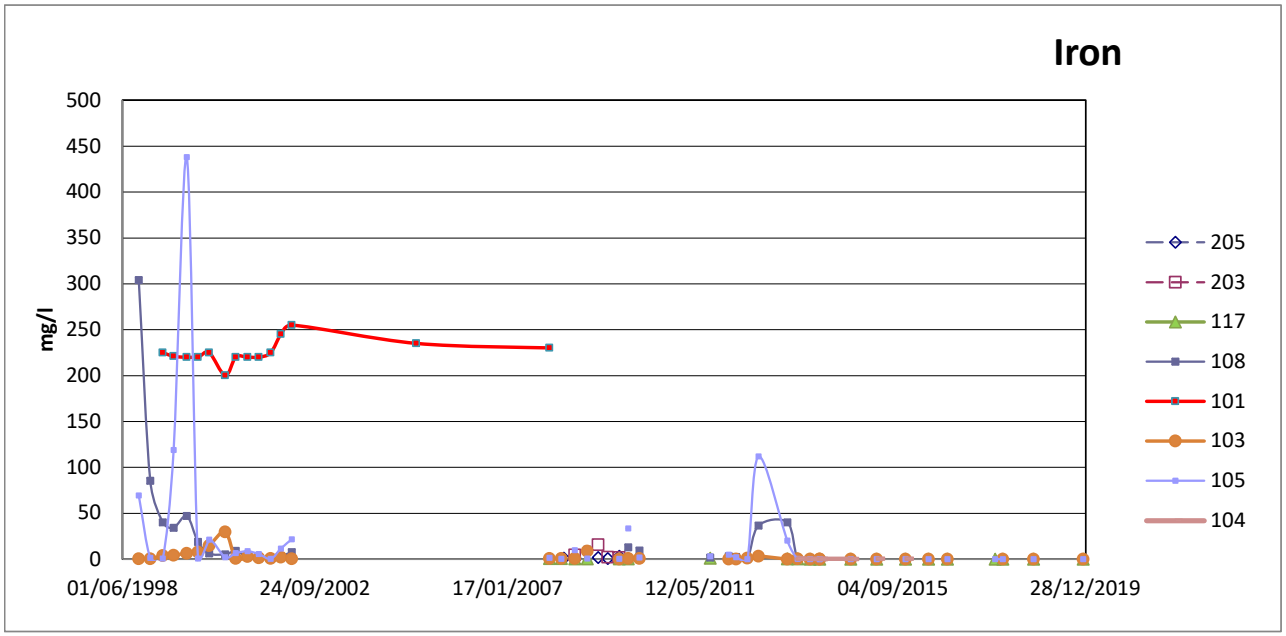
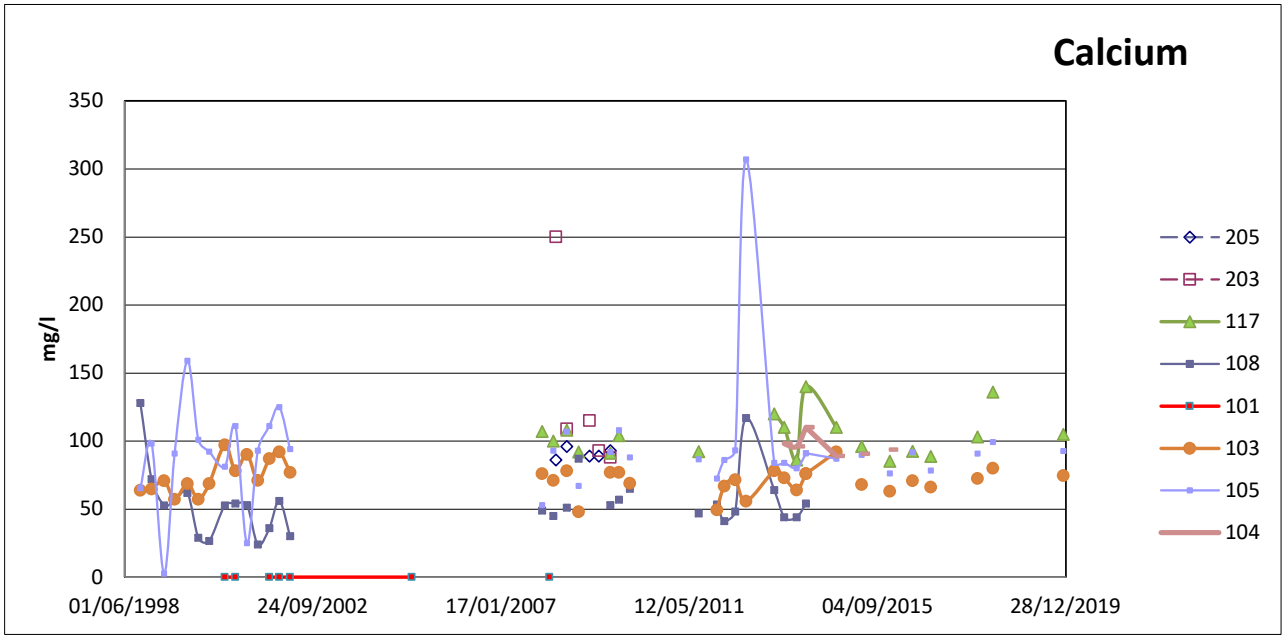
600
500
400
300
200
100
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104

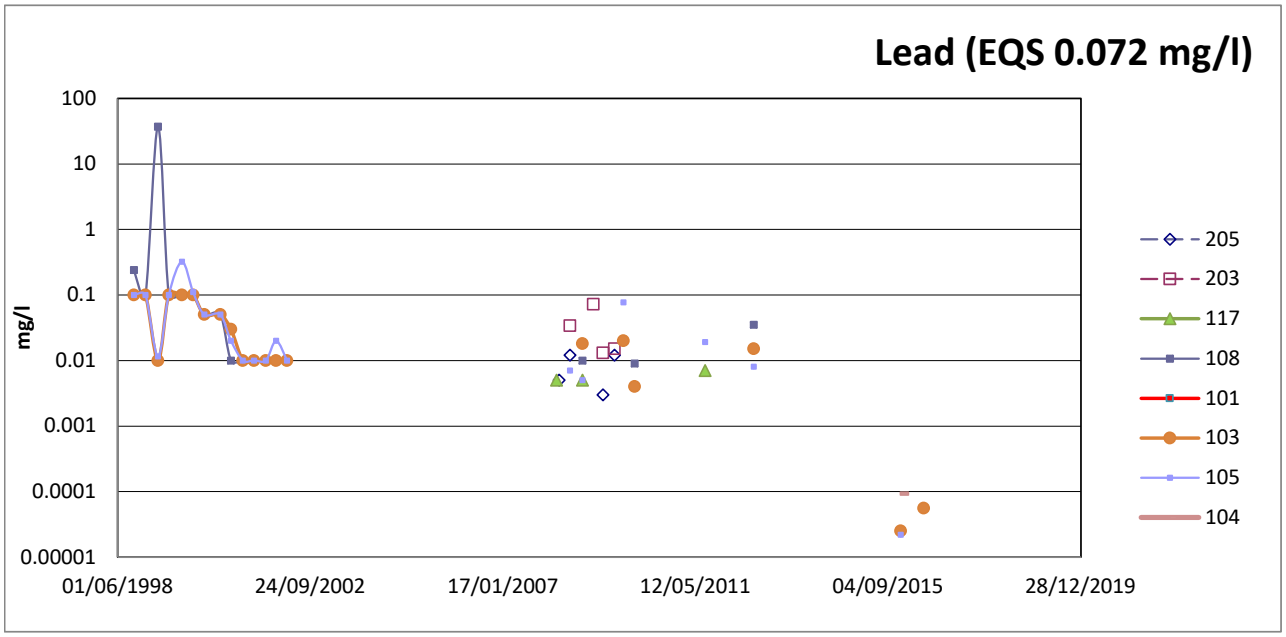

Alkalinity
mg/l
700
600
500
400
300
200
100
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104

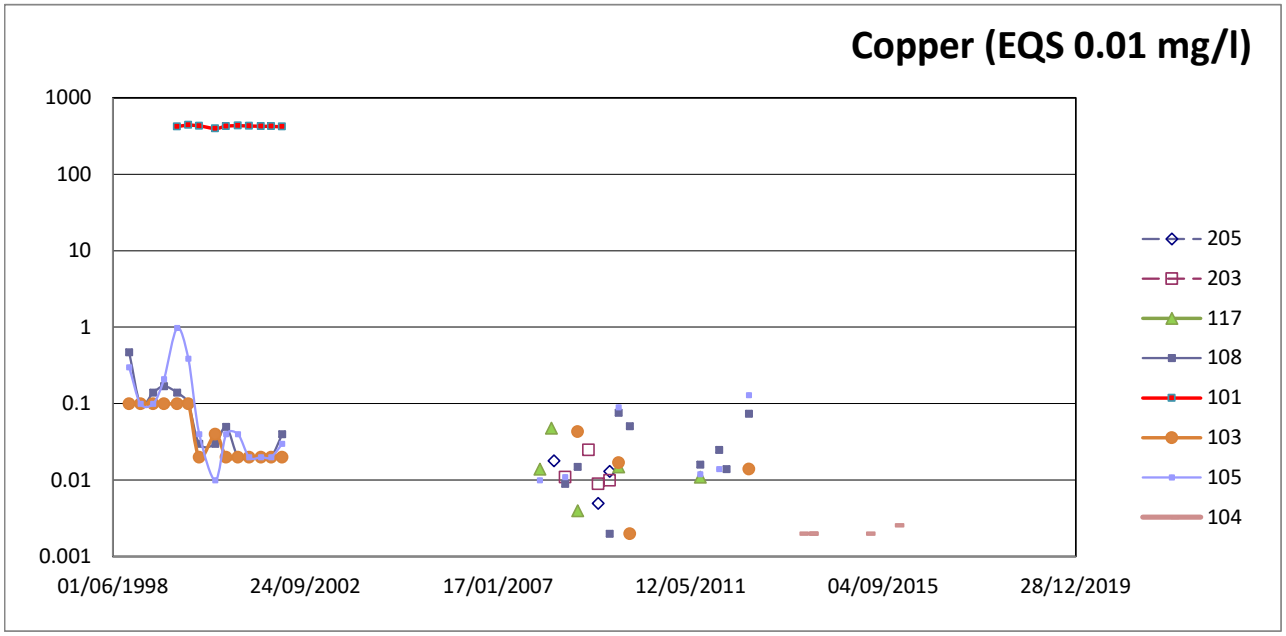

Chloride
mg/l
90
80
70
60
50
40
30
20
10
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104

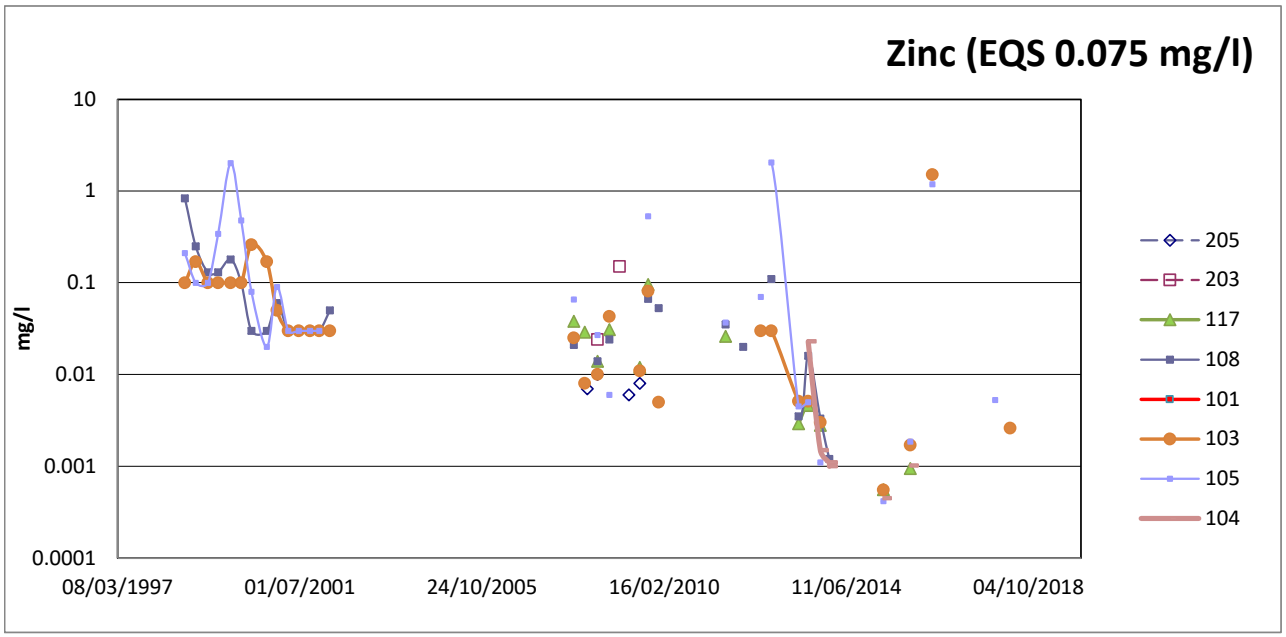

Sulphate (EQS 400 mg/l)
mg/l
40
35
30
25
20
15
10
5
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104

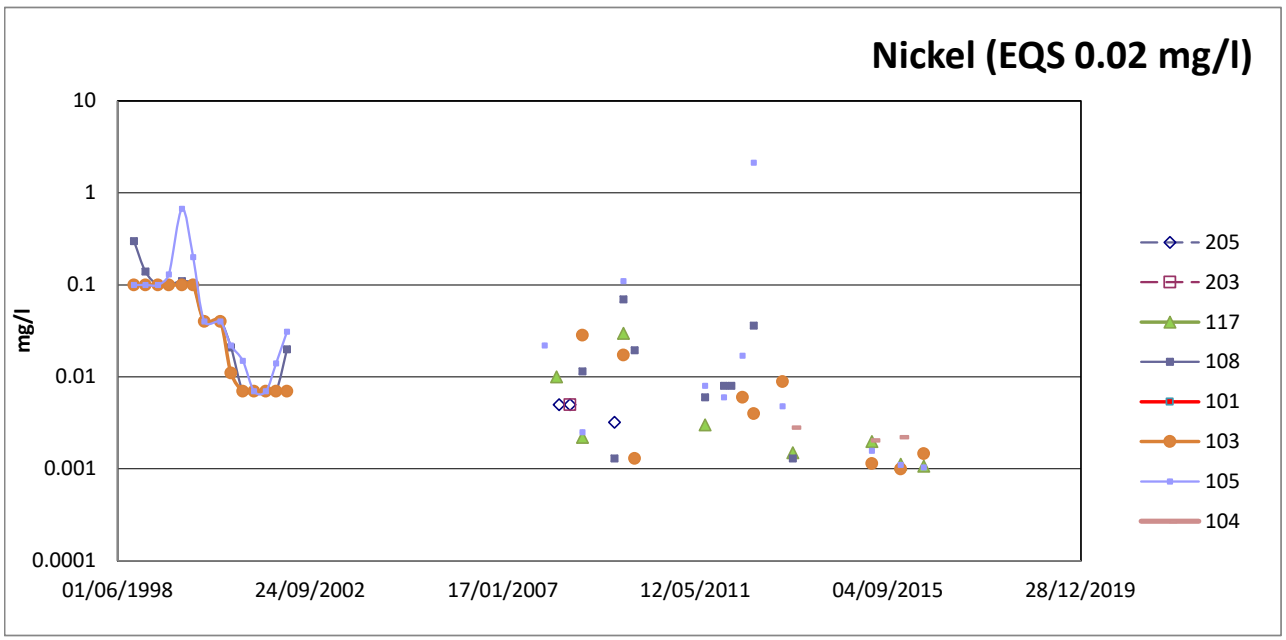

Iron
mg/l
500
450
400
350
300
250
200
150
100
50
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104

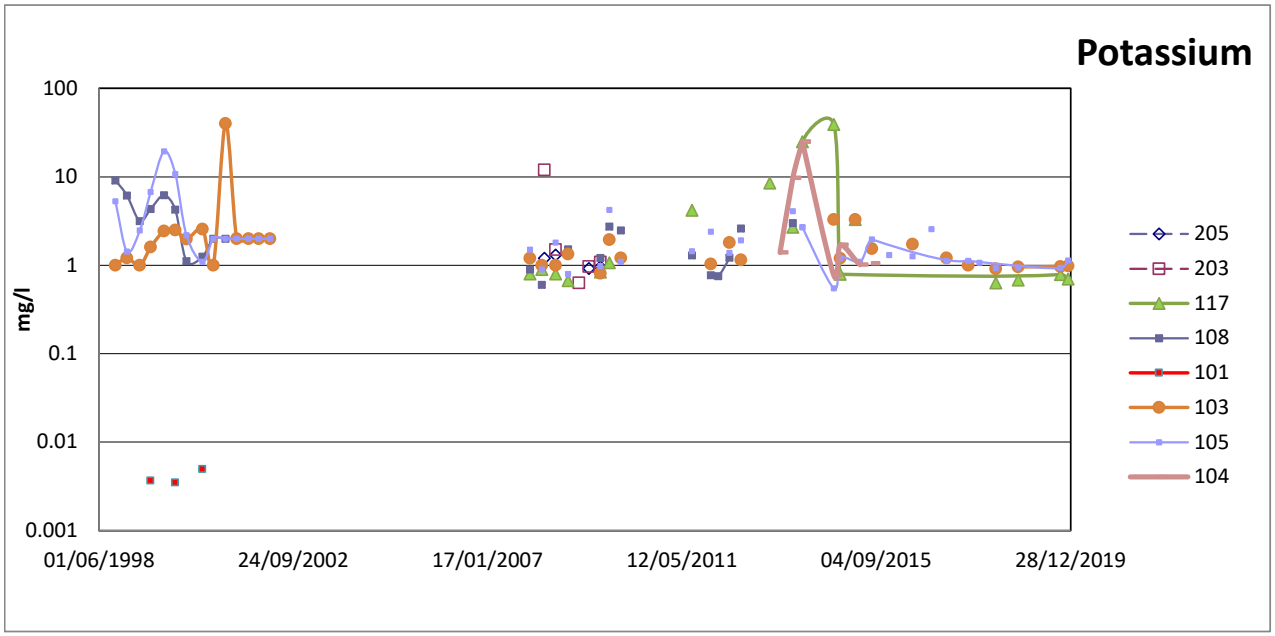

Calcium
mg/l
350
300
250
200
150
100
50
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104


Lead (EQS 0.072 mg/l)
mg/l
100
10
1
0.1
0.01
0.001
0.0001
0.00001
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104


Copper (EQS 0.01 mg/l)
1000
100
10
1
0.1
0.01
0.001
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104


Zinc (EQS 0.075 mg/l)
mg/l
10
1
0.1
0.01
0.001
0.0001
08/03/1997
01/07/2001
24/10/2005
16/02/2010
11/06/2014
04/10/2018
205
203
117
108
101
103
105
104


Nickel (EQS 0.02 mg/l)
mg/l
10
1
0.1
0.01
0.001
0.0001
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104


Potassium
100
10
1
0.1
0.01
0.001
mg/l
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
205
203
117
108
101
103
105
104

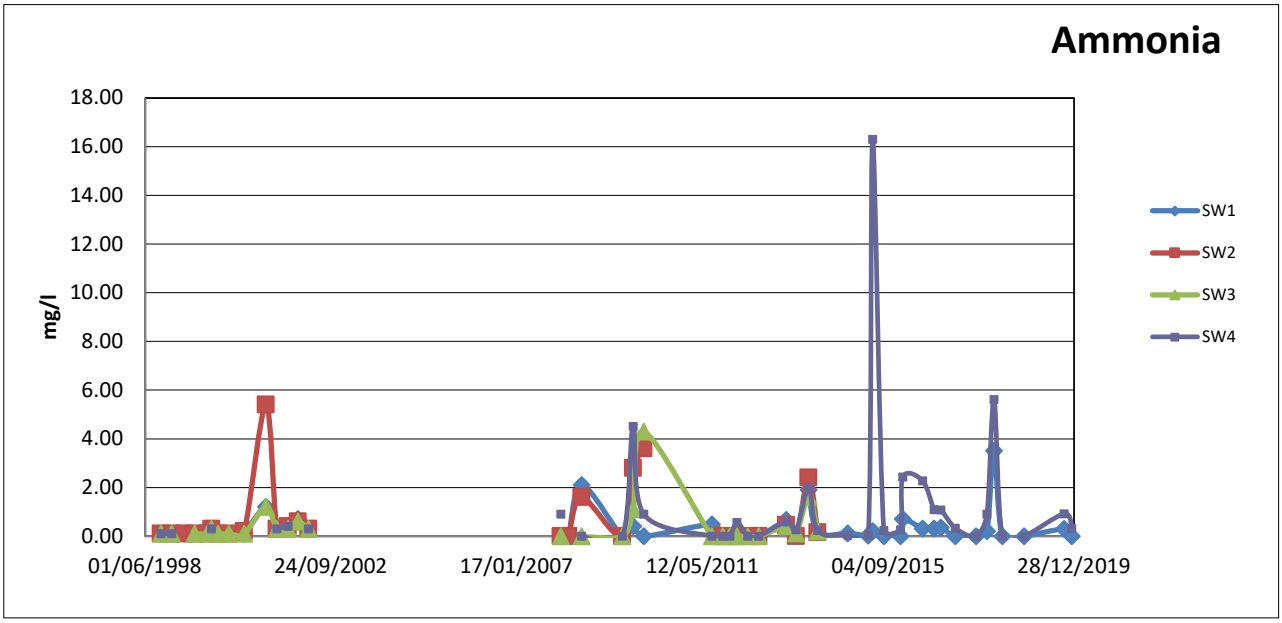
NANT Y CAWS
PHASE 1
CLOSED LANDFILL

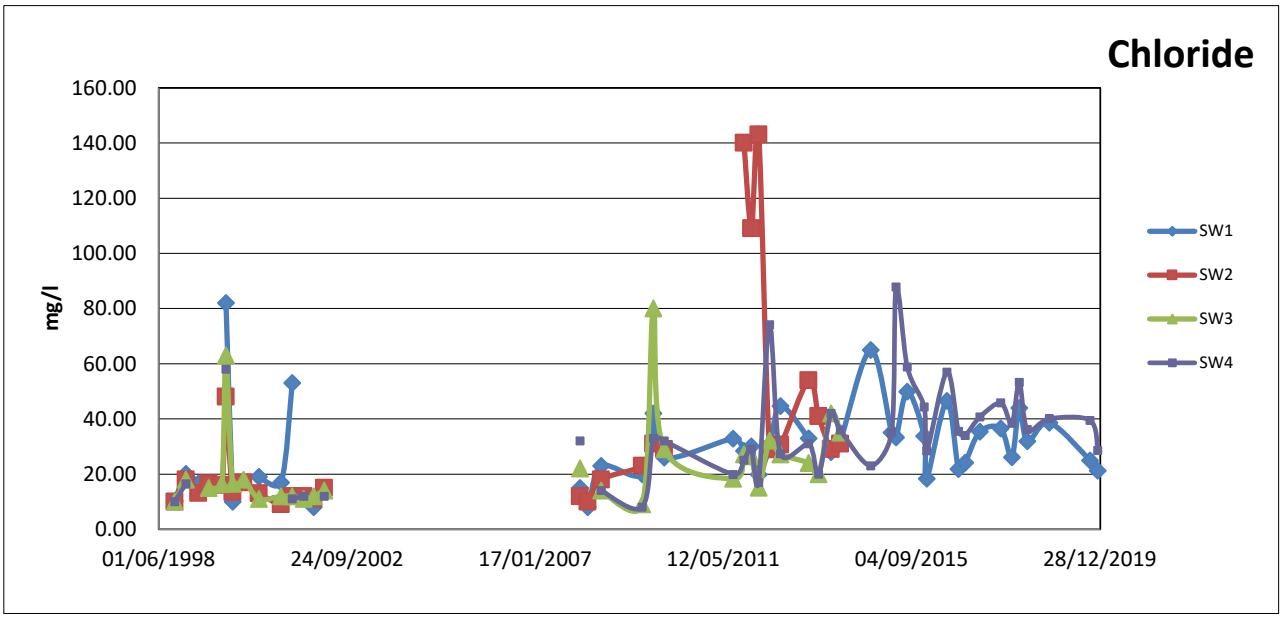
ENVIRONMENTAL
PERMIT EA WML 34183

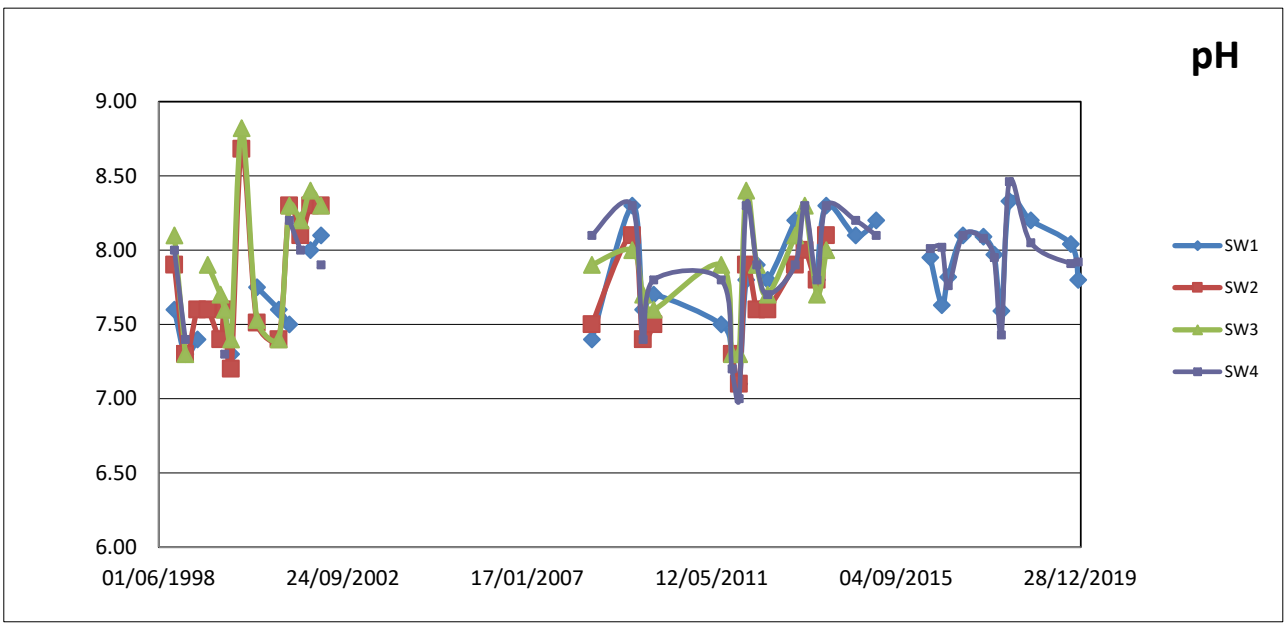
2019 Annual Environmental Monitoring Report

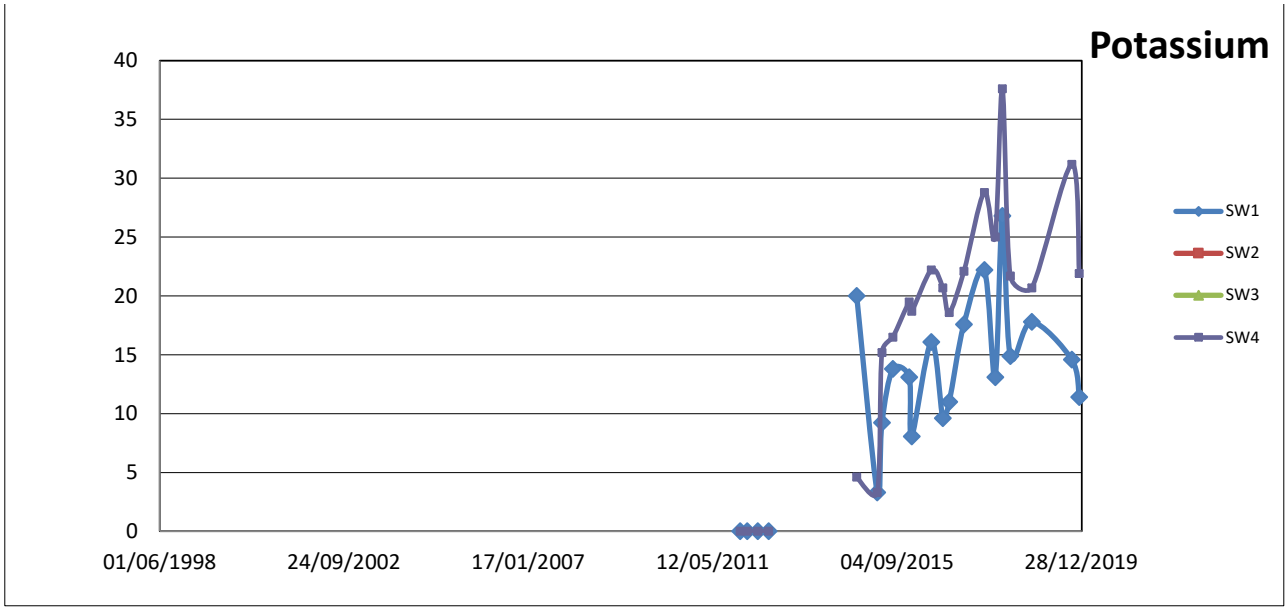
Appendix 4
Surface Water Chemistry

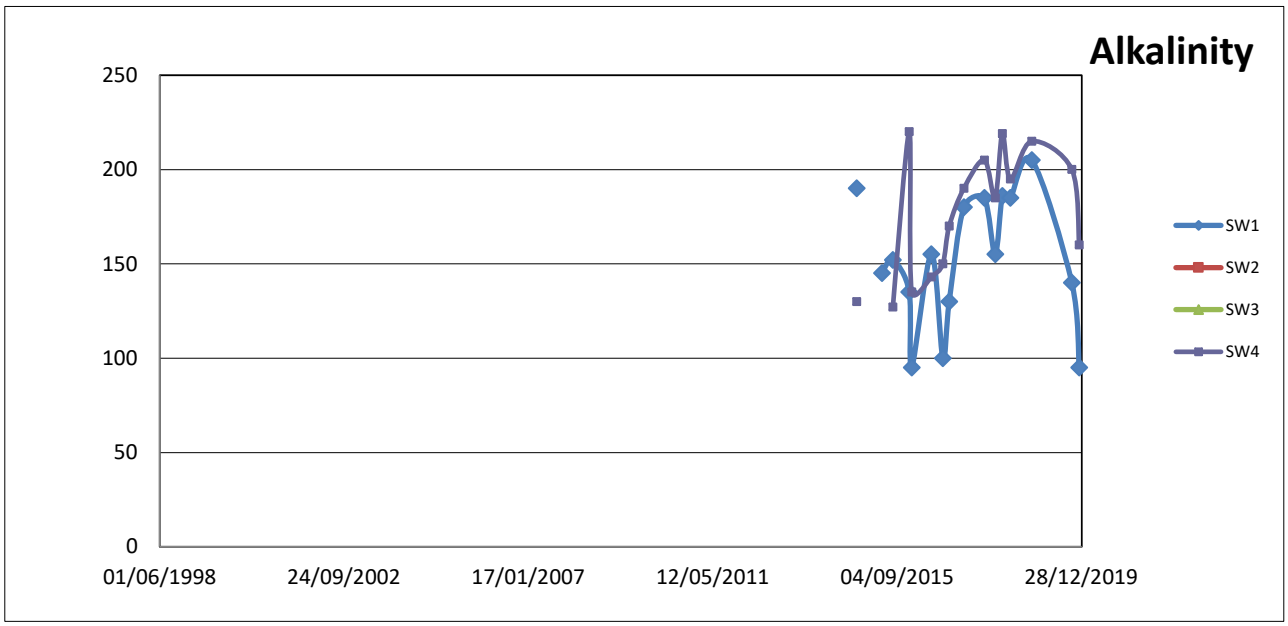
Report Number 1981r1v1d0120

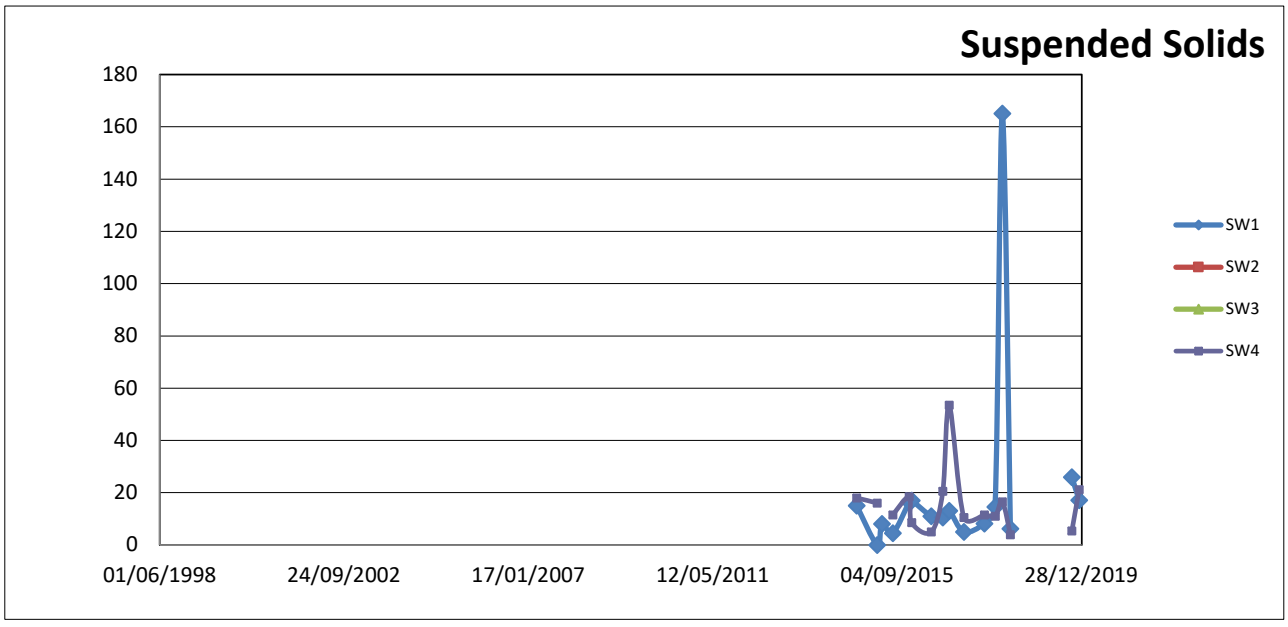

Ammonia
mg/l
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
SW1
SW2
SW3
SW4


Chloride
mg/l
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
SW1
SW2
SW3
SW4


pH
9.00
8.50
8.00
7.50
7.00
6.50
6.00
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
SW1
SW2
SW3
SW4


Potassium
40
35
30
25
20
15
10
5
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
SW1
SW2
SW3
SW4


Alkalinity
250
200
150
100
50
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
SW1
SW2
SW3
SW4


Suspended Solids
180
160
140
120
100
80
60
40
20
0
01/06/1998
24/09/2002
17/01/2007
12/05/2011
04/09/2015
28/12/2019
SW1
SW2
SW3
SW4

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Appendix 5
Isopachyte of Topographic Surface

Report Number 1989r1v1d0120

Rev	Date	Status/Ammendments	

CLIENT

CWM Environmental Ltd

Legend

Fill Levels	Cut Levels
2.4	0.0
2.0	-0.4
1.6	-0.8
1.2	-1.2
0.8	-1.6
0.4	-2.0
0.0	-2.4

FILL - 2019 > 2015
CUT - 2015 > 2019

PROJECT

Nantycaws Annual Topographic Survey - 2019

TITLE

Nantycaws 2019 - 2015 Drone Survey Isopachyte

NOTES

Survey Imagery acquired with Yuneec H520 hexcopter on 23/09/2019.

Isopachyte has been generated by subtracting the 2015 Digital Surface Model (DSM) from the September 2019 DSM. Digital surface model includes structures, vehicles and other equipment present at the time of survey.

As both surface models include vegetation and structures, some areas of cut or fill on the plan are likely the result of changes in these features between the two surveys.

NOTES

DRAWING NUMBER			REVISION
1952 Drawing 2			0
SCALE AT A1	DATE	DRAWN	CHECKED
1:750	11.19	KJT	DRAFT

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