

**MORFA NON-
HAZARDOUS LANDFILL,
PORT TALBOT**

PERMIT BV7311IE

**2020 Annual Review of
Environmental
Monitoring**

Report Number 2092r1v1d0221

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Executive Summary

Since December 2004, Tata Steel (UK) Limited (Tata) has operated the Morfa Non-Hazardous Landfill (MNHL) in accordance with an Environmental Permit. Each year, an annual review report is required by the Permit. This report covers the period to the end of December 2020 and evaluates the leachate, groundwater, surface water, gas and dust data collected since 2005. A recent topographic survey of the site is also presented.

The landfill is designed upon the containment principle. Pollutants are kept within the wastes by surrounding the wastes with barriers that are virtually impermeable to water, liquids and ultimately gases. The landfill is currently being constructed as a series of cells; one currently accepts wastes with a possibility of producing landfill gas and the other accepting wastes with a low gassing potential. Within each cell, leachate produced by the action of rainfall infiltrating and leaching the wastes is managed by extraction and then treatment in the main steelworks. Until 2016, this management programme maintained the leachate at low levels and below Permit control levels. Since 2016 these levels persistently breached the Permit criteria and the landfill was operating outside of the original design parameters and Permit conditions. In response, Tata initially increased the tankering of leachate and in 2019 completed the installation of a float-controlled pumping system to enable leachate removal 24/7. This system became fully operational in late 2019 and during 2020 leachate levels were significantly reduced and are now compliant.

Leachate chemistry is currently characterised by strongly alkaline pH and elevated concentrations of chloride, considered to be due to the combined leaching of slag wastes (source of alkalinity) and filter cake (source of chloride). Other parameters are currently present at low concentrations. Leachate from the unlined upgradient Morfa Closed Landfill is continuing to influence groundwater quality. As the closed landfill was finally fully restored in 2013 this influence has started to decline as rainfall can no longer infiltrate and leach the unlined waste. At this stage, there is no clear discernible evidence that the active MNHL is influencing groundwater quality.

1 INTRODUCTION

Tata Steel (UK) Limited (Tata) operates the Morfa Non-Hazardous Landfill (MNHL) in accordance with Environmental Permit No. BV7311Ie dated 17 December 2004. Since this time the Permit has undergone Variation on two occasions. The latest Variation Notice number is GP3430MH, although a new Variation is imminent.

The Permit applies to only part of the original Morfa Landfill waste management site, with approximately 40% being closed upon the commencement of MNHL and Morfa Hazardous Landfill (MHL). The closed part of the site is referred to as Morfa Closed Landfill (MCL). The location of MNHL and its position relative to key site features including MNHL and MCL is shown on Figure 1 and Figure 2.

Tata submits a report to Natural Resources Wales (NRW) on a three-monthly basis which compares the monitoring results for landfill gas, leachate, surface and groundwater against the relevant emission limits, assessment limits, control levels and compliance limits specified in the permit. Permit Condition 4.2 requires that a further summary review of all monitoring data is produced on an annual basis. This report is the annual monitoring report for MNHL for the period January–December 2020 as required by Permit condition 4.2. This report also includes scale plans from the annual topographic survey, as required by the Permit.

The environmental monitoring commenced in 2005. This report has been compiled and completed by Geotechnology Ltd (Geotechnology) to provide an independent review of the monitoring data collected. Previous annual reports have also been prepared by Geotechnology.

Separate annual monitoring reports describing the monitoring undertaken at MHL and MCL have also been compiled by Geotechnology.

The Permit was eight years old in December 2012 which prompted a review of the initial Hydrogeological Risk Assessment (HRA). The review is provided in Geotechnology report 1177r1v1d0712 and follows the first review in report 711r1v1d0908. In 2017, Geotechnology completed a review of the HRA (Geotechnology report 1739r1v1d1217). NRW has provided feedback on this report during 2020 which has prompted a Variation, which is currently being prepared. The feedback from NRW regarding the 2017 HRA and intervening annual reports is provided in Appendix 2 for reference. The next HRA should be scheduled for 2024 as Geotechnology understands that they are now on a six-year review cycle.

2 SITE DESCRIPTION AND ENVIRONMENTAL SETTING

The Morfa Site has been extensively investigated in support of landfill development. Since the issue of Environmental Permits (EPs) Tata Steel has maintained an extensive monitoring network that includes air quality monitoring, recording and investigating any visual or amenity issues, groundwater and surface water monitoring, landfill gas and landfill settlement. The information gathered to date is used in the following sections to describe the current site setting.

Based on the findings to date, a conceptual site model has been developed. This is illustrated in Figure 3 with each element discussed further below.

2.1 Location

The centre of the site is located at National Grid Reference SS781 838, as shown on Figure 1. The site currently comprises a mixture of casually over-tipped land, landfills constructed in accordance with the current Landfill Directive since 2004 (MNHL and MHL), the unlined but capped MCL, partially excavated sand dunes and pristine dune fields. Aerial photographs of the site are provided in plates 2-1 and 2-2.

The site was granted planning consent for sand extraction and waste disposal in 1973 and has been used in part for these purposes since. The planning boundary covers a large area (as shown on Figure 2), though restrictions within the conditions required a stand-off to be observed between the landfill site and the River Kenfig to the south and Margam Sands to the west. Tata Steel also adopted a voluntary stand-off between the development of MNHL and MHL and Margam Moors, which was designated a SSSI in 1984, 11 years after planning consent for the landfill had been granted.

The site occupies a coastal location, adjacent to the dune system behind Margam Sands. The ground is generally flat with only 2 metres of relief between 6m and 8m AOD, though the western edge of the development encroaches into the dune system, where elevation rises to 14m AOD. The western edge of the site is the coastal dune field over its entire length and is roughly parallel to the beach which lies 75 metres further to the west. The southern edge of the site is occupied by MCL with the eastern edge following the fence line at the western edge of Margam Moors. The central part of the site is occupied by the current MNHL while the northwestern corner is occupied by MHL. The northern edge of the site is defined by a disused access track crossing from the coast road to the edge of the moors. These key features are illustrated in Figure 4.

The site is remote and located at the southern end of the Port Talbot steel plant. It is surrounded by land entirely owned by the company. The adjacent Margam Moors as far as the railway line to the east is owned by Tata Steel (UK) Ltd as is the site as far south as the River Kenfig. KNNR is located to the south of the River Kenfig and is bound by the southern bank of the River Kenfig.

There are no inhabited buildings within 1.9km and the nearest industrial buildings are close to 1km from the site. There are no public roads within 1km of the site and the adjacent beach is also under the private ownership of Tata Steel (UK) Ltd. There are no services crossing the site. One public footpath crosses the moors close to the site.

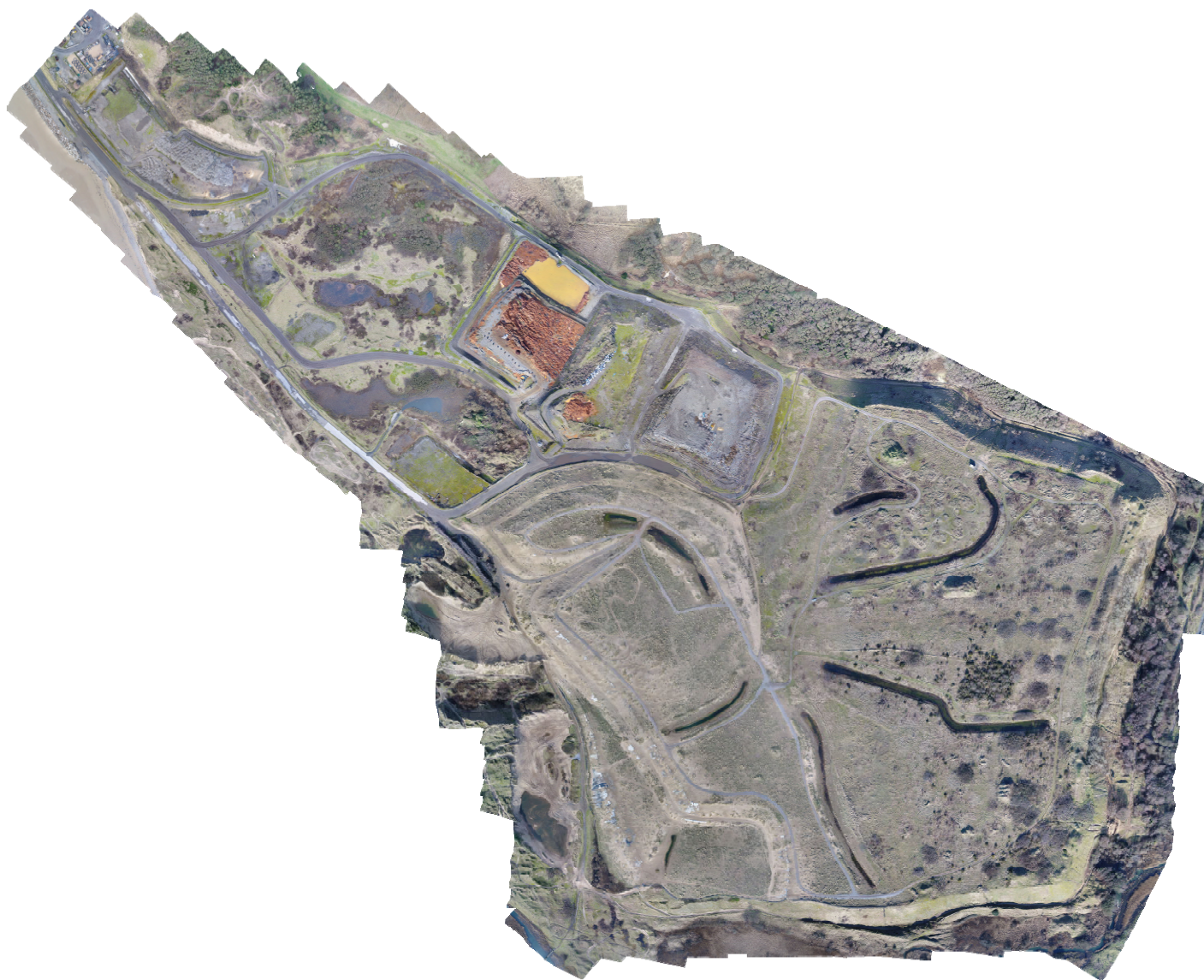


Plate 2-1 Aerial view west over site (taken January 2018). Note recently restored areas on MCL

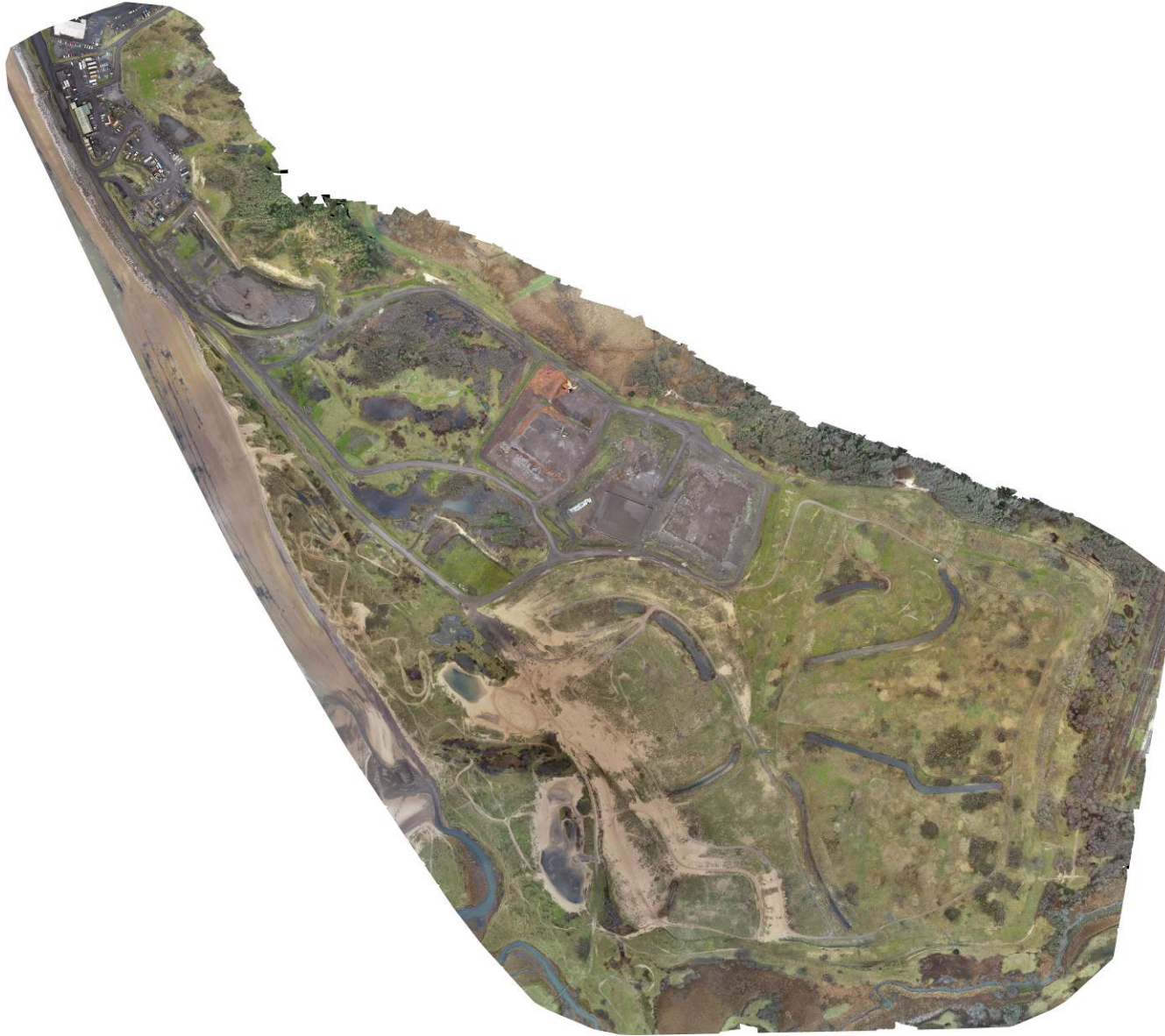


Plate 2-2 Aerial view west over site (taken January 2020)

The site lies in an area of great ecological interest. Some 40m to the south of MCL, on the opposite side of the River Kenfig is the Kenfig National Nature Reserve, a SAC. The site shares a common boundary to the east with the Margam Moors which has also been granted statutory protection by its SSSI designation.

The principal watercourse in the area is the River Kenfig, which drains a catchment to the east of the site. The water quality of the river is routinely monitored by the Environment Agency. Both chemical and biological indicators are used to classify the quality of the river water and the water course. The Kenfig flows to the south of the site, where it breaks the confines of its river valley to spread into a coastal wetland that gives rise in part to the ecological interest of the area. The wetland extends across the entire southern boundary of the closed landfill site, until the river discharges over a pebble bank onto Margam Sands. The pebble bank represents the highest point to which normal tides flow.

Margam moors is a flat, poorly drained moorland which has been artificially managed over many centuries with a ditch or reen system. Precipitation is slow to run-off and the poor vegetation cover supports a small livestock rearing effort. The moors are characterised by the deep man-made reed filled ditches which allow the moors to drain water northwards where it is collected and pumped into the steel plant to be used as process water.

2.2 Geology

Much of the site is underlain by an irregular sheet of wind-blown sand which extends from the ground surface down to an organic/alluvial clay layer. The sand deposit is typically several metres thick, though this locally increases due to sand dune topography. Being wind-blown, the dune sand is poorly graded, with a very uniform grain size throughout. The sand has blown inland from Margam Beach which lies to the west. Locally, the wind-blown sand is overlain by made ground comprising steel making wastes. The small woodland patches along the base of the northeastern flank of the site appear to be dune migration barriers and mark the extent of the blown sand.

Underlying the wind-blown sand at every trial pit and borehole, except those along the southern boundary, is an organic and alluvial clay layer of up to 2.8m thickness. The alluvial clay layer is continuous with the clays found at the surface on the adjacent Margam Moors and therefore this layer represents the moorland surface prior to the deposition of the wind-blown sands.

An examination of the reduced elevation of the clay layer has revealed that it is not completely flat, as it falls from 4.1m AOD at Borehole 14 to 3.2m in Borehole 2, adjacent to Margam Moors. Further, the upper surface of the clay aquitard has been found to have a broad shallow valley or trough running centrally through the site from south to north. Sufficient density of ground investigation data has allowed this feature to be identified and it explains the occurrence of contaminated groundwater emanating from MCL as a springline near SW3/SW2.

Ground investigation works in the southern part of the site has revealed that the clay layer is absent alongside the River Kenfig. The precise line along which it terminates is not known, though this line is considered to lie between Boreholes 14 and 10 and 9 and 16 (see Figure 4 and Figure 5). It is considered most likely that the River Kenfig, in its meandering past has eroded the clay layer, resulting in the sequence of strata seen in Boreholes 16, 15 and 10, where wind-blown sand directly overlies estuarine alluvium.

Throughout the area, the clay layer overlies an estuarine alluvium sequence, comprising principally dirty sands with shell fragments. Locally, finer lenses are seen and on occasions the upper surface of the estuarine fines layer supports a thin organic layer. In the extreme north of the site the estuarine fines dominate the sequence, with the upper 10m of the stratum comprising sandy silt and clays. Locally, within the estuarine deposits, gravels and even cobbles are noted occurring in bands, with one of these traceable between Boreholes 14 and 15.

The estuarine sands overlie glacial gravels at depth, which have been encountered in nearby deep boreholes. None of the investigation boreholes drilled at the site has continued sufficiently deep to intersect these strata. The glacial gravels, which also crop out beneath the seaward edge of the coastal barrier dunes extend inland for some distance. Coal Measures Bedrock underlies the glacial gravels at a depth of approximately 26m at the nearby Newlands Colliery.

2.3 Meteorology

In recent years the on-site weather stations have not been fully functional but in 2020 a new weather station was installed at the landfill offices.

2.4 Air Quality

Air quality at the site is routinely monitored by the Tata Steel Environment Department. Monitoring currently comprises:

- Deposition gauges which collect dust (and rainfall) via a bowl which drains into a bottle at four locations. These instruments record the total amount of dust fallen.
- Flexible poles fitted with 'sticky pads' at 5 sites. As the pads collect airborne dust from 360 degrees dust deposition direction can be evaluated. These were installed November 2005.

Independent quarterly asbestos fibre monitoring is also undertaken at four positions around MHL.

The Morfa Landfill site is not in an Air Quality Management Area.

During 2016, Tata moved the analysis of deposited dust from the BOS labs to the TDC Harbourside laboratory. Tata was aware that the change in laboratory had resulted in a step change in the data and following evaluation Geotechnology understands that this is due to a more sensitive technique being utilised at the accredited laboratory.

2.5 Hydrogeology

Ground investigation boreholes and trial pits excavated around the site have been used to obtain basic groundwater data, including groundwater levels and strata permeabilities. During the investigation works it was apparent that the site is underlain by two water bodies. The first has been encountered throughout the site at shallow depth and lies within the wind-blown sand. This shallow water body sits above the alluvial clay sequence and drilling into the clay has been seen repeatedly to seal off water inflows from this "shallow aquifer".

When the clay layer is breached by drilling works and the underlying estuarine sand sequence is struck, groundwater rises in the drill casing to a different (and normally lower), height than the shallow aquifer. Continued drilling into the estuarine sand sequence maintains a uniform water level, indicating that there is no stratification within the "deep aquifer". The sequence of upper and lower aquifer observed in drilling works has been confirmed to be consistent across the site, except for a strip adjacent to the River Kenfig, where the clay layer separating the aquifer is absent. However, even in this area, shallow piezometers and boreholes reveal a head differential with the wells placed into the lower aquifer indicating stratification of the water body here too.

2.5.1 Shallow Aquifer

The shallow aquifer is the wind-blown sand deposit with vertical downward percolation eliminated or restricted by the presence of the underlying clay. Permeability tests have been undertaken (rising head tests) and these reveal a variation in permeability ranging from $2 \times 10^{-3} \text{ms}^{-1}$ to $5 \times 10^{-5} \text{ms}^{-1}$, with an average permeability of $2.3 \times 10^{-4} \text{ms}^{-1}$. Due to the sand deposits limited thickness the aquifer is thin, with perched water depths typically around 2 to 3 metres, extending from close to ground surface down to the underlying clay layer.

The position of each monitoring point has been established with a differential GPS instrument so that the spatial location of the data can be mapped. This has allowed groundwater surfaces to be constructed onto a base plan of the site.

An examination of the shallow groundwater surface shows that it is typically domed, with a concentric series of groundwater elevation contours centred on the highest elevation close to the centre of the site (see Figure 6). Groundwater flows in response to head loss and accordingly flow lines will be normal to the contours, radiating outward from the central dome. This radial flow pattern is considered to be a response to groundwater recharge in the shallow aquifer, which has very limited extent, following almost exactly the footprint of the site. Clearly, shallow groundwater flow from beneath the Morfa site would be expected toward Margam Moors, Margam Beach, the River Kenfig and the railway sidings.

In Section 2.2, the dune sand was noted to have limited extent, petering out along the site's boundary with Margam Moors. The moorland, which lies directly on the clay layer, is continuous with the clay underlying the dune sand and therefore the presence of a spring-line where the groundwater surface meets the edge of the sand deposit is not unexpected. A significant spring-line 40m from the northeast edge of the boundary along Margam Moors can be seen on the ground and this strip of wet ground supports a fen habitat which has been protected by SSSI status.

To the west of the site, the shallow aquifer discharges into Margam Beach in the inter-tidal zone. It is difficult to see the spring-line under conditions other than dry periods with spring tides but a linear seepage line at an elevation of 2.5m is present.

The shallow aquifer may or may not have localised areas where it is in continuity with the underlying deep aquifer. At every point where an investigation borehole has been drilled sufficiently deep, the presence of the underlying clay layer has been confirmed. It is likely, therefore, that the clay aquitard is either complete or near complete.

Ground investigation data has revealed that the ground alongside the Kenfig and along the southern part of the existing site comprises wind-blown sand over estuarine sands. The clay layer, characteristic of a large part of the existing site and the entire PPC permit boundary, is

absent. This absence, most likely due to river erosion as described earlier, has prevented the clear separation between the upper and lower aquifers. However, there is a permeability contrast between the wind-blown sand aquifer and the underlying estuarine sands and this causes stratification within the groundwater. Greater heads in the shallow groundwater indicates that recharge from the shallow aquifer is active, explaining the difference in chemistry between shallow and deep groundwater along this edge.

Water quality in the shallow aquifer is variably impacted due to seepage from the unlined MCL. Shallow groundwater quality is poorest in the northeast (Margam Moors) downgradient flow zone of MCL where hazardous substances and elevated concentrations of non-hazardous pollutants have been historically found e.g. BH18–20 on Figure 4. When this shallow groundwater eventually discharges along the fringe with the Margam Moors as a springline (SW3 and SW2) it has had an observable ecological impact due to its alkaline mineralised load. Capping of MCL is intended to improve groundwater quality along this fringe line by recharging the system with clean surface water runoff. In topographically low areas secondary precipitates have accumulated where shallow groundwater interacts with the atmosphere. NRW has previously approved the covering of these areas to prevent direct access.

2.5.2 Deep Aquifer

Beneath the alluvial clay layer, the estuarine sands are saturated and piezometric levels are higher than the base of the clay. The water in the lower aquifer is therefore confined by the clay layer. Using data from the monitoring boreholes it has been possible to produce a map of the piezometric surface in the area surrounding the site. The piezometric surface plan of the deep aquifer is included in Figure 7.

Rising head permeability tests have been undertaken in many of the boreholes and these reveal that the lower aquifer is of lower permeability than the upper aquifer, with permeabilities ranging from $5.2 \times 10^{-4} \text{ms}^{-1}$ to $1.5 \times 10^{-7} \text{ms}^{-1}$. This is consistent with descriptions of the lower aquifer stratum as being silty sand.

Locally, thicker deposits of estuarine fines are found interbedded with the sands, with one principal fines stratum shown on the geological sections. At the northern edge of MHL, Boreholes 26 and 27 intersected a sequence dominated by silts and clays, with sand occurring as a minor constituent. Permeabilities here are expected to be accordingly smaller.

Typical deep groundwater piezometric levels are indicated on Figure 7 and the plan shows a pattern of decreasing head towards the north and west. There is no element of a radial pattern to the contours as seen in the overlying shallow groundwater, but rather a uniform loss of head from the east towards the west. Recharge to the deep aquifer takes place at some distance to the east of the site, where the sand and gravel deposits form undulating farmland in the Cornelly/Pyle/Margam district. Groundwater migrating seaward from this higher ground passes beneath the industrial areas (where it has been utilised for water resources), beneath the railway and then beneath the site.

An examination of Figure 7 shows that the deep groundwater surface is at the same level as the River Kenfig at the southern boundary of the site, strongly indicating a degree of interaction with the surface water. In this area drilling has also revealed that the clay aquitard is absent, with the wind-blown sand aquifer directly overlying the estuarine sequence.

The chemistry of the deep aquifer is generally far less contaminated with slag source pollutants than the upper aquifer. Most monitoring results show lower pH, lower alkalinity and lower

calcium levels. Generally, water quality in the lower aquifer is like or better than the overlying shallow aquifer. However, the lower aquifer is contaminated with other pollutants, with ammoniacal nitrogen and nitrate in greater concentration than the shallow aquifer. The chemical profiles are evidence of pollution from various sources, MCL is the source of pollutants for the shallow aquifer, whilst industrial and farmland to the east is the source for the deep aquifer. Where water quality of the upper aquifer is good (i.e. little contamination with Ca, pH and alkalinity) the lower aquifer beneath is also low in these pollutants. Where the upper aquifer can be seen to be affected, the lower aquifer remains less so. This supports the observation that the clay aquitard provides effective separation of the two water bodies over much of the site.

2.6 Hydrology

The site is surrounded by a sand dune field and there are no surface water courses within the site, or at its immediate perimeter. Surface water features near the site comprise the River Kenfig to the south, the Margam Moors ditch system to the north and the Bristol Channel to the west. A small number of isolated ponds are found on the low-lying area to the north of MCL in an area that will be developed as part of MNHL.

The flat lying moors have been managed for centuries for agricultural production by draining the clay soils using a deep network of ditches. The configuration of ditches has been developed to address local ground conditions. The ditches are at their densest along the southern and western edge of the moors where there is a need to drain surface water originating from the pronounced springline. All the ditches feed into the Mother Ditch which flows northward to a single gauged collection point. From here the entire flow of water is abstracted into the works for use as process water. The pumping is carried out after the water discharges over a weir and therefore pumping cannot affect water levels in the ditches.

The River Kenfig drains a small catchment to the east of the site to the sea at Margam Beach. This is the principal watercourse in the area and separates the site from Kenfig National Nature Reserve which is bound by the southern bank of the Kenfig. The river has a 95-percentile low flow of 950 litres/sec. The river is monitored routinely by Natural Resources Wales. Based on 36 measurements made in 2007, the upstream and downstream river stretches were chemically classified by the Agency as Grade B, with low levels of phosphorous but moderately elevated nitrates. The biology of the river stretches is classified as Grade E. The chemical and biological scale used by the Agency runs from A to F (very good to bad). The lack of deterioration in the quality of the River Kenfig demonstrated by the Agency is backed up by the routine monitoring of the River Kenfig undertaken by Tata Steel.

2.7 Ecological Setting

Two sites of ecological importance lie near the site:

- Kenfig National Nature Reserve (KNNR)
- Margam Moors SSSI

2.7.1 Kenfig National Nature Reserve

The northern boundary of Kenfig National Nature Reserve (KNNR) follows the southern bank of Kenfig River which flows to within 40m of the southern edge of MCL, as shown on Figure 4.

KNNR is a Special Area of Conservation (SAC), designated because of the following features:

Habitats of community interest whose conservation requires the designation of Special Areas of Conservation; these are included on Annex I of the European Communities Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora:

1. Fixed dunes with herbaceous vegetation (grey dunes).
2. Dunes with *Salix repens* subsp. *argentea* (*Salicion arenariae*).
3. Humid dune slacks.
4. Atlantic salt meadows (*Glauco-puccinellietalia maritimae*).
5. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation; these are included on Annex II of the European Communities Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora:

1. Fen orchid *Liparis loeselii*
2. Petalwort *Petalophyllum ralfsii*

KNNR is also included under the following United Kingdom designations:

- Sites of Special Scientific Interest (United Kingdom)
- National Nature Reserves (United Kingdom).

It supports populations of Nationally Rare and Nationally Scarce non-vascular plants including Petalwort, *Amblystegium serpens* var. *satium*, *Campylium polygamum*, *Drepanocladus lycopodioides*, *D. sendtneri*, *Moerckia hibernica* and *Chara aspera*. Populations of Nationally Rare vascular plants include Fen Orchid, Sea Stock *Matthiola sinuata*, Long-stalked Orache *Atriplex longipes*, Maiden Pink *Dianthus deltoides*, Green-flowered Helleborine *Epipactis phyllanthes*, Variegated Horsetail, Portland Spurge *Euphorbia portlandica*, Sea Spurge *E. paralias*, *Euphrasia rostkoviana* and *Hutchinsia Hornungia petraea*. Several Nationally Scarce species of vascular plant have also been recorded. In addition, the site also supports a rich assemblage of Nationally Rare and Nationally Scarce invertebrate species. The exceptional wetness of the Kenfig dune system is of national significance and the hydrological regime appears perfectly natural. Although the KNNR groundwater system is thought to be mainly rain-fed, there is the possibility that groundwater inflow from underlying/neighbouring carbonate aquifers also plays a role.

Relevant factors which are known to influence the features at Kenfig and which are likely to influence dunes elsewhere locally include over-stabilisation, with the extent of bare sand having declined from c. 40% in 1946 to c. 2% at Kenfig at present; the virtual cessation of grazing by rabbits (through myxomatosis) and a decline in livestock grazing. Shoreline retreat, preventing the formation of strandline and fore dune communities, has long been a problem at Kenfig with only a small section of the shoreline up to 300m south of the mouth of the River Kenfig showing localised signs of accretion.

2.7.2 Margam Moors SSSI Description

The western part of Margam Moors lies within 40m of the active MNHL and is shown on Figure 4. Margam Moors is a Site of Special Scientific Interest (SSSI) designated because of the following features:

The mosaic of drainage ditches provides the main interest of the moors and it is principally for this feature that the site was designated as a Site of Special Scientific Interest (SSSI). In a Welsh context only the extensive Wentlooge Levels support a similar assemblage of habitats and species.

Important bird species that have been lost through habitat loss and possibly changes in management include White-fronted Goose *Anser albifrons* (a winter visitor) and Yellow Wagtail *Motacilla flava* (a summer visitor).

The site does still support numerous species of high conservation value including aquatic plants such as Frogbit *Hydrocharis morsus-ranae*, Flowering Rush *Butomus umbellatus*, Cyperus Sedge *Carex pseudocyperus*, Brown Sedge *C. disticha*, Unbranched Bur-reed *Sparganium emersum* and Arrowhead *Sagittaria sagittifolia*. In addition to the plants a rich assemblage of scarce aquatic invertebrates is also known to be present in the moors. Continuous management is required to prevent Common Reed *Phragmites australis* from shading out some of the more sensitive species.

Marginal habitats of significance include areas of species-rich mesotrophic marsh. These result from seepage of water from the base of the dunes and support a characteristic suite of species, often with substantial quantities of Yellow Flag *Iris pseudotata* Steel, Meadowsweet *Filipendula ulmaria*, Water Mint *Mentha aquatica*, Ragged Robin *Lychnis flos-cuculi* and Lesser Spearwort *Ranunculus flammula*.

Areas of semi-improved grassland can be found to be in a less favourable condition and uncommon species are known to have been recorded in the past, e.g. Green-winged Orchid *Orchis morio*, Common Twayblade *Listera ovata* and Cowslip *Primula veris*, were either not recorded at all or were very scarce. An area of dense birch/sallow scrub occurs in the very south of the site. Biodiversity Action Plan species associated with the pastures and ditches include Shrill Carder Bee *Bombus sylvarum*, Brown-banded Carder Bee *B. humilis*, Brown Hare *Lepus europaeus*, Skylark *Alauda arvensis* and Reed Bunting *Emberiza schoeniclus*. The Kingfisher, a schedule 1 species protected under the Wildlife and Countryside Act has also been recorded in the past (Gillham, 1976).

2.8 Conceptual Hydrogeological Models

As the intrusive investigation programme has evolved and further monitoring data gathered, Geotechnology has developed and refined a conceptual hydrogeological model of the site that summarises the current level of understanding of the geology beneath the site and groundwater flow. The flow of water through the ground is a direct result of the geometry of the strata beneath and around the site and the physical properties of each stratum.

Due to the shallow trough in the clay aquitard between MCL and MHL, two conceptual models have been developed. One describes the shallow aquifer on the southern side of the trough around MCL and MNHL and one for the northern side of the trough around MHL. In both models the deep groundwater generally moves to the north and west, being recharged off-site in the surrounding industrial and agricultural areas.

In both conceptual models there is a degree of radial flow within the shallow aquifer. In the northern conceptual model, shallow groundwater moves towards Margam Moors and Margam beach. In the southern conceptual model, the radial component results in most of flow in the

shallow aquifer moving toward the Margam Moors with a small contribution flowing towards the Kenfig, although the hydraulic gradient in this area is shallow and subject to sporadic reversal.

Flow to both the Moors and Kenfig is contaminated due to the leaching of wastes from MCL. As the dominant flow path is towards the Margam Moors this results in a concentration of pollution along the springline where the shallow aquifer discharges. This area is typically characterised by alkaline groundwater and precipitates can be found in topographically low areas. Leaching and dispersion of precipitates from this area is also impacting on surface water in Margam Moors.

Along the fringe with the River Kenfig, groundwater is found to be mineralised near MCL. However, the River Kenfig shows no evidence of any impact related to MCL. This is primarily considered to be due to the flat gradients along this fringe limiting advective transport from MCL to the Kenfig and dilution within the Kenfig. Waterlevels in the River Kenfig are higher than those in Margam Moors.

The monitoring conducted to date shows that there is no impact related to either MHL or MNHL. Shallow groundwater is currently polluted due to leaching of wastes deposited at MCL, whilst deep groundwater is polluted due largely to off-site recharge with a small contribution from MCL.

3 REGULATORY FRAMEWORK

3.1 Background

The Permit defines the regulatory emission limits that must be met at MNHL. These have included leachate limit levels, emission limits to air for particulates and landfill gas, emission limits for surface water and Compliance Limits for emissions into groundwater. Since the issue of the Permit these have changed on several occasions. To ensure these changes can be traced they are documented in Appendix 1.

New criteria were proposed in the 2017 annual review but NRW did not formally comment upon these until 2020, as summarised in Appendix 1 and 2. In the meantime, Tata continued to implement the criteria developed in 2013. Despite these latter criteria being implemented for many years, NRW queried their use during 2020 following the most recent Permit Variation (Variation EPR/BV7311IE/V006). During these discussions it became apparent that there was some confusion but Geotechnology understands that this situation is now being clarified and a new Permit Variation application has recently been submitted (January 2021) to consolidate the currently accepted assessment criteria and monitoring regime. This is set out in a letter from Tata to NRW dated 20 January 2021. A copy of this letter is included in Appendix 2.

In this report, the criteria set out in the Permit Variation application have been used to assess the monitoring results alongside the internal control levels.

3.2 Applicable Assessment Criteria

3.2.1 Emissions to Air

Tata has requested NRW to remove these criteria from the Permit in the latest Variation application.

3.2.2 Surface Water Control Levels

The surface water control levels are set out in Table 3-1. These are not included in the Permit but are for internal use and assessment of surface water quality along the Margam Moors springline.

Table 3-1 Assessment Levels for Surface Water

		Control Level 1	Control Level 2
SW2, SW4	Chloride (mg/l)	100	150
	Arsenic (microg/l)	35	40

3.2.3 Groundwater Compliance Limits

The groundwater Trigger Limits are summarised in Table 3-2.

Table 3-2 Groundwater Trigger Levels

		Arsenic	Chloride
		microg/l	mg/l
BH3S, BH4S, BH6S, BH30	Trigger Level	50	200

3.2.4 Leachate Control Levels

The leachate assessment levels are summarised in Table 3-3. The above criteria are not included in the recent Permit Variation as they relate to assessment levels.

Table 3-3 Leachate Control Levels

Leachate Point	Ammoniacal nitrogen	Cl	As
Unit	mg/l	mg/l	mg/l
Control levels	70	70000	3

3.2.5 Leachate Level Limits

The head of leachate shall not be permitted to exceed 1 metre above the base of any leachate monitoring point at any time throughout the operational or aftercare phases.

3.2.6 External Gas Monitoring Compliance Limits

The Compliance Limits are summarised in Table 3-4.

Table 3-4 Perimeter Compliance Limits and Assessment Levels

Perimeter gas position	Methane Limit	Carbon Dioxide Limit
GA7 – GA15	1	1.5
GA16	6	2

3.2.7 Internal Landfill Gas Compliance Limits

Compliance Limits are not established for the internal landfill gas monitoring wells during operation. Once a cell is capped, NRW require the average methane flux and total methane emission to be measured and compared to permissible emission rates stipulated in the Permit. As part of the recent Permit Variation application, Tata has requested that this requirement is reviewed, as set out in the letter included in Appendix 2.

3.3 Assessment against Permit Criteria

The focus of this annual summary report is to evaluate the data collected against the applicable Assessment Criteria. To enable rapid and efficient data evaluation, time series graphs have been generated where applicable. These are presented in Appendices 3 to 9. Spatial summaries of key parameters are provided in Appendix 10.

Time series graphs have been plotted for most parameters where Compliance Limit and Control levels apply and where sufficient data is available for graphical plotting. Any agreed changes to the relevant Assessment Criteria are included where applicable. Time series plots of other key parameters are also presented in the relevant appendices. Where possible, the scale of the y-

axis has been standardised on each graph for the same parameter from different monitoring locations to facilitate rapid comparison of the data.

3.4 Hydrogeological Risk Assessment Criteria

One of the objectives of the HRA review undertaken every 6 years is to ensure that the computer simulations used as part of the design of the landfill do not become detached from the reality of landfill construction and operation. Therefore, in addition to evaluating the data against the assessment criteria set out in the Permit, Geotechnology also uses the preparation of the annual report as an opportunity to compare the actual leachate chemistry with that modelled as part of the most recent HRA. The model input parameters against which the leachate chemistry is compared are summarised in Table 3-5. These were not modified as part of the recent HRA review as the assessment concluded that they are still protective of the controlled water environment.

Table 3-5 Modelled leachate inventory

LandSim Parameter	Ammonia	Arsenic	Chloride
	mg/l	mg/l	mg/l
Minimum Value	0.05	0.005	1000
Most Likely Value	10	0.3	10000
Maximum Value	50	3	61000
PDF Used	Triangular	Triangular	Log Triangular

3.5 Recharge Chambers

The Permit requires Tata to monitor waterlevels in Recharge Chambers C, D E and F. The chambers are not yet constructed but recharge chamber C should be constructed during 2021. Chemical parameters will also require monitoring.

4 MONITORING NETWORK

The full monitoring network available to Tata for all the landfills is shown in Figure 4.

4.1 Integrity of Monitoring Infrastructure

Each time samples are collected by Geotechnology, the monitoring infrastructure is inspected. The landfill operator also inspects parts of the monitoring infrastructure during more routine site checks.

4.1.1 Landfill Leachate Monitoring Infrastructure

The landfill leachate infrastructure is performing well. Dedicated pumps were provided for the purging and sampling of each sump to prevent cross contamination but samples are now retrieved using a sampling container connected to a length of rope.

4.1.2 Groundwater Monitoring Infrastructure

The integrity of the groundwater monitoring network is inspected monthly. The monitoring infrastructure continues to perform well although vandalism is sometimes a problem. Routine maintenance and repairs are rapidly undertaken by the contractor commissioned by Tata to manage the landfill. Routine clearance of vegetation is required to ensure safe and full access to the whole monitoring network.

4.1.3 Shallow Piezometer Monitoring Network

A series of shallow piezometers have been manually installed into the shallow aquifer along the boundary with Margam Moors, as shown on Figure 2.

4.1.4 Surface Water Monitoring Network

The integrity, access and safety of each of the surface monitoring locations are inspected monthly. Installation of hand/rope rails would aid in the safe recovery of surface water samples as would routine vegetation clearance. Dense vegetation sometimes prevents routine safe access.

4.1.5 External Gas Monitoring Infrastructure

The integrity of the external gas monitoring wells is inspected monthly.

4.1.6 Internal Gas Monitoring Infrastructure

The integrity of the internal gas monitoring wells in bio-cells A and B is inspected monthly. There are no problems with this aspect of the monitoring network although the vents, which are open to the atmosphere, are not designed for monitoring. Consequently, the data gathered to date has been influenced by atmospheric processes and dilution. Some monitoring points in the bio-cell are also difficult / impossible to safely access due to dense growth of buddleia and because the bales are sometimes separated by large gaps. Consequently, not all wells can be routinely safely accessed.



Plate 4-1 Gaps between bales in bio cell

4.1.7 Dust Monitoring Infrastructure

Dust monitoring is undertaken by Tata Environment Department. Up until 2011, dust monitoring comprised two types of monitoring:

- Deposition gauges which collect dust (and rainfall) via a bowl which drains into a bottle at four locations. These instruments record the total amount of dust fallen.
- Flexible poles fitted with 'sticky pads' at 5 sites. As the pads collect airborne dust from 360 degrees, the direction from which dust has deposited can be determined. These were installed November 2005.

Since 2011, only the deposition gauges D15-D19 have been used. The 'sticky pad' poles were not used in 2011 as this aspect of the monitoring is not a Permit requirement and is now only considered by Tata during the implementation of contingency actions, documented in the Dust Management Plan for the site.

4.2 Actions required

Based on recent observations of the available monitoring network, the following items require address to ensure that the series of high quality data continues to be collected:

- Vegetation near several sampling points requires routine clearance to enable continual safe access throughout the year
- Site weather stations should be routinely maintained to ensure they continue to operate satisfactorily

5 ANALYTICAL TESTWORK

5.1 Laboratory Selection

All aspects of the analytical and monitoring programme are directly managed by Tata Environment Department. Under the direction of the Environment Department, Geotechnology and the analytical laboratory undertake several aspects of the sampling and analysis. These include surface water, groundwater and leachate samples for laboratory analysis, measurement of groundwater and surface water levels and the on-site monitoring of landfill and ground gas. The landfill operator (Darlow Lloyd and Sons Ltd) undertakes the routine leachate level monitoring required by the Permit. Tata Environmental Department undertakes all other monitoring aspects. All analysis is undertaken by TDC at the Harbourside laboratory, Port Talbot.

5.2 QA/QC

Analytical data is reported directly to Tata. Several weeks sometimes passes between the time of sampling and data reporting. This data is subsequently reported each quarter to NRW and then compiled at the end of each year as part of this annual review. During the compilation of the annual report several errors have been noted with the data reported by the laboratory. This has resulted in the lab reports being re-issued. This has not affected the parameters that have either control or trigger levels.

During 2020 duplicate samples were collected at two positions. The data is summarised in Table 5-1. To enable the results of the two samples to be compared the relative percentage difference (RPD) has been calculated. The comparison reveals several significant differences in the concentrations reported for several parameters that should be discussed with the laboratory. Geotechnology will also review sampling procedures but this is not considered to be a significant contributor to the differences noted as the duplicate samples were collected at the same time from the same sample container i.e. a large container containing the sample was mixed and then the sample poured into the duplicate sample containers.

Table 5-1 Comparison of Duplicate Samples

		pH field	Conductivity field	As	Ca	Alkalinity	Ammoniacal N	Cl	COD	NO3	No2	PO4
		su	microS/cm	µg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
L8	20/07/2020	10.5	3400	2.5	15260	84	6.08	14690	6045	4.54	<0.03	6.14
L80	20/07/2020	10.5	3400	2.8	9230	146	6.12	43.4	7065	4.86	<0.03	4.86
		0.0%	0.0%	11.3%	-49.2%	53.9%	0.7%	-198.8%	15.6%	6.8%	0.0%	-23.3%
BH200S	20/07/2020	11	631.8	2.8	51.2	92	2.63	197	118	4.37	<0.03	4.37
BH20S	20/07/2020	11.5	625	25.6	34.7	87	12.65	197	107	39.24	1.38	<0.03
		4.4%	-1.1%	160.6%	-38.4%	-5.6%	131.2%	0.0%	-9.8%	159.9%	191.0%	-198.0%

6 SITE ACTIVITY

6.1 Waste Treatment Centre

Since 2007, Tata has operated a waste treatment centre that comprises recycling, screening, sorting and bailing facilities, together with areas for the storage of processed and unprocessed materials prior to recovery. The facility mostly treats general wastes comprising plastics, paper, timber, glass, brick and concrete. Consequently, these wastes are largely diverted from landfill. This facility is located to the northwest of the active landfill cells of MNHL, as shown on Figure 4.

6.2 Construction of MNHL

Since issue of the Permit, four cells have been constructed; two biodegradable cells used for the deposition of wastes with a gassing potential and two cells for the deposition of non-hazardous waste without a significant gassing potential. A current topographic plan of the cells, as required by Permit condition 3.6.3 is provided in Figure 8. This is based on a topographic survey completed on 8 January 2021. Table 6-1 provides a summary of the cells constructed to date.

Table 6-1 Landfill Cell Details

Cell Name	Leachate Sump	Waste Types	Operational Status
Cell 1	L7	Non-hazardous non-biodegradable	Full, non-active & awaiting capping
Cell 2	L8		Active but approaching capacity
Bio Cell A	L1	Non-hazardous biodegradable	Full, non-active & awaiting capping
Bio Cell B	L6		Active (close to capacity)

Each cell of MNHL is designed upon the containment principle. Pollutants are kept within the wastes by surrounding the wastes with barriers that are virtually impermeable to water, liquids and gases. The landfill is currently being constructed as a series of cells, each measuring some 200m x 115m. The Engineered Barrier System (EBS) of each cell comprises Bentonite Enhanced Sand (BES) overlain by a High-Density Polyethylene (HDPE) liner. Above the EBS is a leachate collection system. A cross section of the key landfill engineering systems is provided in Figure 9.

Despite diminishing waste inputs (as shown in Chart 6-1), the existing biodegradable waste cells are now very close to capacity, though there is large remaining industrial waste capacity in non-hazardous Cell 2. To address the shortage of biodegradable waste capacity, NRW approved extending the Biocell capacity by recovering waste from Cell 1.

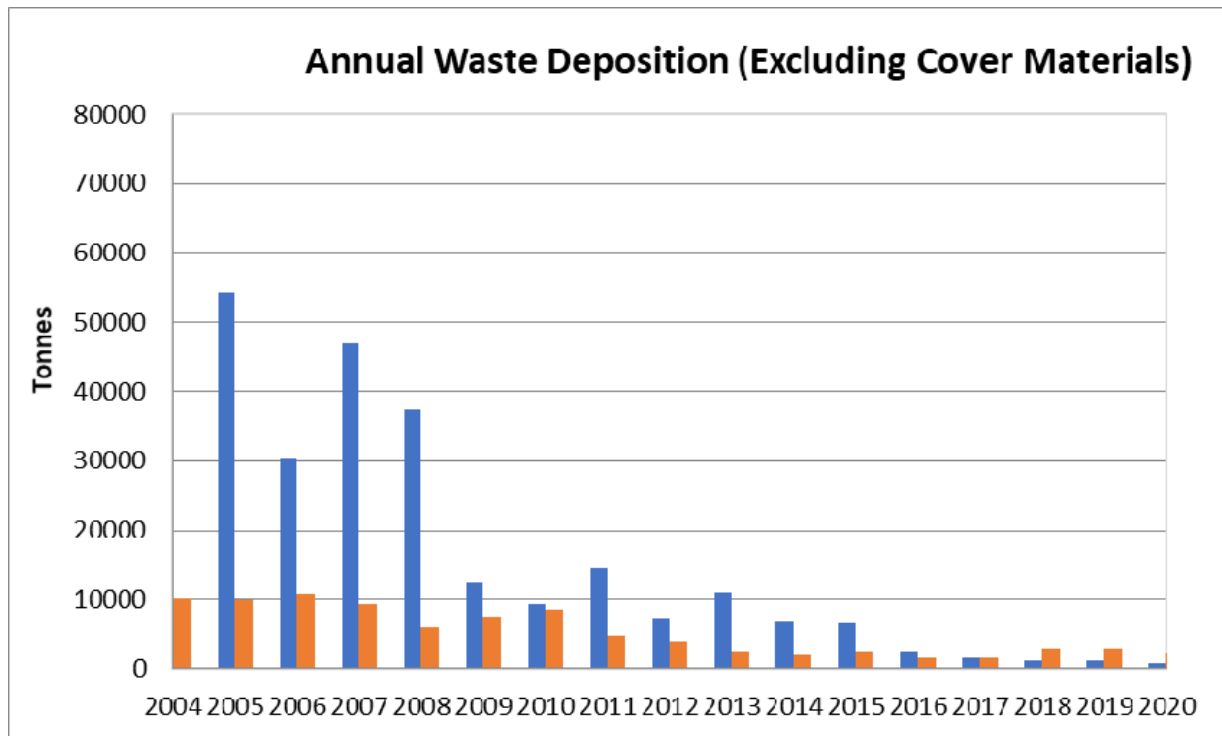


Chart 6-1 Tonnes of waste deposited each month

The existing Biocell is separated from non-hazardous Cell 1 by a deep narrow valley where the opposing south flank of Cell 1 meets the north flank of the Biocell, as shown in Plate 6-1. The approved restoration contours for the landfill require that this valley is infilled to produce a single elevated landform. To secure additional biodegradable void space, NRW has approved a cut into the upper part of the southern flank of Cell 1 and extension of the biodegradable waste cell lining system into the void to provide sufficient biodegradable waste capacity to 2028. Once the new cell area is available for waste disposal, the completed areas of the Biocell must then be restored by December 2021. At the time of writing, approximately 50% of the biocell extension has been completed. This is referred to as cell Ci.



Plate 6-1 View north towards Non-hazardous Cell 1, valley feature and Biocell

6.3 Sand Extraction

Restoration of MCL was completed in 2013. Following completion, there was no immediate demand for sand. However, since this time parts of the restored cap of MCL have been subject to wind erosion as the self-seeding vegetation is yet to take hold. Therefore, approximately 5000 tonnes has been excavated from Borrow Pit 1, as part of aftercare maintenance. Further extraction is envisaged as set out in the ROMP phasing plans (see Geotechnology report 1914r1v1d0819).

6.4 Landfilling at MNHL

6.4.1 Waste from Steelworks

A summary of the waste types and tonnages deposited at the landfill as recorded by the landfill operator is regularly submitted to NRW in accordance with the Permit requirements. A full graphical record of waste deposition is presented in Appendix 11 and a summary in Chart 6-1. The mass of waste being landfilled is declining, as shown in the chart below.

During 2006, part of the filter cake from the unlined Storage Bays located on MCL started to be deposited within Cell 1 of MNHL. Any leachate contained within or produced by this material would report to landfill sump L7. Leachate from similar material that has been historically landfilled in the upgradient unlined MCL is already impacting groundwater upgradient and down gradient of MNHL.

Since October 2008, hot mill sludge (HMS) filter cake generated by the steelworks has been landfilled in Bio Cell B. This process has subsequently continued at a rate of approximately 500-700 tonnes/month. In accordance with Improvement Condition 1 of the Variation Notice this prompted the monthly monitoring of Benzo(a)pyrene (BaP) on samples collected from sump L6. In September 2010, this data was reviewed by Geotechnology to establish whether BaP control levels were required (see report 993r1v1d0910). As the data showed that BaP was not detected in the leachate, control levels were not considered to provide additional environmental protection. Benzo(a)pyrene has continued to be present in leachate below the analytical detection limit.



Plate 6-2 View North over MNHL Cell 2. Note dominance of iron rich filter cake

6.4.2 Third Party Waste Storage

The Tata landfills are only permitted to accept wastes generated by the company. However, in 2011, during an exceptional fire at an industrial unit in Fforestfach, Swansea Tata was approached to assist. The unit contained an estimated 5000t of tyre fluff from the treatment of shredded tyres. During the days immediately following the fire, the Fire Rescue Service (FRS) discovered that the fire could not be readily extinguished using conventional firefighting techniques. A crust was forming on the surface of the material, limiting the effectiveness of the cooling water so the mass kept burning. Using expertise from elsewhere in the country a means of extinguishing the burning waste was developed: a quenching technique that involved mechanically placing excavated masses of the burning material into large water filled skips. This proved to be the only means of extinguishing the fire.

After quenching large volumes, the extinguished material required immediate removal as there was no space at the fire site. Following a request by the multi-agency task force coordinating the response to the incident, Tata agreed to the use of Cell 2 of MNHL for the temporary storage of the waste. On 25 June Tata started to accept waste into Cell 2 of MNHL. This process continued until 20 July 2011. This waste was moved from Cell 2 of MNHL into Cell 2 MHL in March 2014. This work was inspected by NRW at the time and a Construction Quality Assurance (CQA) report produced by Geotechnology following the works (see Geotechnology report 1327r1v1d0314).

6.5 Construction of Morfa Hazardous Landfill

Two cells have been constructed at MHL. Cell 2 was completed in August 2012. This new cell received the fire waste from Cell 2 of MNHL in March 2014. The rate of landfilling at the hazardous landfill has also reduced in recent years, as shown in Chart 6-2.

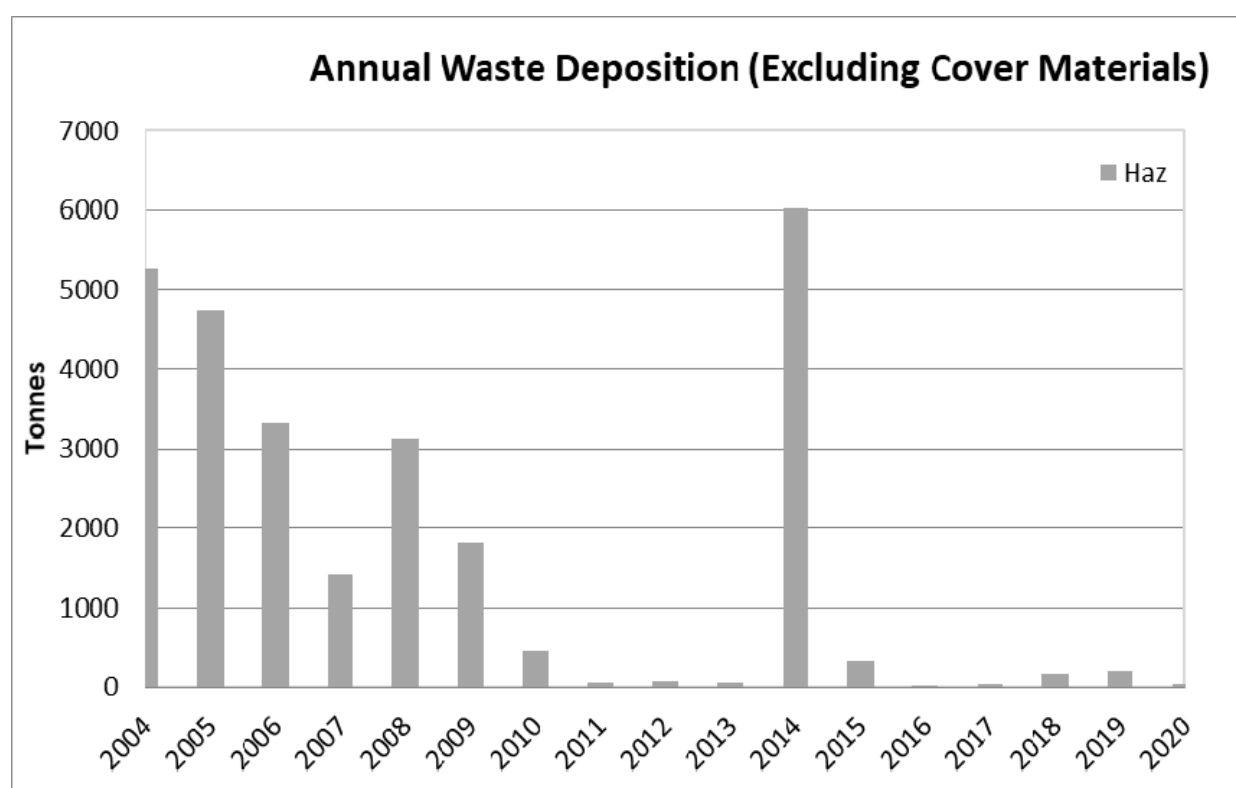


Chart 6-2 Landfilling at Hazardous Landfill

6.6 Progressive Restoration

Progressive restoration of each cell should occur once it has been filled. This will limit leachate generation and enable better environmental control. At this stage, none of the cells at either MNHL or MHL have been restored although NRW requires part of the biodegradable waste cell of MNHL to be restored by December 2021.

Once restoration does take place the final landform will ultimately be similar to that described in Section 6.8 for the restored adjacent closed landfill.

6.7 Leachate Management

Leachate levels are regularly monitored in the sumps with the data summarised as a series of time series graphs in Appendix 3.

Until 2019, leachate was collected from the sump by vacuum pumps and tankered away from the landfill using 10m³ or 15m³ road-going tankers. These tankers took the leachate to the Tata wastewater treatment facility at the steel works. This system has now been replaced by a fixed pumped system, discharging directly into the works via a holding / balancing tank facility. A plan of the as-built system is reproduced in Figure 10.

The new system involves pumping leachate from all cells at MNHL and MHL (currently five cells). There are currently three individual leachate pipe runs, one for the two MNHL bio-cell sumps, one for the two non-hazardous cell sumps and one for the MHL cell sump. Pumping at each cell is float controlled to ensure that leachate heads are within permitted trigger and maximum limits.

The three individual pipe runs discharge initially into a holding/balancing tank located on the permitted Waste Transfer Station hardstanding (concreted) area near to the DLS offices. The balance tank is also float controlled and combines all leachates for further pumping into the end discharge sump within the main works, located at Morfa Coke Ovens, Gas Holder Deep Sump. Flowmeters are located at each sump location, and at the balance tank, to record individual and cumulative leachate outflows. The use of flowmeters will provide a check on the potential for leakage from any of the three pipes entering the balance tank.

Since the new system has become fully operational in early 2020, leachate levels have been reduced as the quantity of leachate removed from each cell has increased. This data is summarised in Appendix 3 and shows that leachate levels have been compliant with the Permit requirement of <1m depth at the leachate sump in recent months, since the system became fully functional and controlled. Controlling leachate levels in this way reduces the risk to the environment as it reduces the hydraulic pressure gradients within each cell.

6.8 Restoration of Morfa Closed Landfill (MCL)

Phased restoration of unlined MCL was undertaken between 2004 and 2013. The restoration involved the placement of site won dune sand over the plateau and parts of the re-profiled slopes. Below the sand, the restoration scheme involved placement of geomembranes which, in combination, provide gas and surface water management as well as providing barriers to precipitation ingress and gas egress. The sympathetic restoration also involves the placement of sand on top of the geomembranes, creating dune morphology like the surrounding land.



Plate 6-3 Typical restoration profile on surface of MCL

During 2012 and 2013, restoration included the short-term recovery of materials to be used in the steel making process as the topography was re-profiled. During this phase, waste which had remained undisturbed for several decades was exposed. Such wastes will therefore have been temporarily susceptible to weathering and leaching prior to them being capped. Seepage infiltrating to groundwater in these areas would be expected to pass beneath and around MNHL as MCL is hydraulically upgradient of MNHL.

6.8.1 Recharge Trench

The sand restoration layer that has been placed on MCL will permit infiltration to the underlying drainage composite, where it will be directed to percolate toward collector ponds. Overflow pipes from the ponds then transport the water into stilling chambers before flowing out into a series of ditches excavated into the natural sand along the boundary with Margam moors. Currently, part of the recharge trench system adjacent to MCL is complete with most of captured rainfall now being directed under gravity towards the boundary with Margam Moors near BH17, towards the River Kenfig near to BH15 and to the south near BH10. Cells of MNHL which are no longer active will be being progressively capped to enable similar restoration.

The accumulation of secondary precipitation in localised areas along the boundary of the site with Margam Moors is well documented. These have formed due to near surface interactions between shallow groundwater that is impacted by leachate from the unlined MCL and the atmosphere. Precipitates and poor-quality groundwater are present throughout this area but become visible in topographically low areas, where groundwater may be sometimes exposed. Wider dispersion and leaching of these previously accumulated precipitates and groundwater

has been previously observed in response to changes in shallow groundwater levels. NRW has approved the covering of these areas with site won sand to limit direct access.



**Plate 6-4 Accumulation of secondary precipitates adjacent to MCL
(between BH17 and P12)**

NRW has also provided support in principle for a new way of operating the recharge trench system. This new approach, involving a more passive system, is currently being designed.

6.9 Summary of Landfilling and Restoration Activity

The timeline of landfill construction and operation is summarised in Table 6-2.

Table 6-2 Summary of site activity to date

Activity	Start	Finish
Construction of MNHL Cell 1	1 June 2004	19 October 2004
Construction of MHL Cell 1	1 June 2004	19 October 2004
Restoration of MCL	September 2004	8 June 2013
Construction of MNHL Bio Cell A	14 June 2004	8 September 2004
Construction and operation of waste treatment centre	5 December 2006	Ongoing
Construction of MNHL Bio Cell B	August 2007	13 October 2007
Construction of MNHL Cell 2	6 May 2008	31 July 2009
Landfilling of HMS filter cake in MNHL Bio Cell 2	28 October 2008	Ongoing
Construction of MHL Cell 2	October 2011	Ongoing
Temporary storage of fire waste	25 June 2011	14 March 2014
Construction of recharge trench sections A & B	30 Aug 2012	12 Oct 2012
Connection of recharge trenches to ponds and commissioning of system	Ongoing	(partly completed during 2016 but damaged due to vandalism)
Installation and operation of new leachate pumping system	2018	October 2019
Construction of Bio Cell Extension Ci	April 2020	January 2021

7 TOPOGRAPHIC SURVEY AND LANDFILL VOID SPACE

The Permit requires an annual topographic survey to be completed.

7.1 Topographic Survey

A topographic survey of the operational landfill cells was carried out on 10 January 2020 and a repeat survey on 8 January 2021. Following data acquisition, the digital data was imported into a digital terrain model for each of the cells to calculate the available void space.

Since 2013 the surveys have been completed using an unmanned aerial vehicle (UAV) with survey control established using a GPS land-based GR-3 system. The UAV data is then used together with ground control points to create a digital terrain model. This method of surveying collects data points at significantly closer intervals than methods previously used and is therefore able to create a more detailed topographic model, as shown in Figure 8.

7.2 Remaining Void Space

Based on a comparison of the topographic levels observed at the start of 2020 and 2021, an assessment of void space available in each active cell has been made. This is summarized in Table 7-1.

At the time of this survey, a sub section (approximately 4200m²) of the full extension of sub-cell C has been completed, including the placement of a basal liner and drainage blanket. As the new sub-cell is yet to be brought into use, biodegradable wastes are being temporarily stored on the surface of Biodegradable Cells A & B. This additional waste accounts for the negative capacity values reported in Table 7-1. This waste is to be moved to the new sub-cell once it's construction has been approved.

The void space available in each cell is reported in Table 7-1. Table 7-2 summarizes the volume changes associated with the Biodegradable Cell C Extension. These volumes will be incorporated into the individual cell totals when sub-cell C comes into use.

Table 7-1 Individual Cell Volume Totals

Volumes (m ³)	Biodegradable Cell A	Biodegradable Cell B	Biodegradable Sub-Cell Ci	Non-Hazardous Cell 1	Non-Hazardous Cell 2
Total	94858	93068	16024	179600	208340
Consumed Capacity	81607	94218	0	171666	73506
Available Capacity	13251	-1150	16024	7934	134835
% Available Capacity	13.97	-1.24	100.00	4.42	64.72

Table 7-2 Biodegradable Cell Extension Volumes

	Volumes (m ³)
Biodegradable Sub-Cell CiAs Built Capacity	16024
Non-Hazardous Cell 1Capacity Reduction	13817
Non-Hazardous Cell 1 Waste Removed	22856*

*This figure includes waste removed from the footprint of Sub-Cell Ci and Sub-Cell Cii

A contour plan of the topographic surface generated by the drone survey is included in Figure 8.

8 LEACHATE

8.1 Leachate Level and Volumes

Based on the monitoring results provided by the landfill operator, the variation of leachate levels above the base of the sump is fully illustrated in Appendix 3 and summarised in Chart 8-1. The monitoring reveals that leachate levels exceeded 0.75m above the concrete slab in the winter periods of 2013, 2014 and 2015. Between 2016 and winter 2019, the leachate levels regularly breached the compliance 1.0m level which means that this aspect was not in accordance with the Permit requirements.

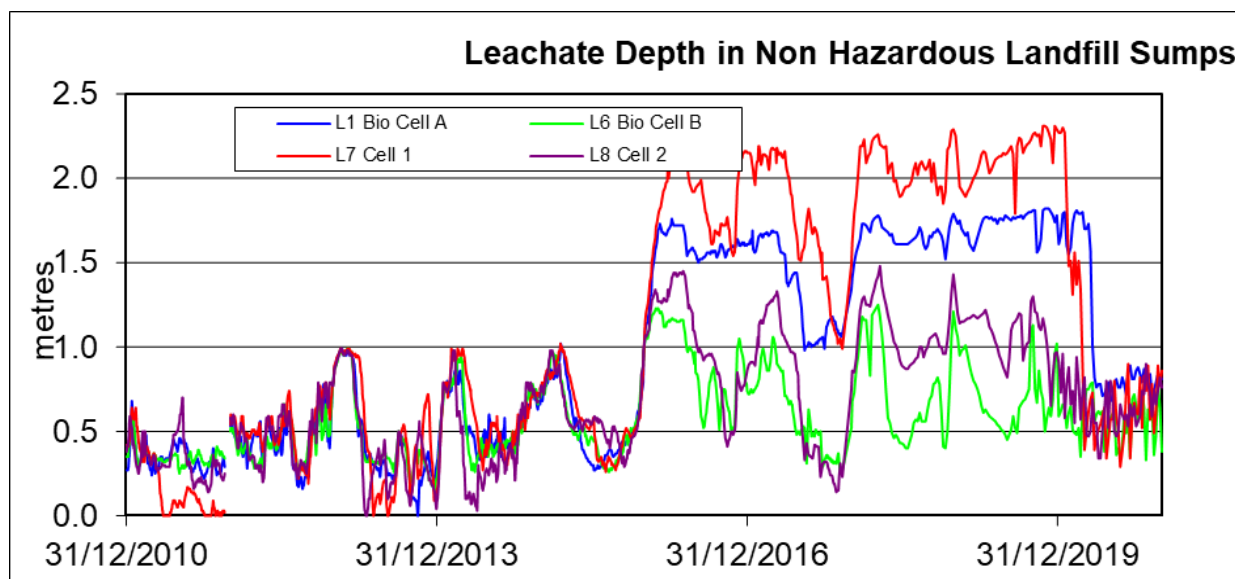


Chart 8-1 Leachate levels

Since early 2020, the new leachate management system has had a dramatic influence on leachate levels with significant leachate level reductions in all cells. This step change is a direct consequence of the new system enabling the volume of leachate extracted to be significantly increased. This has enabled the landfill to be compliant with the 1.0m leachate level compliance limit set in the Permit.

8.2 Leachate Chemistry

Each landfill cell is monitored at a separate landfill sump. Leachate samples L1 and L6 are in the sumps in Bio Cells A and B and L7 and L8 in Cell 1 and Cell 2 respectively. In each cell the daily cover used to encapsulate the wastes comprises slag.

8.2.1 Non-Volatile Species

Analysis of the leachate samples to date has revealed that it is typically dominated by a highly characteristic signature comprising elevated pH, calcium and alkalinity and low sulphate. This signature is strongest in the leachate in Cells 1 and 2 (sumps L7 and L8). The hydrochemistry of the leachate is illustrated in the graphs included in Appendix 3 and compared to other water chemistry in Chart 8-2.

As noted previously, the leachate has continued to become more dilute with the electrical conductivity declining, most likely because of dilution due to high rainfall and previously persistent high leachate levels. The lower mineralisation is characterised by lower levels of ammonia, calcium, alkalinity and most notably chloride (see charts below of selected chemistry).

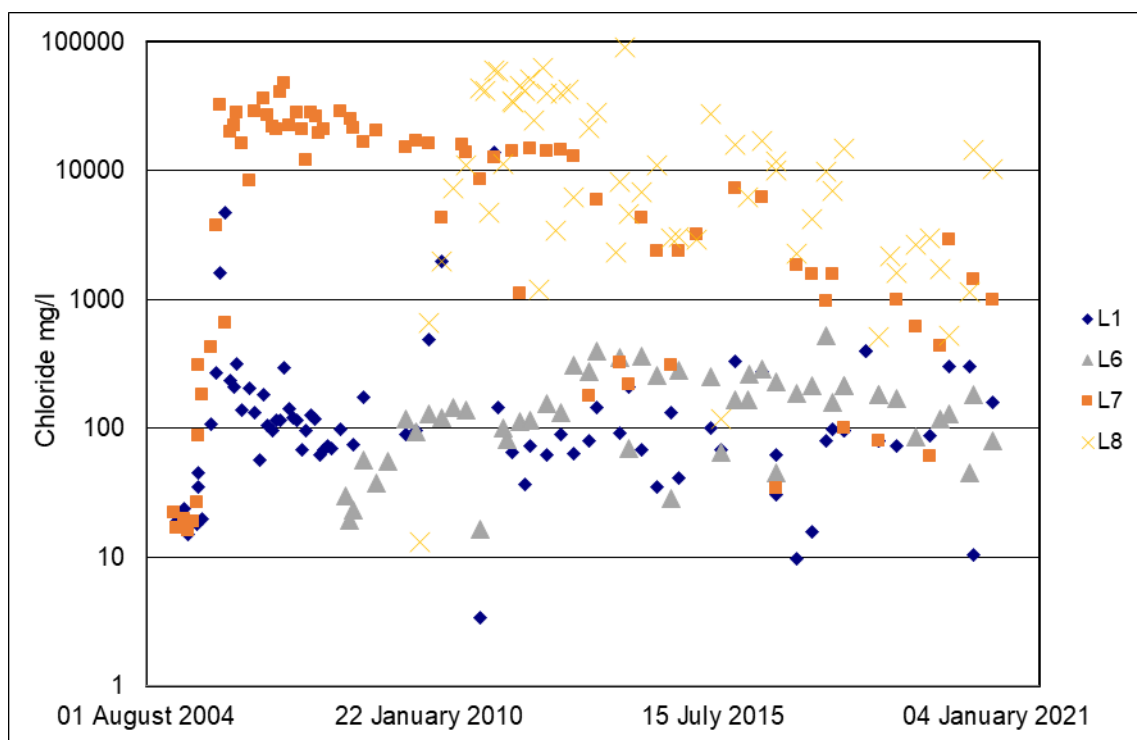
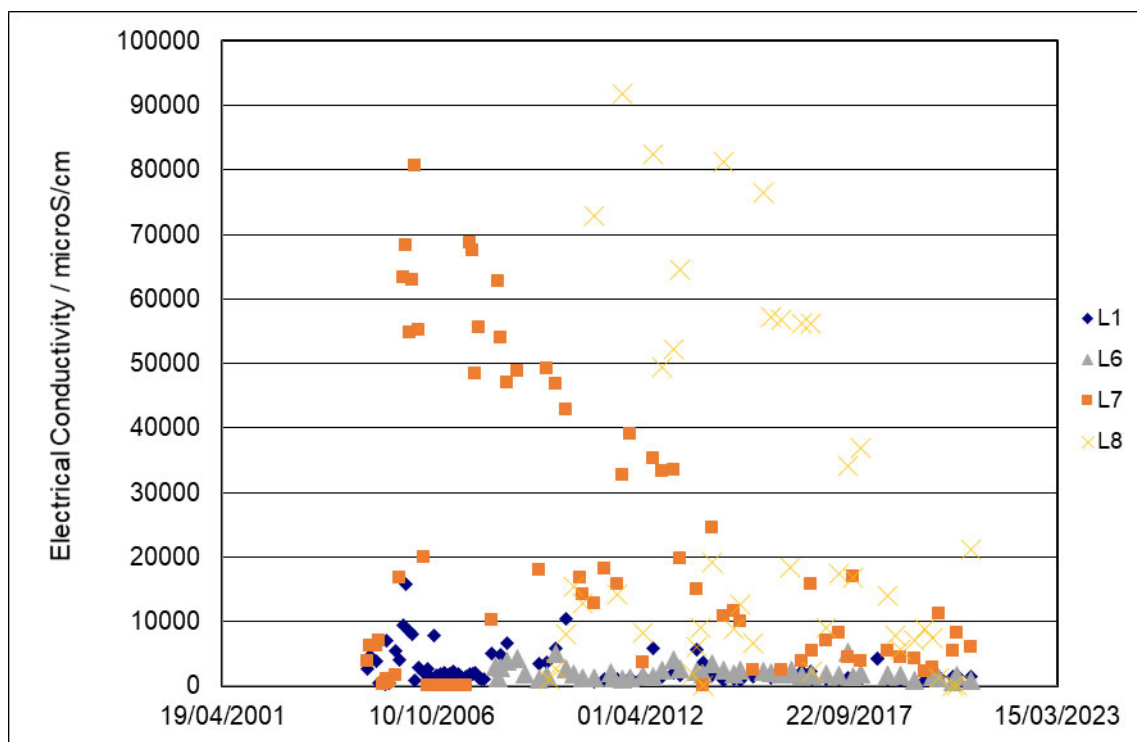


Chart 8-2 Comparison of leachate chemistry

Filter cake (EWC code 11 01 10) has been placed into Cells 1 and 2 (with leachate draining to sumps L7 and L8) at a rate of approximately 500 - 800t/month since the start of monitoring. Produced by the lime neutralisation of acidic ferrous chloride and pickling solutions at the cold mill effluent treatment plant, the waste principally comprises iron oxyhydroxide chloride phases, calcium chloride, iron chloride and mixed oxides. Within the landfill, the soluble components of the waste are leached by infiltration. This process is suspected to be the main source of the elevated levels of chloride and calcium. As the waste becomes buried and less oxygenated, the oxyhydroxide iron phases may also start to undergo changes. Some may start to age and crystallise, forming more stable iron oxide phases and some may undergo reductive dissolution in anaerobic conditions that may be present in parts of the landfill. This latter process could potentially release iron into the leachate along with other trace metals adsorbed to the iron precipitates.



Plate 8-1 Cell 2 leachate sump L8. Note staining due to iron.

This latter process was previously considered to be occurring within Cell 2 at L8, as iron significantly increased in concentration from <1mg/l to over 1000 mg/l during the latter part of 2012 and was elevated on several occasions during 2013. At the same time, the leachate sampled at sump L8 was found to be green in colour and the laboratory measured pH variable over a relatively brief time i.e. dropping from over pH 11 to pH 4 and then returning to pH 11 within 12 weeks (see chart below). Similar patterns were observed during 2014, 2015 and 2016. During 2019 and 2020, these variations were less pronounced.

Nitrogen and phosphorous species are not typically persistently detected within the leachate.

Hazardous substances such as mercury, lead and cadmium are rarely found and only at very low concentrations. Many non-hazardous pollutants are also either not detected above the analytical detection levels or present at very low levels, some of which are comparable to or below current Environmental Quality Standards (EQS). The mobility of most of these substances is being limited by the elevated pH although substances capable of forming oxyanions, such as vanadium, are more frequently detected.

A comparison of the 2020 leachate chemistry with selected EQS is presented in Table 8-1. This reveals chloride is significantly elevated but that the concentration of many other parameters, including several trace metals, are only moderately elevated when compared to the EQS. The tabulated summary, time series charts in Appendix 6 and the comparative charts reproduced below, indicate that the concentrations observed in leachate are often comparable to, or lower than, those seen in groundwater upgradient of the site and that elevated concentrations are not persistent.

Table 8-1 Comparison of selected data from 2020 with EQS

	EQS	6-9		50		250	400					
		pH field	Conductivity field	As	NH3	Cl	SO4	Nitrate	Nitrite	Phosphate		
			us/cm	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		
Max	Shallow Groundwater	12.0	2940.0	41.5	12.7	197.0	10.9	39.2	5.9	4.4		
Average		9.7	893.7	13.5	2.6	62.5	4.1	3.5	1.4	1.9		
Max	Deep groundwater	10.0	6100.0	93.0	47.8	2230.0	13.2	1.3	21.5	1.2		
Average		7.9	1717.0	24.5	22.4	777.7	2.6	1.0	21.5	0.8		
Max	Leachate	12.0	21100.0	5.1	6.1	14690.0	342.0	53.2	1.4	6.1		
Average		10.1	3759.3	1.8	3.1	2079.9	120.4	15.3	0.8	5.5		
Max	Surface water	9.1	2140.0	22.1	0.8	578.0	10.2	5.7	1.2	1.6		
Average		7.4	879.9	5.3	0.5	174.2	6.0	2.6	1.1	1.6		
	EQS	2000	4.7 / 32	1.0	1.0	0.123 (bio)	4 / 34 (bio)	1.2 / 14	20.0	10.9	0.15 / 0.25	0.1
		B	Cr (total)	Cu	Fe	Mn	Ni	Pb	V	Zn	Cd	Hg
		µg/l	µg/l	µg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	ug/l	ug/l
Max	Shallow	181.0	15.6	14.0	0.1	<0.10	<0.05	<0.03	29.0	7.1	<0.03	<0.03
Average		80.3	8.4	10.1	0.1	<0.10	<0.05	<0.03	8.5	5.3	<0.03	<0.03
Max	Deep	864.0	1.3	28.2	20.8	<0.10	<0.05	<0.03	8.7	2.0	2.7	<0.03
Average		430.5	0.9	15.0	16.0	<0.10	<0.05	<0.03	2.5	2.0	2.7	<0.03
Max	Leachate	2390.0	38.0	34.1	<0.15	<0.10	<0.05	40.5	48.1	42.3	0.3	<0.03
Average		1043.0	17.5	11.4	<0.15	<0.10	<0.05	13.9	23.3	20.7	0.3	<0.03
Max	Surface water	61.8	0.5	16.3	<0.15	<0.10	<0.05	1.0	1.6	33.3	0.0	<0.03
Average		37.9	0.5	6.9	<0.15	<0.10	<0.05	0.5	0.6	14.3	<0.03	<0.03

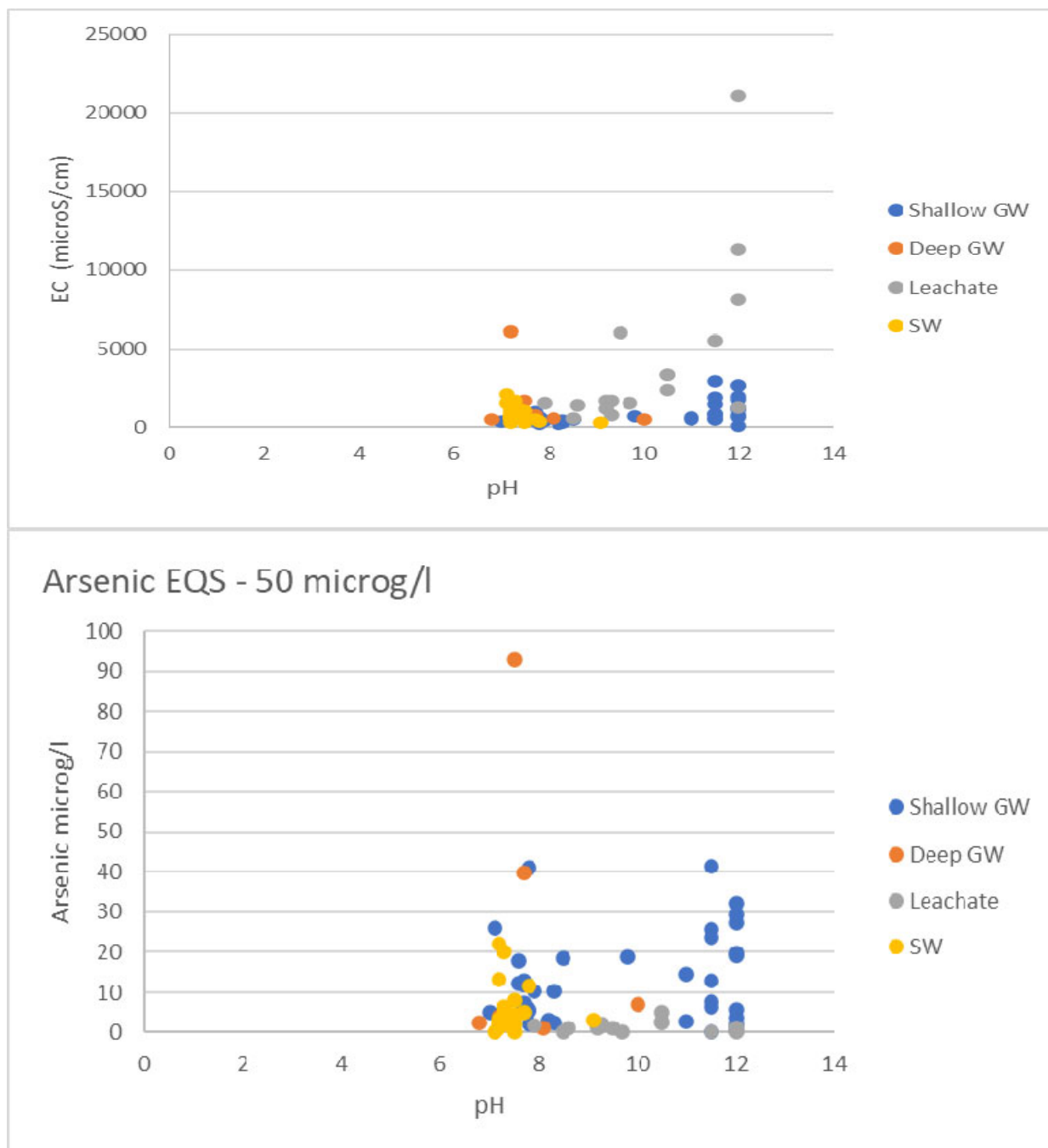


Chart 8-3 Comparison of selected chemistry from 2020

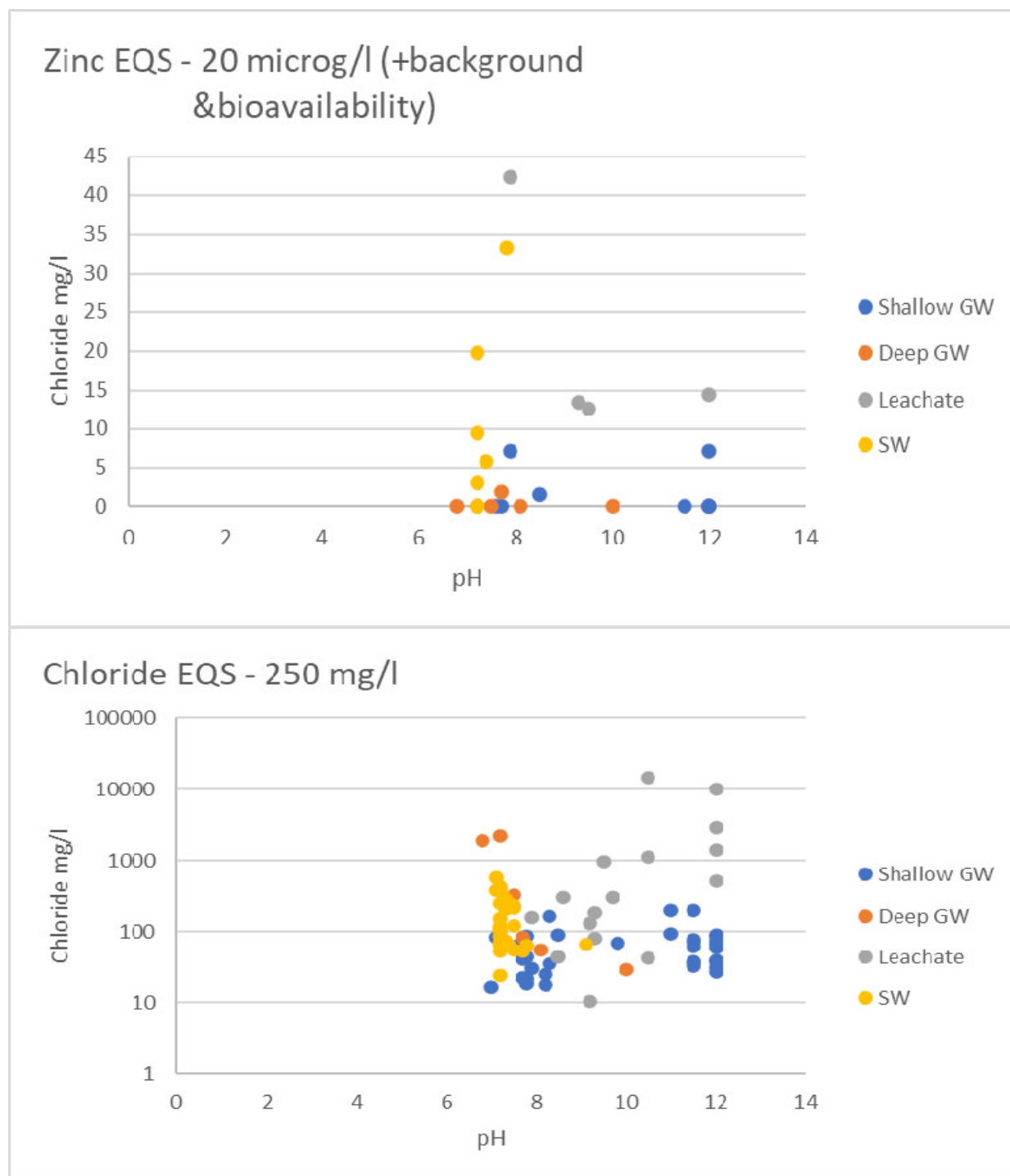


Chart 8-4 Comparison of Zinc and Chloride concentrations from 2020

8.2.2 Volatile Species

Due to the nature of the waste streams very low levels of hydrocarbons, volatile organic compounds (VOCs) and semi VOCs have been detected to date. No substances have been detected in the recent years.

8.3 Evaluation against Control Levels and LandSim Criteria

Table 8-2 provides a comparison of recent leachate chemistry with the leachate inventory used in the most recent HRA and the Permit Control Levels. This demonstrates that the most recent leachate chemistry is comparable to the lower end of the Probability Density Functions (PDFs) used to describe the leachate inventory in the most recent HRA and is below the Permit control levels.

Table 8-2 Evaluation of Leachate Chemistry

	Ammonia	Arsenic	Chloride
	mg/l	mg/l	mg/l
LandSim PDF*	Triangular (0.05, 10, 50)	Triangular (0.005, 0.3, 3)	Log Triangular (1000, 10000, 61000)
Control Levels	70	3	70000
Leachate chemistry 2018			
Maximum 2018 Leachate chemistry (L1, L6, L7, L8)	2.15	0.004	2160
Leachate chemistry 2019			
Maximum 2019 Leachate chemistry (L1, L6, L7, L8)	1.19	1.09	3010
Leachate chemistry 2020			
Maximum 2020 Leachate chemistry (L1, L6, L7, L8)	6.08	0.005	14690
*PDF – Probability Density Function used to describe statistical distribution of parameter. Triangular and Log Triangular are the PDFs used in most recent HRA. Values in parenthesis are minimum, most likely and maximum values used in LandSim model			

8.4 Contingency Actions Taken

Tata and the landfill operator have pro-actively engaged with NRW regarding the plans to reduce the elevated leachate levels. This included the implementation of increased pumping in the short-term and construction of a dedicated leachate pumping system that became operational October 2019. This has had a step-change positive impact on leachate levels and directly reduced risk to the controlled water environment. Progressive restoration is also soon to commence.

9 GROUNDWATER

9.1 Groundwater Level and Flow

Groundwater levels in the shallow and deep aquifer are presented in Appendix 5 and Plate 9-1. The patterns of groundwater flow encountered during 2020 are very similar to those observed previously.

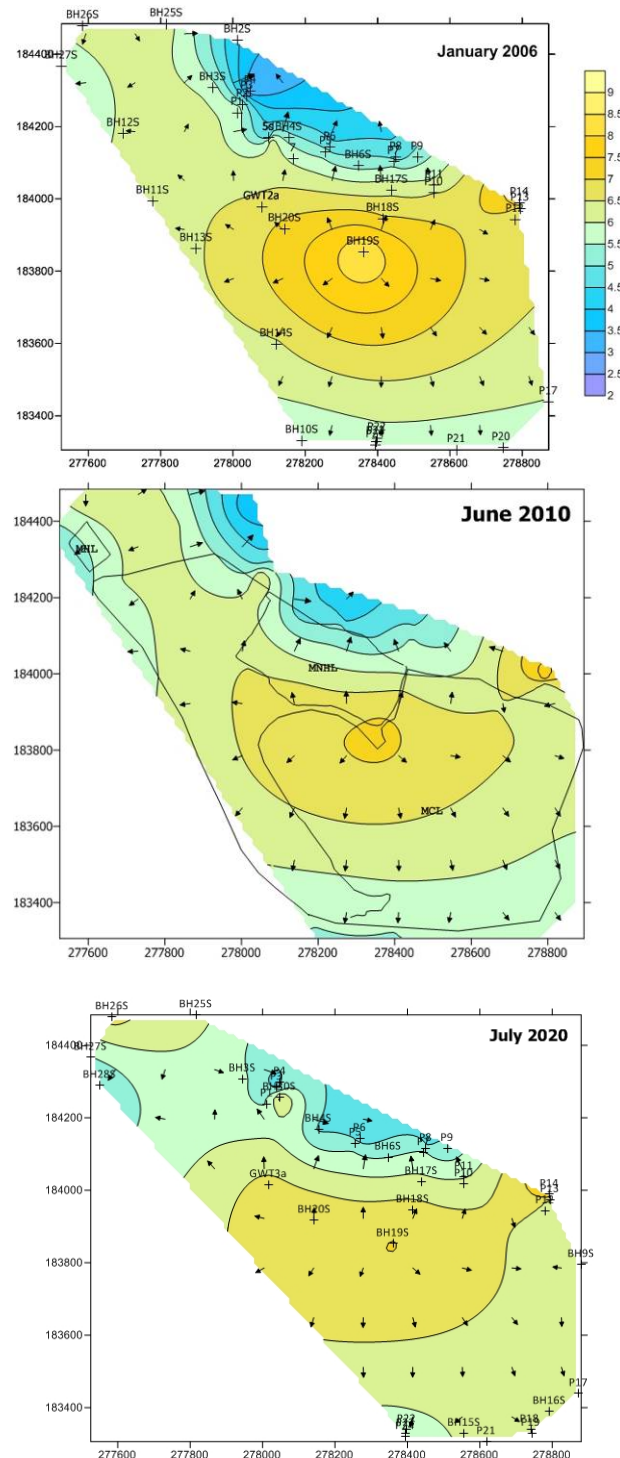


Plate 9-1 Shallow Groundwater Level Contours

9.2 Groundwater Chemistry

9.2.1 Shallow Aquifer

The latest monitoring results are very similar to those observed previously with temporal variations illustrated in Appendix 6. Also included in Appendix 10 are spatial plots highlighting several key parameters.

The monitoring programme continues to confirm the diminishing impact of leachate from the adjacent unlined but capped MCL on groundwater directly upgradient of MNHL. Over the past few years, upgradient groundwater along the northern boundary of MCL has shown a sustained decrease in mineralisation, suggesting an overall change and improvement in water quality, most likely due to capping. This is most obvious at monitoring positions BH17S-BH20S which are directly upgradient of MNHL and downgradient of MCL. More recently, similar changes have started to be observed to the south of MCL, as shown in Charts 9-1 and 9-2. At these positions, there have been sustained decreases in the concentration of several parameters including pH, Electrical Conductivity, ammonia, chloride, calcium, alkalinity and Chemical Oxygen Demand (COD) in the shallow aquifer as shown by the time series charts in Appendix 6 and selected charts below. With time, the water quality is likely to become less alkaline as less slag-based waste is exposed. As the water quality changes, trace metals may potentially become slightly more mobile and this may explain some of the impersistent variations in trace metal concentrations.

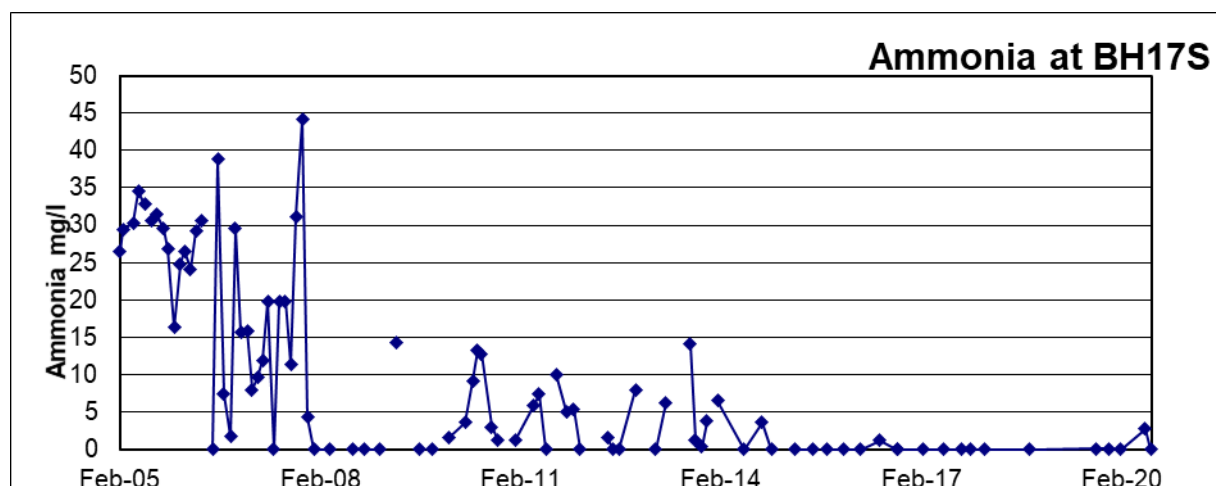
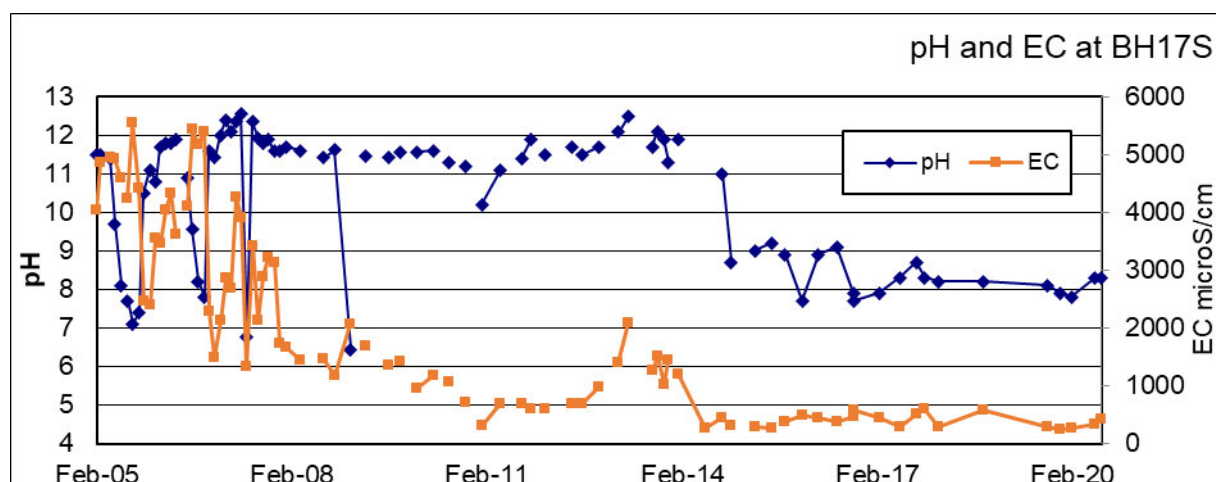


Chart 9-1 Temporal variation of water chemistry at BH17S

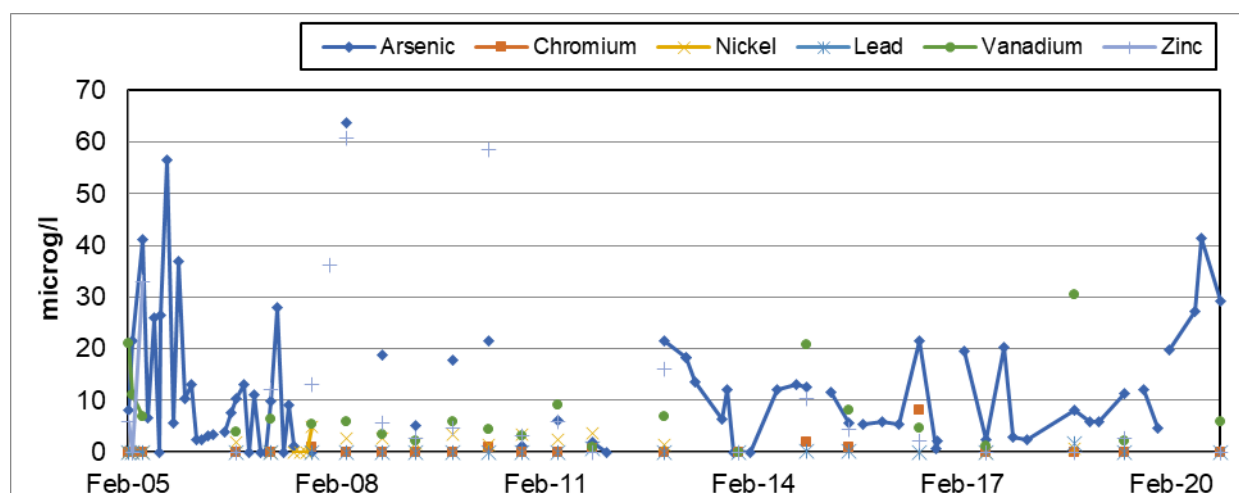
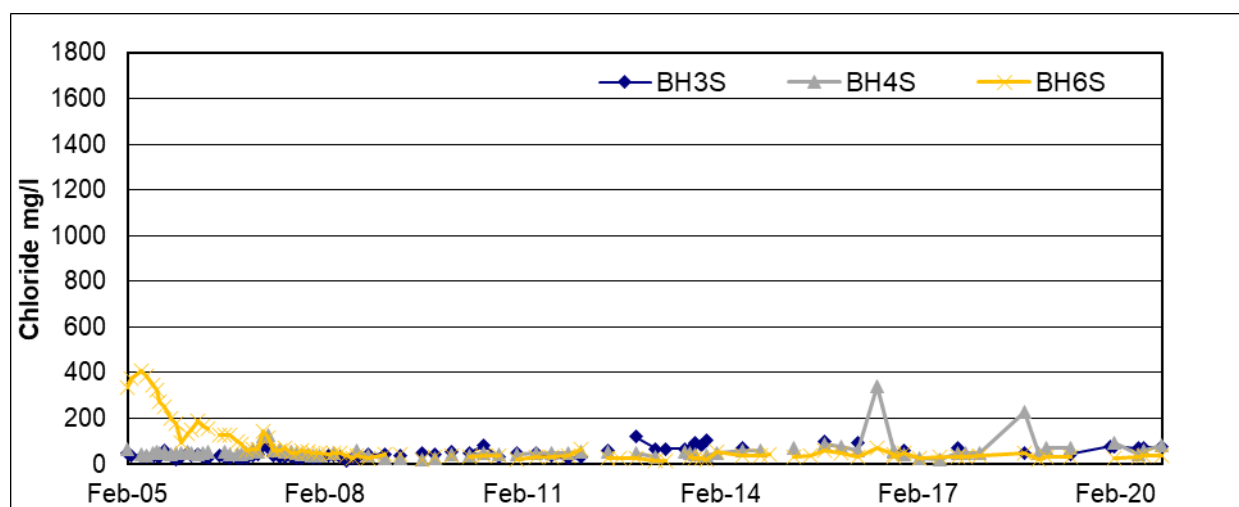


Chart 9-2 Temporal variation of water chemistry around edge of site

In the shallow aquifer downgradient of the active cells, samples of groundwater have for some time revealed relatively short-term increases in alkalinity. These are considered to be related to the leaching of alkaline components from MCL, other areas of unlined waste and variations in shallow groundwater levels. Short-term variations in the concentration of ammonia and calcium may also be due to the same processes. There is no evidence to suggest seepage from MNHL is the cause as chloride, a key indicator of leachate is not sustainably increased. Groundwater quality downgradient of MNHL, along the boundary with Margam Moors SSSI (BH3, BH30, BH4 and BH6) is like the upgradient chemistry observed at GWT3A and BH17S – BH20S. At BH30 and BH4, the groundwater is less mineralised than groundwater to the west at BH3 and to the east at BH6. This may be indicative of variations in shallow groundwater quality caused by the occurrence of the springline to the west and historical seepage from MCL to the east.

At BH3S and BH4S, arsenic has increased to concentrations not seen for many years. The levels are still low and below EQS and trigger levels but the precise cause is unclear.

9.2.2 Deep Aquifer

This is the eighth annual report since the introduction of the reduced monitoring schedule for the deep aquifer. Samples are now only collected annually.

The data suggests that there has been minor change in deep groundwater chemistry and that the reduced monitoring programme is not hampering understanding of the site conditions.

Interestingly, some of the deep groundwater wells around the toe of MCL and upgradient of MNHL have shown improvements in groundwater quality since the on-set of MCL capping. Others, such as BH20D have revealed slightly different trends with increased concentration of sodium and arsenic. These contrasting variations may be indicative of different drainage patterns below and around MCL and the expected short-term influence from the exposure of wastes during capping.

9.3 Assessment against Permit Compliance Limits and EQS

The graphs presented in Appendix 6 reveal temporal trends. Table 9-1 compares the 2020 downgradient groundwater chemistry with the Permit trigger levels. This reveals no breaches during 2020.

Table 9-1 Evaluation of downgradient Groundwater data against Trigger Levels

		Arsenic	Chloride
		microg/l	mg/l
	Trigger Level	50	200
BH3S	15/01/2020		
BH3S	05/02/2020	19.80	59.6
BH3S	15/06/2020	27.2	75.4
BH3S	20/07/2020	41.5	72.2
BH3S	04/12/2020	29.3	86.4
BH4S	05/02/2020	12.4	60.1
BH4S	16/06/2020	26.2	84.5
BH4S	20/07/2020	41	88.6
BH4S	04/12/2020	19.2	91
BH6S	05/02/2020	2.70	25.22
BH6S	16/06/2020	<1.5	32.85
BH6S	20/07/2020	3.9	38.99
BH6S	04/12/2020	2.2	37.98
BH30	05/02/2020	12	41.25
BH30	16/06/2020	23.9	63.1
BH30	20/07/2020	32.2	67.5
BH30	04/12/2020	18.5	92.3

9.4 Contingency Actions Taken

No specific contingency actions have been required but Tata has been in close communication with NRW during 2020 to rectify some of the monitoring inconsistencies identified during recent reviews. Further improvements will be made once the latest Variation is in place. These will be aimed at speeding up the turnaround of data reporting and identification of data trends.

10 SURFACE WATER LEVELS

The results of the surface water monitoring are presented in Appendix 7 and Appendix 8. Spatial variations in selected water chemistry are also provided in Appendix 10.

10.1 Assessment against Permit Control Levels

Surface water immediately northeast of MHL on Margam Moors is already known to be significantly impacted by seepage from MCL, as there is a well-developed highly alkaline springline.

Due to the low risk that MNHL directly poses to surface water under active management control and the historical impact of seepage from MCL, there are no Permit Compliance Limits for surface water. Instead, there are two assessment levels (AL1 and AL2). An evaluation of the 2020 dataset against these levels is presented in Table 8-1. This analysis reveals no persistent breaches.

Table 10-1 Comparison of SW4 surface water quality with assessment levels

	Arsenic	Chloride
	microg/l	mg/l
Control level 1	35.00	100.00
Control level 2	40.00	150.00
05/02/2020	8	216
30/06/2020	13.3	68.9
20/07/2020	20	75.1
04/12/2020	2.1	63.9
Data from SW2 not available as insufficient water at springline at time of sampling		

Over the past four years, elevated alkalinity has been observed at SW4, particularly during the period May-November.

Other surface water sample locations immediately downstream of the landfill (SW13 and SW14) do not show such variations and the chemistry observed during recent years is consistent.

Sample SW15 is taken from pooled water (because of the ground surface intersecting shallow groundwater) to the north of the landfill. This position is close to a slag hardstanding used for vehicle storage and maintenance. The water chemistry observed at this position has also remained relatively consistent, like that at SW13 and SW14, although the alkalinity concentration has been variable since 2015. The cause of these variations is unclear but could be related to variations in pool water level resulting in exposure and subsequent flushing of made ground dominated by slag.

10.2 Contingency Actions Taken

No contingency actions were required.

11 DUST

Tata has been routinely monitoring dust around the Morfa landfills for many years. A previous review of data lead Tata to question the environmental benefit of monitoring at the continued frequency. A full description of the work that has led to this position was set out in the 2017 annual report for MNHL (see Geotechnology report 1761r1v1d0218). Tata has previously requested that NRW considers the results and the cessation or reduction of monitoring, as set out in the Variation application in Appendix 2.

11.1 Assessment against Permit Control Levels

The relative locations of the dust monitoring points are as follows:

- D15 is located at the northern end of the site near the offices and close to the coal stockyards.
- D16 is in the middle of Margam Moors north of MNHL.
- D17 is located east of MNHL near the old landfill bordering the SSSI.
- D18 is located to the southeast of MNHL near the old landfill and rail sidings.
- D19 is located to the west of site near to the beach and road.

The results from the depositional dust monitoring undertaken in 2020 are summarised in Appendix 12. The results are broadly similar to those observed in previous years with elevated levels of particulates found to be highly soluble with low or no detectable iron and elevated carbon. This suggests that the particulates are not coal (given the solubility) but more likely marine or plant matter in origin.

11.2 Contingency Actions Taken

No specific contingency actions have been taken by Tata. The landfill operator routinely deploys a bowser to spray water on all landfill haul roads to minimise the generation of dust in accordance with the air quality management plan for the landfill. The data demonstrates that dust from the landfill cells is not an issue of significant concern.

12 LANDFILL GAS

12.1 Internal Monitoring

Internal landfill gas chemistry can be measured at GA1, GA2 and W1 – W8 within Bio Cell A and W9 – W16 in Bio Cell B. Due to the fixed height of the gas wells they can only be safely monitored when the waste level surrounding the well is sufficiently high and stable.

Until 2011, the monitoring had failed to detect more than 1.6% carbon dioxide or methane and 33 ppm carbon monoxide. In March 2011, this pattern changed with landfill gas containing up to 61% methane and 48% carbon dioxide detected at GA1 and GA2 in Bio Cell A. The occurrence was, however, short-lived and localised. No other gas wells detected such levels and all subsequent measurements at GA1 and GA2 has failed to detect methane and carbon dioxide above 2%. In Bio Cell B, methane has never exceeded 0.6% and carbon dioxide 5.7% with the highest concentrations typically found at W10 and W11. Some of this data is presented in Appendix 9.

As the waste is not capped in either bio-cell, the gas is free to vent to the atmosphere and these measurements should only be considered indicative.

12.2 External Monitoring

External landfill gas is monitored around the northern (GA7, GA15 & GA16), eastern (GA8, GA9 & GA10) and southern (GA11 & GA12) boundaries of the bio cell (see Figure 4).

Along the southern and eastern boundaries, ground gas has been infrequently detected. Since 2014, methane has not been detected and carbon dioxide has not been detected above 0.2%. Low levels (<10 ppm) of carbon monoxide and hydrogen sulphide have been infrequently detected.

Historically, the situation has been different along the northern boundary as ground gas has been detected along this boundary for several years, most notably at GA16 but more recently at GA7. In response, the compliance limits for GA16 were increased following an evaluation of the likely ground gas sources that concluded that the landfill was not the source of the gas. At no point since 2012 have the monitoring results breached the compliance limits at GA15 or GA16. At no point since 2012 has the concentration of methane or carbon dioxide exceeded 0.5%, which is the tolerance of the GA5000 instrument used to undertake the monitoring. Low levels (<10 ppm) of carbon monoxide and hydrogen sulphide have been infrequently found. On 14 March 2017 a reading of 193ppm hydrogen sulphide was detected. A repeat of the measurement at the time failed to detect any hydrogen sulphide. Such elevated levels have never been detected at any monitoring location and all monitoring since March 2017 has failed to detect hydrogen sulphide above 2ppm at any position.

12.3 Contingency Actions Taken

No contingency actions were required but Tata has recognised that improvements to the headworks at several gas monitoring locations are required. Some of these changes are necessary due to localised flooding occurring along the toe of MCL and MNHL (between BH17 and BH6 on Figure 4). Such flooding could also influence ground gas chemistry.

13 SUMMARY AND RECOMMENDATIONS

13.1 Evaluation and Summary

At MNHL there will always be difficulty in determining influences on groundwater as both the shallow and deep aquifers have been impacted to varying degrees by seepage from unlined areas of waste and other off-site sources. Additionally, as the construction of the landfill was subject to CQA during construction and this included a leak location survey, the volume of leakage that is predicted by the LandSim model is small. Identifying seepage from the landfill is not, therefore, straightforward given variations and similarities between the leachate and upgradient groundwater and the low volume predicted to leak.

There is, however, one key tracer and this is currently chloride. Although the current concentration of chloride has reduced in the leachate sumps it remains above most levels observed in shallow groundwater and surface water. Based on the hydrochemical monitoring data collected to date there is no evidence to suggest that the landfill is not behaving as initially predicted and the identified receptors remain protected from impacts related to MNHL. Leachate levels have, until recently, been elevated above the compliance level for many months but there has been a step-change reduction in leachate levels during 2020 with all levels now compliant. As cells cease to operate, progressive restoration should also be taking place as this limits the amount of leachate requiring management, potentially reduces the mineralised content requiring treatment and reduces the potential flux of contaminants.

13.2 Environmental Protection

The initial risk assessments, completed as part of the Permit Application, clearly demonstrated the potential for the landfill to emit non-hazardous pollutants to groundwater and potentially surface water. There was also the potential that the landfill would generate dust during landfilling activity and associated vehicular movements and earthworks. Landfill gas is not likely to be associated with the industrial components of the waste, but the generation of small amounts could not be wholly discounted, particularly within the biodegradable cell.

To ensure that the landfill performs at least as well as predicted throughout the lifespan of the Permit, a monitoring programme was put in place to evaluate the leachate source concentrations, leachate head, groundwater flow, surface water chemistry, gas generation and dust deposition. Based on the monitoring data reviewed to date, there is no evidence to suggest that the landfill is not behaving as initially predicted and the identified receptors remain protected.

13.3 Regulatory Framework

In January 2013, a new set of control levels and compliance limits were established. Since this time additional data has been gathered and the HRA was reviewed in 2017. Based on the information available at the time Geotechnology suggested revised control levels and compliance limits focussed on arsenic and chloride in the 2017 annual review. NRW has now reviewed these suggestions and Tata has recently submitted a Permit Variation aimed at consolidating the agreements and changes. Once these aspects have been agreed and finalised the management system for the landfill should be updated accordingly. Where relevant, the monitoring teams and laboratory should be informed of the latest monitoring schedules.

13.4 Actions Required

The annual report has identified several items requiring action:

- Vegetation near several sampling points requires routine clearance to enable continual safe access.
- Variation application outcome should be consolidated into documented management system

Figure 1 Site Location Plan



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Figure 2 Detailed Site Plan Showing Planning and Permit Boundaries

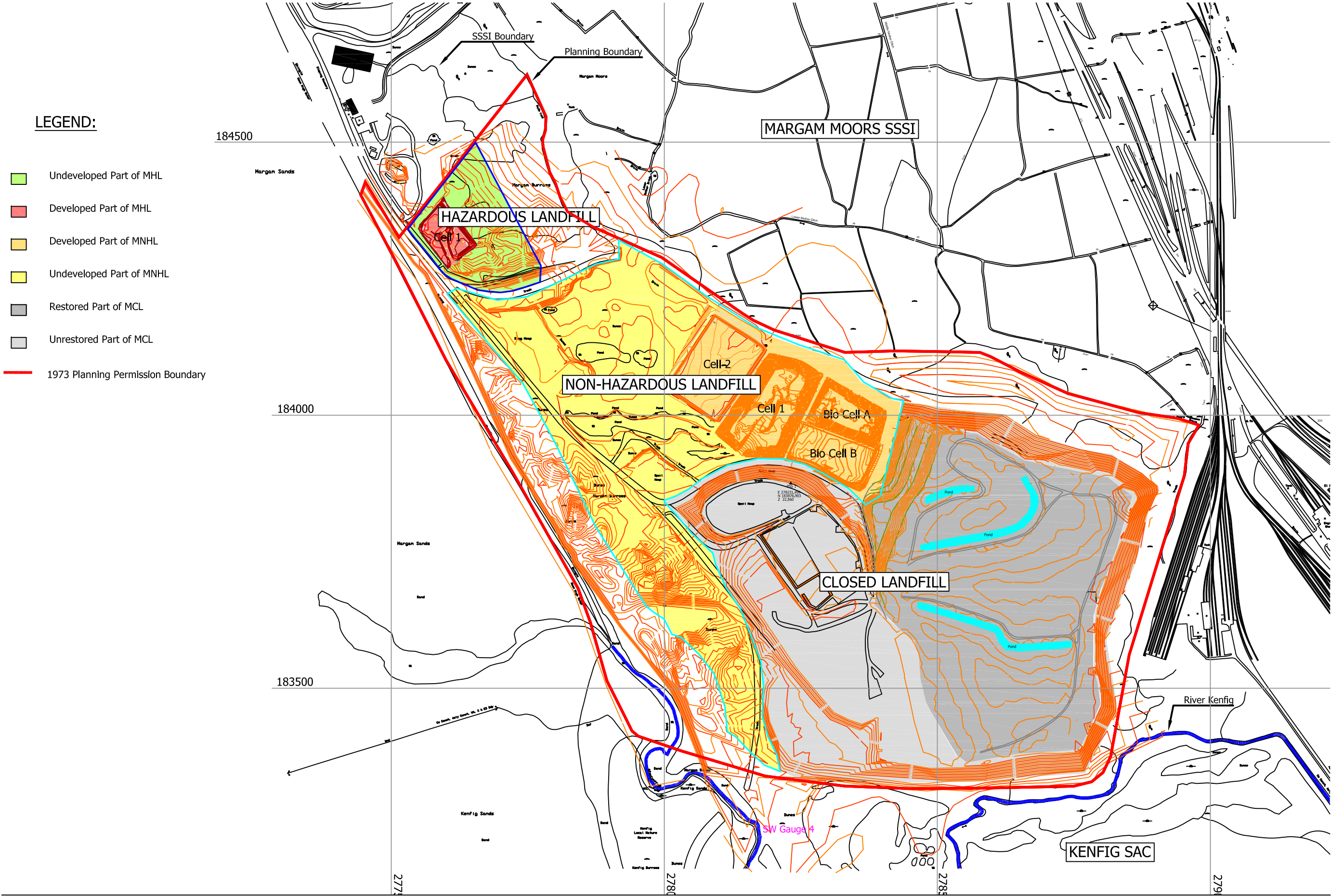


Figure 3 Conceptual Site Model

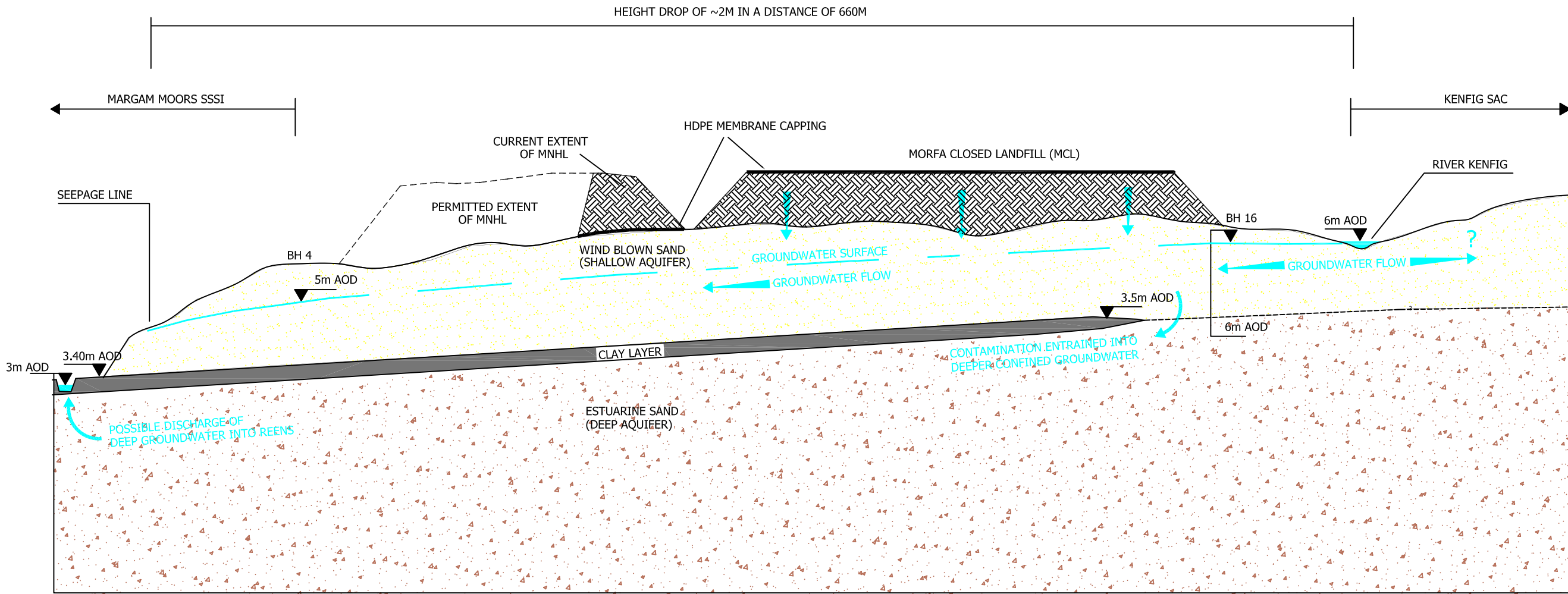


Figure 4 Available Monitoring Network

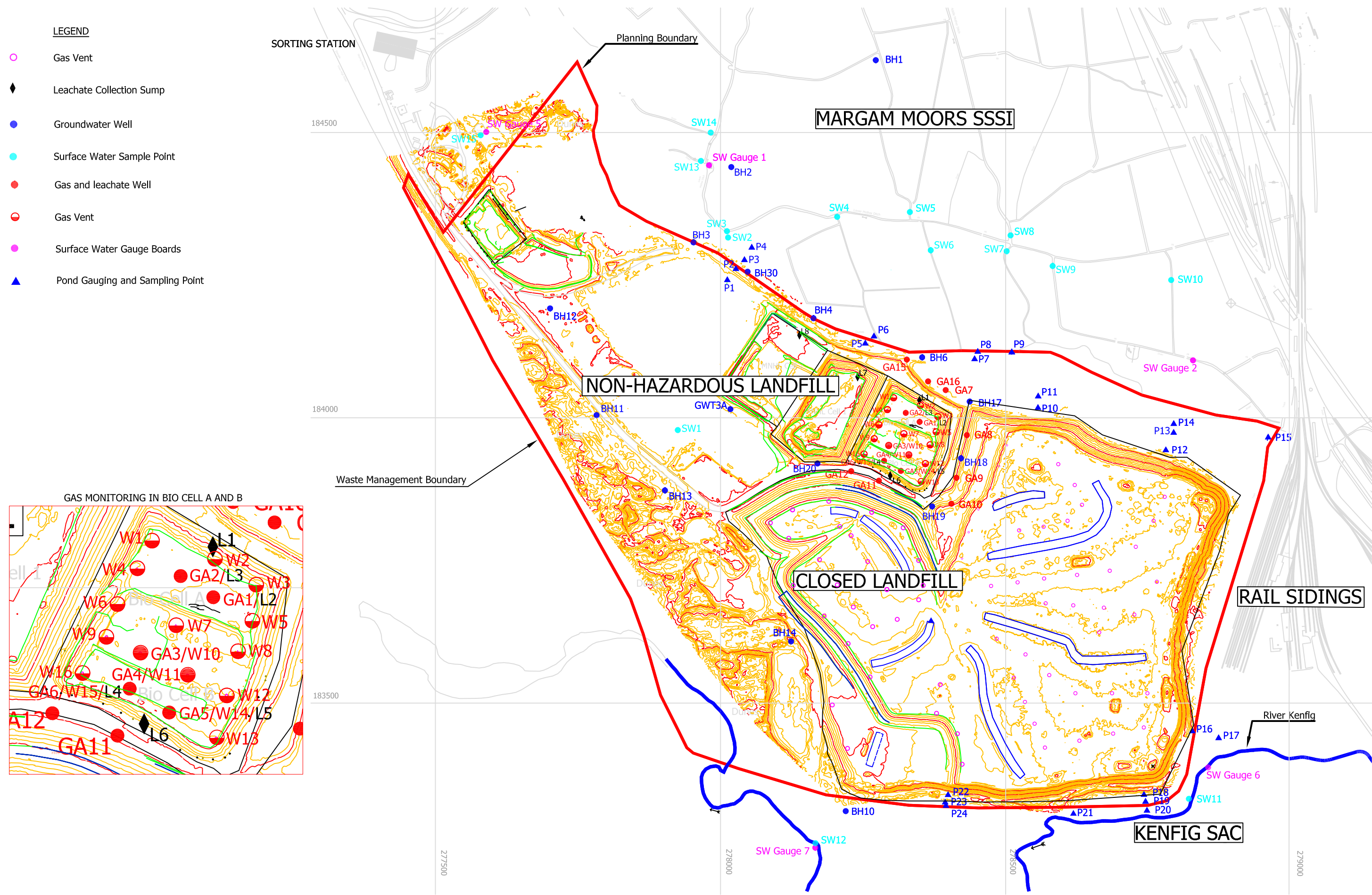


Figure 5 Extent of Clay Layer

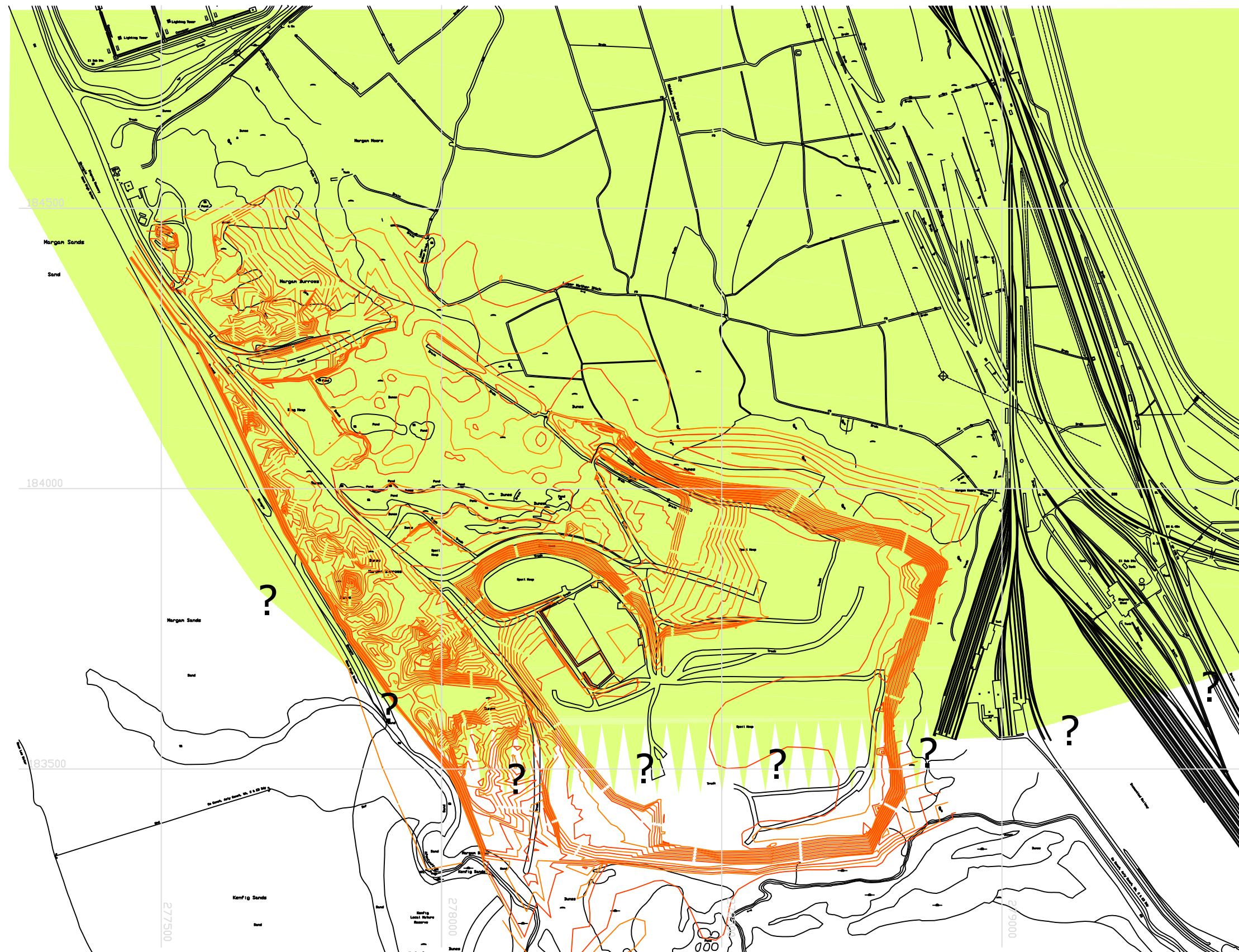


Figure 6 Typical Contour Plan of Piezometric Surface in Shallow Aquifer

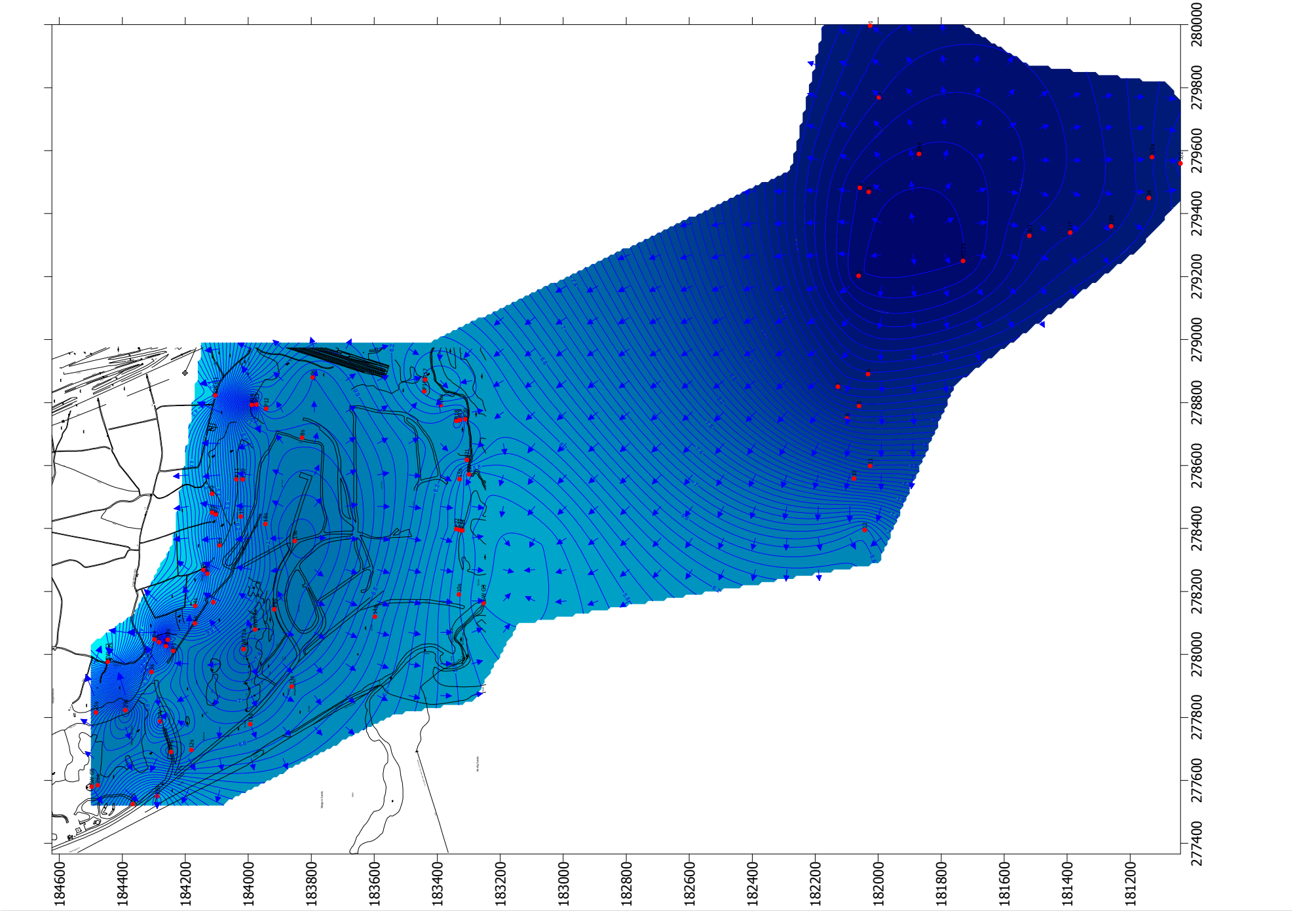
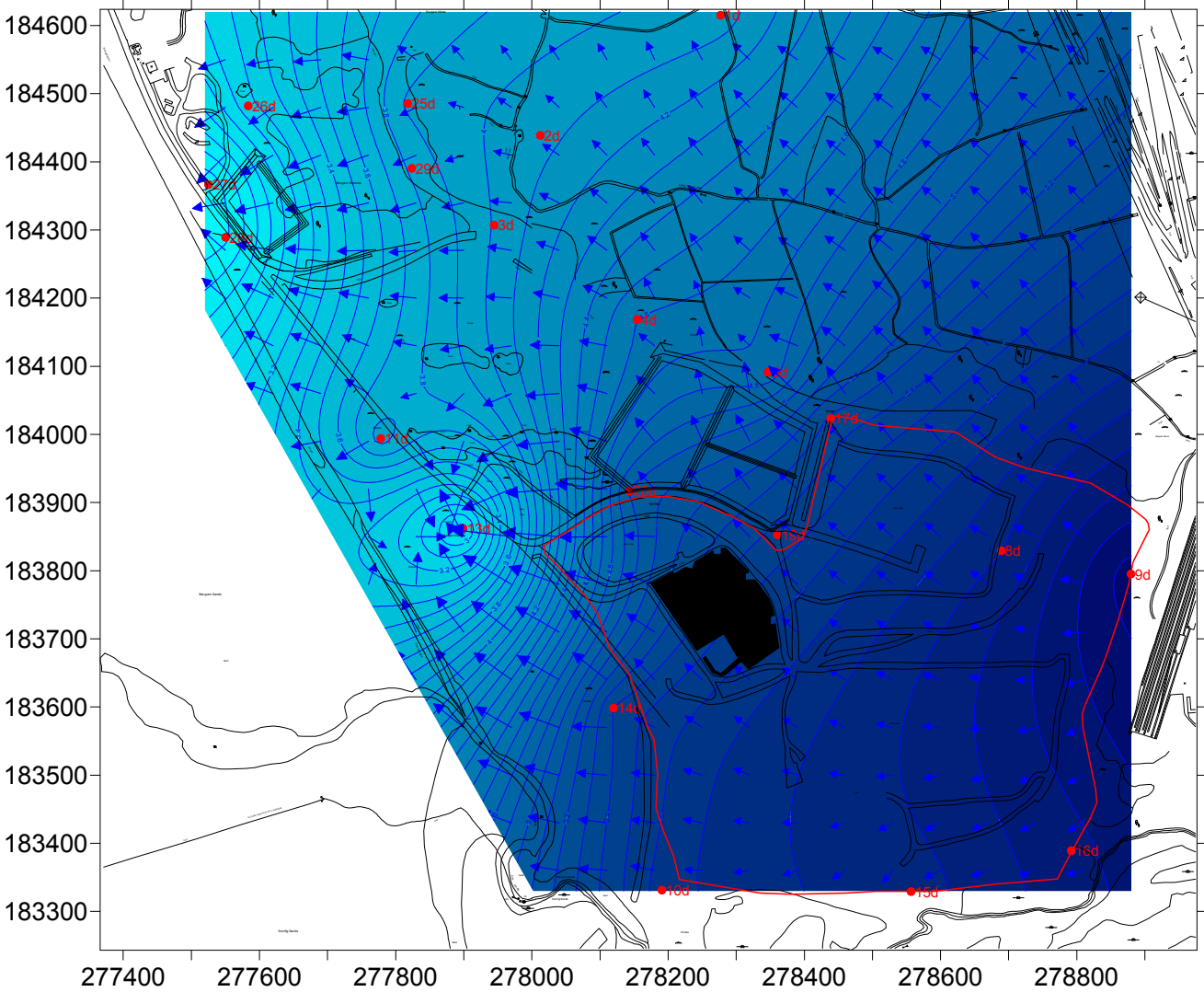
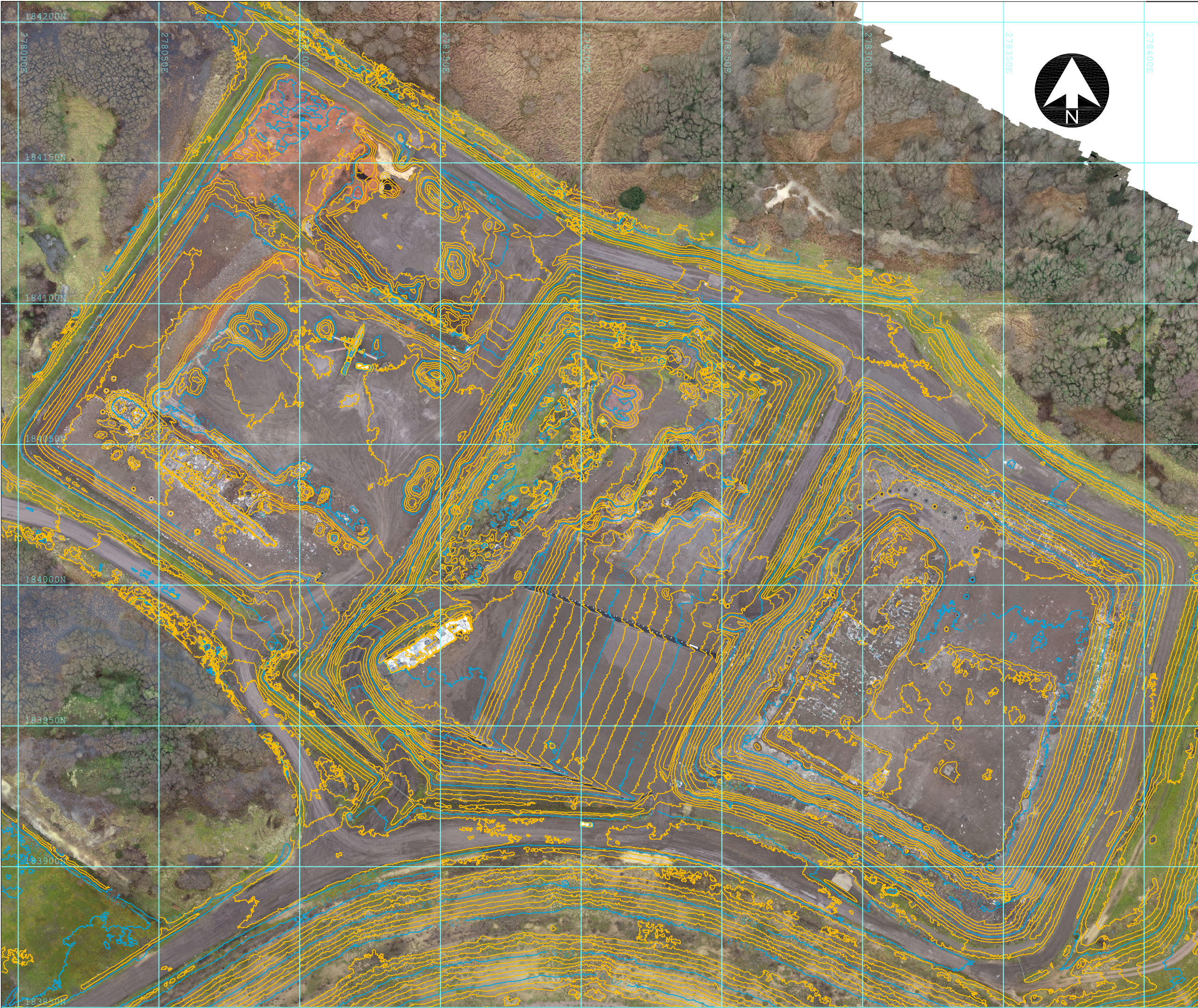


Figure 7 Typical Contour Plan of Piezometric Surface in Deep Aquifer





Drawing Number 2092/8

Legend

 Prominent Contour (2.5m)

 Normal Contour (0.5m)

Notes

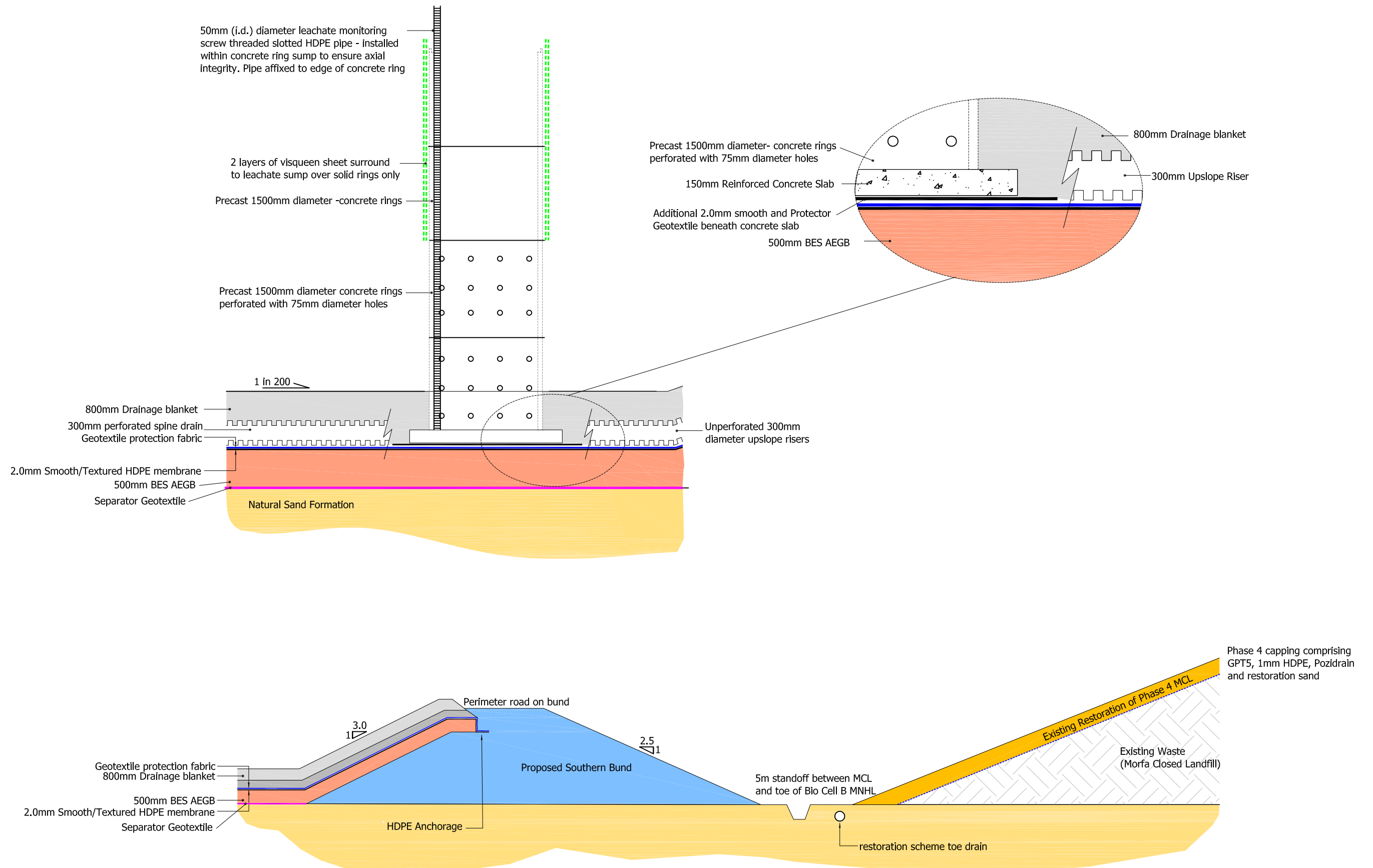
Digital survey model generated using Pix4D image processing software.

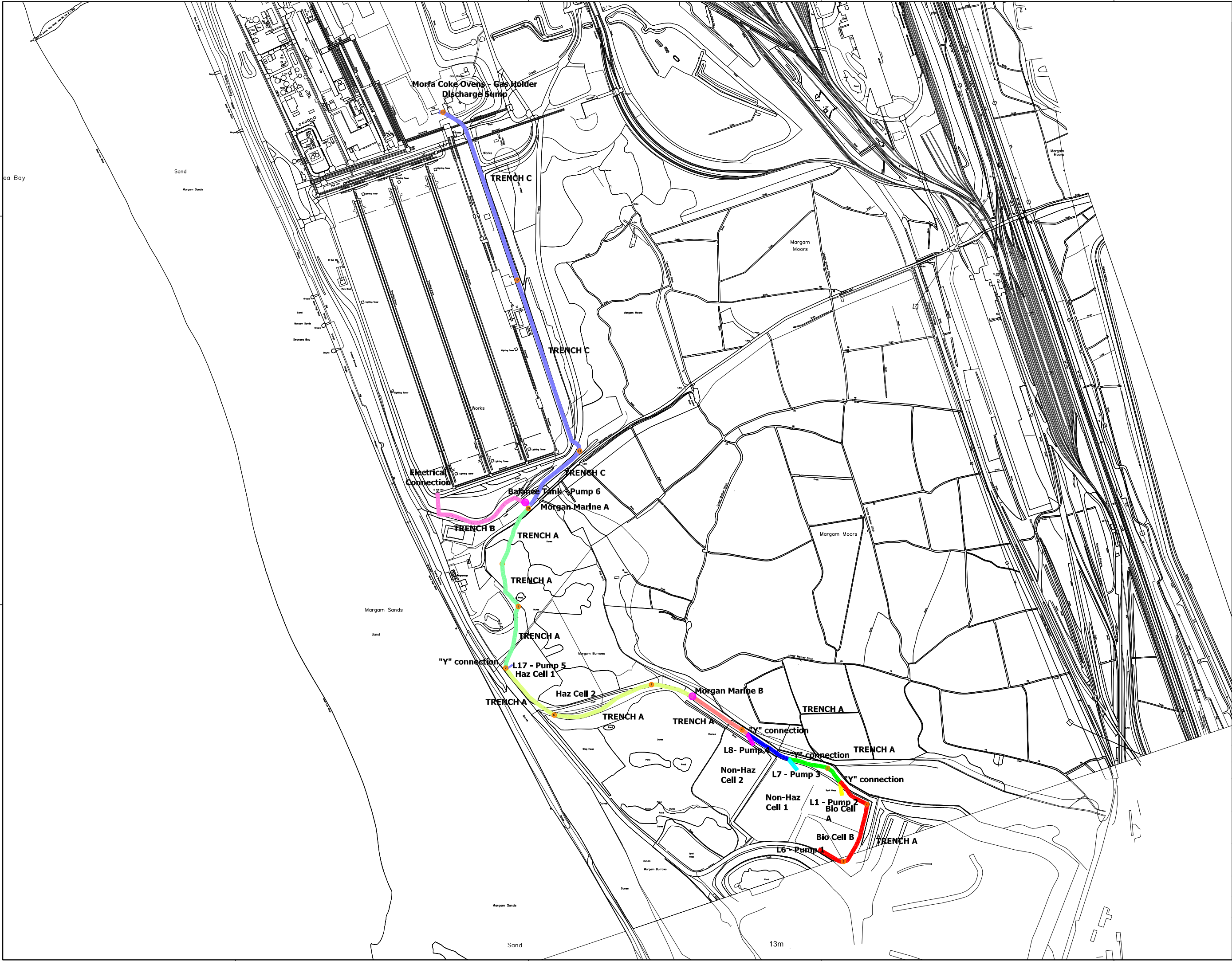
Imagery acquired by DJI Phantom 4 pro RTK photogrammetry survey on 08 January 2021.

Survey control installed using Topcon Hiper SR dGPS Network Rover.

Rev	Date	Status/Ammendments	
CLIENT			
Darlow Lloyd & Sons			
PROJECT			
MNHL Annual Report 2020			
TITLE			
Current Topographic Plan of Landfill Cells			
DRAWING NUMBER		REVISION	
2092/8		0	
DATE	DRAWN	CHECKED	SCALE AT A3
01.21	KJT		1:1250
Geotechnology Limited Ty Coed, Cefn-yr-Allt, Aberdulais, Neath SA10 8HE 01639 775293 www.geotechnology.net			
			

Figure 9 Cross Sections of Key Landfill Engineering Systems





Drawing Number 2092/10

Legend

- Sump Number
- Survey Check Point (see Table 7-1)
- Location of Electrical Control Panel - Morgan Marine A or B
- Chainage A
- Chainage B
- Chainage C
- Chainage D
- Chainage E
- Chainage F
- Chainage G
- Chainage H
- Chainage I
- Chainage J
- Chainage K
- Chainage L

NOTE

Rev	Date	Status/Amendments
CLIENT		
TATA STEEL (UK) Ltd.		
PROJECT		
MORFA NON-HAZARDOUS LANDFILL 2020 ANNUAL REVIEW OF ENVIRONMENTAL MONITORING		
TITLE		
LEACHATE COLLECTION SYSTEM		
DRAWING NUMBER		REVISION
2092/10		FINAL
SCALE AT A1	DATE	DRAWN
1:4000	2.20	AJ/KT
CHECKED		

**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

PERMIT BV7311IE

**2020 Annual Review of
Environmental
Monitoring**

**Appendix 1
Record of Permit
Update**

Report Number 2092r1v1d0221

Record of Permit Update

This summary is intended to signpost the reader to reports and correspondence related to changes to the monitoring programme that have occurred since Permit issue.

- Subsequent to the issue of the Permit, Geotechnology presented a revised set of Assessment Criteria for groundwater, surface water and leachate in accordance with the Permit Improvement Conditions. These revised Assessment Criteria were initially presented by Geotechnology following a review of the Hydrogeological Risk Assessment (HRA) (see Geotechnology report 403.1/1/1006 Review of Hydrogeological Risk Assessment) after commencement of landfilling. These criteria were further updated following feedback from NRW in Geotechnology letter 403/reviewHRA/lt1/BR/kp (dated 17 January 2007) to the Agency and also in the 2006 annual monitoring report (see Geotechnology report 528.1/0/0307).
- During 2007, NRW commented upon the revised criteria presented in the 2006 annual report and after slight modification, a revised set of Assessment Criteria for groundwater and surface water were agreed (see Geotechnology correspondence 244Permit_lt1/BR/kp and NRW correspondence dated 30 April 2007 and 7 June 2007 (ref: BV7311IE)).
- The 2006 annual monitoring report also indicated that dust levels regularly exceeded the Permit limit of 100 mg/m²/day and that the generation of dust was not solely related to landfilling activities according to Tata. On 28 September 2007, Tata submitted a request to NRW that suggested apportioning 50% of the measured dust to the landfill with a limit value of 200 mg/m²/day and the other 50% allocated to other activities at the works and natural deposition.
- Further minor operational changes to the Permit were requested by Tata on 13 June 2008 (Tata reference LANDFILLPPC_017). The request related to leachate control levels, surface water assessment levels, dust levels and Compliance Limits at external gas well GA16. These changes were prompted by the 2007 annual monitoring report (see Geotechnology report 620.1/0/0108), a meeting with the NRW on 10 June 2008 and NRW Compliance Assessment Reports 01718 and 01770. In response, NRW agreed the minor changes to the Permit in a letter dated 30 July 2008. For clarity, this letter summarised the changes and the applicable assessment criteria.
- As part of a Permit Variation Notice (Variation Notice No. GP3430MH) an Improvement Programme required Tata to undertake a review of copper trigger levels. Geotechnology undertook this assessment at the request of Tata (see Geotechnology report 990r1v1d0610 dated June 2010) and NRW has reviewed and accepted the new groundwater copper trigger levels. The NRW review and acceptance is set out in Compliance Assessment Report 03451 issued 25 November 2010.
- As part of the 2011 annual review (Geotechnology report 1130r1v1d0412) new assessment levels for carbon monoxide and compliance levels for methane were derived in accordance with The Industry Code of Practice (ICOP) guidance.
- As part of the 2012 HRA review, new assessment levels were presented for leachate, groundwater and surface water (see Geotechnology report 1177r1v1d0712). These were also consolidated in a letter to NRW from Tata on 4 February 2013. Given the acceptance of these new levels towards the end of 2012, Tata only started implementing the use of these new control and compliance levels in January 2013.
- In the 2017 annual review a series of new control and trigger levels were proposed alongside modifications to the analytical and monitoring programme. These were verbally agreed by NRW at a Technical Working Party meeting but written feedback was not provided until 2020.

- In January 2021, Tata submitted Permit Variation aimed at consolidating changes previously discussed with NRW but not formally documented.

**MORFA NON-
HAZARDOUS
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TALBOT**

PERMIT BV7311IE

**2020 Annual Review of
Environmental
Monitoring**

**Appendix 2
Correspondence with
NRW**

Report Number 2092r1v1d0221

Yeliz Marshall
Lead Environmental Engineer
Safety, Health and Environment
Tata Steel UK Limited
Port Talbot Works
Port Talbot
SA13 2NG

Ein Cyf/Our ref: BV7311IE
Eich Cyf/Your ref:

Date: 6th April 2020

Dear Yeliz

Morfa Non-Hazardous Landfill - Hydrogeological Risk Assessment Review – 2017 and 2017 Annual Monitoring Report¹

As you are aware it recently came to light that the 2017 review of the site's hydrogeological risk assessment (HRA), which was submitted by Tata in 2018, has not been assessed by NRW. The HRA review also referred to the 2017 annual monitoring report (AMR) which proposed a revision to some of the control levels and compliance limits.

I have since asked our Geoscience team to review these submissions and in general NRW is satisfied with the HRA, but we need to clarify a few points before we can formally accept the submissions. Firstly, there are some general points which are similar for both the hydrogeological risk assessment and annual report; these have been put together for ease of reference. These are either points to note, corrections or questions to answer. Secondly there are comments on the proposed changes to permitted compliance points, control levels, compliance limits and monitoring frequencies. These are also discussed.

General comments

1. Groundwater Regulations 1998 (and 2009) – these no longer exist as they are now part of Environmental Permitting Regulations 2018 under Schedule 22.
2. Reference to CCW (post Apr 2013) was made in the HRA this should be changed to NRW in future submissions.
3. For future reference any proposed changes to groundwater and leachate chemistry control levels, compliance limits and points and monitoring frequency should be

¹ Morfa Non-Hazardous Landfill, Port Talbot, Environmental Permit Bv7311IE – Review of Hydrogeological Risk Assessment. Geotechnology Ltd., Report Number 1739r1v1d1217, December 2017. Morfa Non-Hazardous Landfill – Permit BV7311IE – 2017 Annual Review of Environmental Monitoring. Geotechnology Ltd, Report Number 1761r1v1d0218, February 2018.

included within the HRA and not in the annual reports.

4. Trend analysis was suggested for consideration during 2018 with the development of a tool to help undertake this work. Has a trend analysis tool been developed and is it in use at the site? If so, what success has there been since 2018?
5. We note that the site has been used for landfill of steel works waste prior to any permits or licences for the site. Can you expand on the comments about slag material around the site – is it in pockets of defined areas or is it generally found around the site. We note it is used for temporary capping.

Proposed changes to permit*

6. Table 14.2 remove BH11, BH12, BH13 and BH14 as up gradient monitoring from 6 monthly to annually – we have no objection to this change in principle *.
7. Table 14.2 request the removal of BH1 and BH2 from 6 monthly monitoring – we disagree with removal from 6 monthly to annual monitoring for these two monitoring locations. BH1 and BH2 are located further downgradient along the flow path from active cells and potentially act as a backup for checking the extent of any likely pollutant plume from the site.
8. Table 14.1 remove COD, TOC and P, but add K, Mo, Se, V, B, Na, Cd and F to quarterly monitoring – we have no objection to this change in principle *.
9. Please expand in the proposed use of alternating Quarter 2 and Quarter 4 for annual sampling. Potentially this could lead to no monitoring for up to 18 months – we would prefer annual monitoring to be complete in the same quarter each consecutive year.
10. Table 13.6 control levels and compliance limits for groundwater and surface water – we note the temporary removal of control levels and compliance limits for ammoniacal nitrogen, which will be reviewed every year during the annual report and using trend analysis – has this been done?
11. Table 13.2 leachate control levels – why are the control levels for ammoniacal nitrogen and chloride a lot higher than the maximum concentration observed? Why has the opposite approach been taken for arsenic which has a control level much lower than the maximum concentration observed?

***Once the questions above have been addressed to our satisfaction, Tata will need to apply to vary their permit to ensure that the permit reflect these proposed changes.**

If you wish to discuss the letter, please feel free to contact me by email.

Yours sincerely

Neil Herbert

Arbenigwr Arweiniol - Rheoleiddio Diwidiant a Gwastraff
Lead Specialist – Industry & Waste Regulation

Tîm Rheoleiddio Diwydiant a Gwastraff - De-Orllewin Cymru /
South West Wales Industry & Waste Regulation Team

Cyfoeth Naturiol Cymru / Natural Resources Wales

E-bost/E-mail: neil.herbert@cyfoethnaturiolcymru.gov.uk

Note: Novel Coronavirus (COVID -19)

The escalation in the threat posed by the novel coronavirus (COVID – 19) pandemic, has resulted in the imposition of several stringent measures across the United Kingdom.

These measures to control and reduce the spread and impact of the disease are having an impact on both NRW's and the operator's normal operating practices. At the time of writing all routine regulatory visits and meetings have been suspended by the regulator. The situation is dynamic and extremely fluid however these restrictions are expected to remain in place for several weeks if not longer. During this pandemic there will be a continued expectation that operators continue to meet the conditions of their permits. Where the operator has identified an issue that is likely to result in permit non-compliance or increased environmental risk, the operator is expected to speak to the regulator at the earliest opportunity.

From: Marshall, Yeliz

Sent: Tuesday, April 14, 2020 1:07 PM

To: Herbert, Neil <Neil.Herbert@cyfoethnaturiolcymru.gov.uk>

Cc: Grainger, Claire <claire.grainger@tatasteeleurope.com>

Subject: FW: NRW comment - Non-Hazardous Landfill - Hydrogeological Risk Assessment Review – 2017 and 2017 Annual Monitoring Report

Hi Neil,

Please see below our response to the comments on the attached.

General comments

1 – 3. Understood. Many thanks.

4. Trend analysis is reviewed during the annual reports but has not yet progressed as hoped due to continued changes in background water chemistry. This is presumably related to the success of the capping of MCL resulting in changes to water quality.

5. The site has been used for landfill of steel works waste prior to any permits or licences at the site. The comment relating to slag material around the site refers to this material. As far as we are aware, this material is largely constrained to the central and southern areas of the undeveloped areas – close to the northern edge of MCL and southern / south western edge of MNHL.

Proposed changes to Permit

6. Understood.

7. Understood. BH1 and BH2 to be retained.

8. Understood.

9. Understood. Suggested alternating sampling frequency to be removed.

10. Ammonia has continued to be monitored. In the annual reports time series plots and data summaries have been used as tools to evaluate the data. Higher concentrations are typically found in environmental media rather than leachate.

11. This is a typographical error. Apologies. The arsenic concentrations presented in Table 13.1 are microg/l rather than mg/l i.e. the maximum concentration should be 0.00647 mg/l rather than 6.47. All concentrations in Table 13.2 are mg/l. The higher control levels are reflective of the leachate inventory in the Landsim model i.e. the leachate chemistry is far below the leachate chemistry PDF.

Met vriendelijke groet / Kind regards,

Yeliz Marshall

Lead Environmental Engineer
Safety, Health and Environment

Tata Steel

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E: yeliz.marshall@tatasteeleurope.com
www.tatasteeleurope.com

Follow us:



Compliance Assessment Report

Report ID: CAR_NRW0036308

This form will report compliance with your permit as determined by an NRW officer

Site	Morfa Non Hazardous Landfill	Permit Ref	BV7311IE
Operator/Permit holder	Tata Steel UK Limited		
Regime	Installations		
Date	7 th February 2020 (followed by revisions on receipt of 2019 annual report)		
Assessment type	Report/ Data Review		
Parts of the permit assessed	2019 Q1 to Q4 quarterly monitoring reports, comment on 2019 annual report (and 2017 HRA review)		
Lead officer's name	Neil Herbert	Accompanied by	N/A
Recipient's name/position	Yeliz Marshall - Lead Environmental Engineer TATA Safety, Health and Environment	Date issued	25 th March 2020

Section 1 – Compliance Assessment Summary

This is based on the requirements of the permit under the Environmental Permitting Regulations. A detailed explanation is captured in "Compliance Assessment Report Detail" (Section 2) and any actions you may need to take are given in the "Action(s)" (Section 4). This summary details where we believe any non-compliance with the permit has occurred, the relevant condition and how the non-compliance has been categorised using our Compliance Classification Scheme (CCS). CCS Scores can be consolidated or suspended where appropriate, to reflect the impact of some non-compliances more accurately. For more details of our CCS scheme, contact your local office.

Permit conditions and compliance summary	CCS Category	Condition(s) breached
A1 - Specified by permit	3	2.8.1 & 3.1.2 (x 4)
B1 - Infrastructure - Engineering for prevention and control of emissions	N	
B2 - Infrastructure - Closure and decommissioning	N	
B3 - Infrastructure - Site drainage engineering (clean and foul)	N	
B4 - Infrastructure - Containment of stored materials	N	
B4 - Infrastructure – Plant and equipment	N	
C1 - General Management - Staff competency/training	N	
C2 - General Management - Management system and operating procedures	N	
C3 - General Management - Materials acceptance	N	
C4 - General Management - Storage, handling labelling, labelling and Segregation	N	
D1 - Incident Management - Site security	N	
D2 - Incident Management - accidents, emergency and incident planning	N	
E1 - Emissions - Air	N	
E2 - Emissions - Land and groundwater	3 (x3)	3.1.6 x 3 (2x scores SUSPENDED)
E3 - Emissions - Surface water	N	
E4 - Emissions - Sewer	N	
E5 - Emissions - Waste	N	
F1 - Amenity - Odour	N	
F2 - Amenity - Noise	N	
F3 - Amenity - Dust/ fibres/ particulates/ litter	N	
F4 - Amenity - Pests/birds/scavengers	N	
F5 - Amenity - Deposits on road	N	
G1 - Monitoring and Records, Maintenance and Reporting - Monitoring of emissions and environment	3 (x4)	3.5.1(c) x 4 - (SUSPENDED)
G2 - Monitoring and Records, Maintenance and Reporting - Records of activity, site diary/journal/events	N	
G3 - Monitoring and Records, Maintenance and Reporting - Maintenance records	N	
G4 - Monitoring and Records, Maintenance and Reporting - Reporting and notification to Natural Resources Wales	N	
H1 - Resource Efficiency - Efficient use of raw materials	N	
H2 - Resource Efficiency - Energy efficiency	N	

KEY: See Section 4 for breach categories, suspended scores will be indicated as such.

A = Assessed or assessed in part (no evidence of non-compliance), **N** = Not Assessed

Number of breaches recorded	11	Total compliance score (see section 5 for scoring scheme)	44 (20 excluding suspended)
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If the number of breaches recorded is greater than zero, please see Section 3 for our proposed enforcement response

Section 2 – Compliance Assessment Report Detail

This section contains a report of our findings and will usually include information on:

- The part(s) of the permit that were assessed (e.g. maintenance, training, combustion plant, etc.)
- Where the type of assessment was 'Data Review' details of the report/results triggering the assessment
- Any non-compliances identified
- Any non-compliances with directly applicable legislation
- Details of any multiple non-compliances
- Information on the compliance score accrued including:
 - details of advice given;
 - any other areas of concern;
 - any actions requested;
 - any examples of good practice;
 - a reference to photos taken.

Introduction

NRW have undertaken a partial¹ review of quarterly monitoring reports submitted over the 2019 period. It should be noted that in undertaking this assessment it has become apparent that there is some confusion over the monitoring requirements relating to this permit (including the monitoring for the adjacent Morfa landfills (Closed and Hazardous)). This has been communicated already to the operator and a meeting has been scheduled for the end of March. The main issue appears to be discrepancies in the monitoring requirements and more importantly emission limits specified in the landfill permits versus the current monitoring programme adopted by the operator. It appears that this situation has arisen for a number of reasons, including the adoption of some monitoring changes without the requisite permit variation (to reflect the changes) being undertaken. In other cases, it is unclear why changes have been adopted where there is no acceptance or approval. It has therefore been particularly difficult to undertake a compliance assessment of the 2019 monitoring submissions. Our review was initially limited to groundwater results for those locations with a specified emission limit (as identified in table S3.3 of the permit). The Environment Agency did agree to changes² to the groundwater emission limits and parameters in response to the 2012 Hydrogeological Risk Assessment review. However, this was conditional on a number of matters being addressed and it is not clear whether this was ever completed. Therefore, in order to consider the 2019 GW results we have reviewed them against the original permit table but where there are emission limit or other failures noted any compliance scores have been suspended where appropriate.

We have also undertaken a review of leachate level compliance as part of this work. Any compliance scores relating to this assessment will not be suspended as this compliance measure is unaffected by the matters discussed above.

Please find attached comments and observations on aspects of the following submitted reports:

Quarterly Monitoring Reports - Q1 (Jan – March 2019); Q2 (Apr-Jun 2019); Q3 (Jul – Sep 2019) & Q4 (Oct – Dec 2019)

Q1 - Groundwater

Assessment against requirements of Table S3.3 of the permit.

- BH3S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia and alkalinity parameters have been submitted and these are below the limit specified in the permit.
- BH4S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia and alkalinity are below the limit specified in the permit.
- BH6S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia and alkalinity are below the limit specified in the permit.
- BH11S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia and alkalinity are below the limit specified in the permit.
- BH12S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia and alkalinity are below the limit specified in the permit.
- BH13S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia and alkalinity are below the limit specified in the permit.
- BH14S - There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia was below the limit specified in the permit.
The reported result for the alkalinity parameter was in breach of the limit specified in the permit. Note: the results for Q2 and Q4³ also indicate the limit was exceeded on those occasions.

¹ Primarily groundwater requirements set out in Table S3.3 and leachate levels.

² Letter dated 24th October 2012.

³ No results were submitted for Q3.

- *BH30 – Whilst this point was not identified as a compliance point in the original permit (table S3.3) it was suggested as new compliance point in the 2012 HRA review. We have therefore checked the results over this quarter for the three parameters with emission limits (Ammonia, Alkalinity and Chloride). These parameters were analysed during this quarter and were below the emission limits proposed.*

Compliance - Q1 Monitoring: The failure to monitor all the parameters specified in table S3.3. of the permit is a breach of condition 3.5.1c of the permit. Compliance classification scores (CCS) of 3 have been attributed to these breaches (g1 compliance heading). However, in accordance with of CCS scoring guidance we have consolidated these breaches into one compliance breach covering the Quarter 1 monitoring period. Condition 3.5.1c (g1) – Quarter 1 – CCS 3. **NOTE: This score has been suspended as the operator sought to remove these parameters following the 2012 HRA review and it appears that it was agreed in principle with the EA.**

Compliance – Q1 Emission Limit: The breach of the alkalinity emission limit at BH14s is contrary to condition 3.1.6 of the permit. A CCS score of 3 has been attributed to this breach (e2 compliance heading). Condition 3.1.6 (e2) – Quarter 1 – CCS 3. **NOTE: This score has been suspended as the operator sought to remove this monitoring location following the 2012 HRA review and it appears that it was agreed in principle with the EA.**

Q2 - Groundwater

Assessment against requirements of Table S3.3 of the permit.

- BH3S - The reported result for the mercury parameter in Q2 was in breach of the limit specified in the permit. No follow up samples were taken to investigate this breach were taken in Q3 or Q4. The results for the other reported parameters are below the limits specified in the permit.
- BH4S - The reported result for the ammonia parameter in Q2 was in breach of the limit specified in the permit. Note: the results for Q3 and Q4 indicate that levels returned to compliance. The results for the other reported parameters are below the limits specified in the permit.
- BH6S - The results for all reported parameters are below the limits specified in the permit.
- BH11S - The results for all reported parameters are below the limits specified in the permit.
- BH12S - There are no results for any parameter reported in Q2 for this monitoring point.
- BH13S – The results for all reported parameters are below the limits specified in the permit.
- BH14S – The reported result for the alkalinity parameter was in breach of the limit specified in the permit. Note: there were no results submitted in Q3, so it appears no follow up sample was taken. The results for Q4 also indicate the limit was exceeded in Q4.
- *BH30 – Whilst this point was not identified as a compliance point in the original permit (table S3.3) it was suggested as new compliance point in the 2012 HRA review. We have therefore checked the results over this quarter for the three parameters with emission limits (Ammonia, Alkalinity and Chloride). These parameters were analysed during this quarter and were below the emission limits proposed.*

Compliance – Q2 Monitoring: The failure to monitor all the parameters specified in table S3.3. of the permit is a breach of condition 3.5.1c of the permit. Compliance classification scores (CCS) of 3 have been attributed to these breaches (g1 compliance heading). However, in accordance with of CCS scoring guidance we have consolidated these breaches into one compliance breach covering the Quarter 2 monitoring period. Condition 3.5.1c (g1) – Quarter 2 – CCS 3 **NOTE: This score has been suspended as the operator sought to remove these parameters following the 2012 HRA review and it appears that it was agreed in principle with the EA.**

Compliance – Q2 Emission Limits: The breach of the alkalinity, ammonia and mercury emission limit at three separate monitoring points is contrary to condition 3.1.6 of the permit. However, in accordance with of CCS scoring guidance we have consolidated these breaches into one compliance breach covering the Quarter 2 monitoring period. Condition 3.1.6 (e2) – Quarter 2 – CCS 3 **NOTE: This score has NOT been suspended. The result for ammoniacal nitrogen at BH4S was above the original limit specified in the permit (3.12mg/l) and the revised limit (4 mg/l) proposed during the 2012 HRA review. For this reason, this ccs score will remain active.**

Q3 – Groundwater

Assessment against requirements of Table S3.3 of the permit.

- BH3S - There are no results for Cd, Hg or Cu in Quarter 3. The results for ammonia and alkalinity parameters have been submitted and these are below the limit specified in the permit.
- BH4S - There are no results for Cd, Hg or Cu in Quarter 3. The results for ammonia and alkalinity parameters have been submitted and these are below the limit specified in the permit.

- BH6S – There are no results submitted for BH6S in Q3, although another tab in the report indicates that mercury was sampled in this quarter. Therefore, this appears to be a reporting failure, but this needs to be confirmed by the operator. **Action**
- BH11S - There are no results submitted for B11S in Q3.
- BH12S - There are no results submitted for B12S in Q3.
- BH13S – There are no results submitted for B13S in Q3.
- BH14S – There are no results submitted for B14S in Q3.
- *BH30 – Whilst this point was not identified as a compliance point in the original permit (table S3.3) it was suggested as new compliance point in the 2012 HRA review. We have therefore checked the results over this quarter for the three parameters with emission limits (Ammonia, Alkalinity and Chloride). These parameters were analysed during this quarter and were below the emission limits proposed.*

Compliance – Q3 Monitoring: The failure to monitor all the parameters specified in table S3.3. of the permit is a breach of condition 3.5.1c of the permit. Compliance classification scores (CCS) of 3 have been attributed to these breaches (g1 compliance heading). However, in accordance with of CCS scoring guidance we have consolidated these breaches into one compliance breach covering the Quarter 3 monitoring period. Condition 3.5.1c (g1) – Quarter 3 – CCS 3

NOTE: This score has been suspended as the operator sought to remove these parameters/locations following the 2012 HRA review and it appears that it was agreed in principle with the EA.

Q4 - Groundwater

Assessment against requirements of Table S3.3 of the permit.

- BH3S - There are no results for Cd, Hg or Cu in Quarter 4.
The results for ammonia and alkalinity parameters have been submitted and these are below the limit specified in the permit.
- BH4S - There are no results for Cd, Hg or Cu in Quarter 4.
The results for ammonia and alkalinity parameters have been submitted and these are below the limit specified in the permit.
- BH6S - There are no results submitted for B6S in Q4.
- BH11S - There are no results for Cd, Hg or Cu in Quarter 4.
The results for ammonia and alkalinity parameters have been submitted and these are below the limit specified in the permit.
- BH12S - There are no results for any parameter reported in Q4.
- BH13S – The results for all reported parameters are below the limits specified in the permit.
- BH14S – There are no results for Cd, Hg or Cu in Quarter 1.
The results for ammonia was below the limit specified in the permit.
The reported result for the alkalinity parameter was in breach of the limit specified in the permit.
- *BH30 – Whilst this point was not identified as a compliance point in the original permit (table S3.3) it was suggested as new compliance point in the 2012 HRA review. We have therefore checked the results over this quarter for the three parameters with emission limits (Ammonia, Alkalinity and Chloride). These parameters were analysed during this quarter and were below the emission limits proposed.*

Compliance – Q4 Monitoring: The failure to monitor all the parameters specified in table S3.3. of the permit is a breach of condition 3.5.1c of the permit. Compliance classification scores (CCS) of 3 have been attributed to these breaches (g1 compliance heading). However, in accordance with of CCS scoring guidance we have consolidated these breaches into one compliance breach covering the Quarter 4 monitoring period. Condition 3.5.1c (g1) – Quarter 4 – CCS 3

NOTE: This breach has been suspended as the operator sought to remove these parameters following the 2012 HRA review and it appears that it was agreed in principle with the EA.

Compliance – Q4 Emission Limits: The breach of the alkalinity limit at BH14S is contrary to condition 3.1.6 of the permit. A CCS score of 3 has been attributed to this breach (e2 compliance heading). Condition 3.1.6 (e2) – Quarter 4 – CCS 3 **NOTE:** This breach has been suspended as the operator sought to remove this monitoring location following the 2012 HRA review and it appears that it was agreed in principle with the EA.

Leachate Levels Q1

Assessment against requirements of Table S3.1 of the permit.

- Leachate Level monitoring was undertaken in January to March to the frequencies and locations⁴ required by the permit.
- Leachate Levels were exceeded at Bio-cell A (L1), Cell 1 (L7) and Cell 2 (L8) for the entire duration of the Q1 monitoring period (39 breaches).
- Leachate levels in Bio-cell B (L6) were in breach of the permitted limits during the first two week of January, but compliant thereafter during this quarter.

Compliance – Q1

The failure to maintain leachate levels (during the Q1 monitoring period) in accordance with the limits set in the permit are a breach of conditions 2.8.1 and 3.1.2 of your permit. Compliance classification scores (ccs) of 3 will be allocated against the a1 compliance heading. In accordance with ccs scoring guidance the reported permit breaches applicable to these points have been consolidated into **one** score, covering the **Q1** reporting period i.e. one ccs score of 3 will be allocated to the breaches that occurred at these points over the January to March (2019) reporting period.

Leachate Levels Q2

Assessment against requirements of Table S3.1 of the permit.

- Leachate Level monitoring was undertaken in April to March to the frequencies and locations required by the permit.
- Leachate Levels were exceeded at Bio-cell A (L1) and Cell 1 (L7) for the entire duration of the Q2 monitoring period (26 breaches).
- Leachate levels in Cell 2 (L8) were in breach of the permitted limits during April and May, but compliant thereafter during this quarter.
- Leachate levels in Bio-cell B (L6) were compliant throughout the monitoring period

Compliance – Q2

The failure to maintain leachate levels (during the Q2 monitoring period) in accordance with the limits set in the permit are a breach of conditions 2.8.1 and 3.1.2 of your permit. Compliance classification scores (ccs) of 3 will be allocated against the a1 compliance heading. In accordance with ccs scoring guidance the reported permit breaches applicable to these points have been consolidated into **one** score, covering the **Q2** reporting period i.e. one ccs score of 3 will be allocated to the breaches that occurred at these points, over the April to June (2019) reporting period.

Leachate Levels Q3

Assessment against requirements of Table S3.1 of the permit.

- Leachate Level monitoring was undertaken in July to Sep to the frequencies and locations required by the permit.
- Leachate Levels were exceeded at Bio-cell A (L1) and Cell 1 (L7) for the entire duration of the Q3 monitoring period (26 breaches).
- Leachate levels in Cell 2 (L8) periodically breached the limit over the Q3 monitoring period (9 breaches).
- Leachate levels in Bio-cell B (L6) were compliant for most of the monitoring period with the exception of one event at the end of September (1 breach)

Compliance – Q3

The failure to maintain leachate levels (during the Q3 monitoring period) in accordance with the limits set in the permit are a breach of conditions 2.8.1 and 3.1.2 of your permit. Compliance classification scores (ccs) of 3 will be allocated against the a1 compliance heading. In accordance with ccs scoring guidance the reported permit breaches applicable to these points have been consolidated into **one** score, covering the **Q3** reporting period i.e. one ccs score of 3 will be allocated to the breaches that occurred at these points, over the July to August (2019) reporting period.

Leachate Levels Q4

Assessment against requirements of Table S3.1 of the permit.

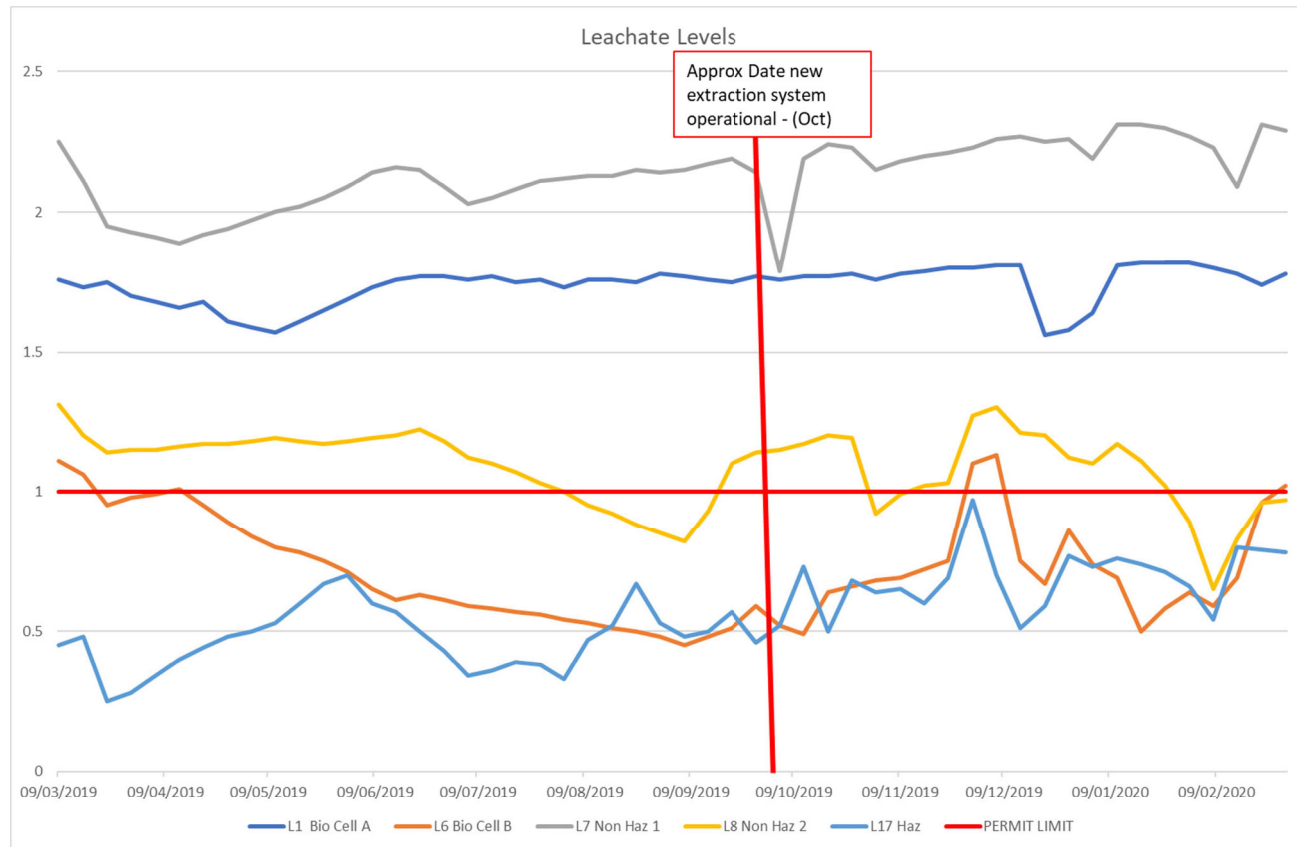
- Leachate Level monitoring was undertaken in Oct to Dec to the frequencies and locations required by the permit.
- Leachate Levels were exceeded at Bio-cell A (L1) and Cell 1 (L7) for the entire duration of the Q4 monitoring period (26 breaches).
- Leachate levels in Cell 2 (L8) continuously breached the limit over the start of Q4 monitoring period but then returned to compliance (8 breaches).
- Leachate levels in Bio-cell B (L6) were compliant for most of the monitoring period with the exception of two events one at the start and one at the end of September (2 breaches)

⁴ The monitoring point references for some of the wells identified in the permit (i.e. monitoring point location plan) differ and this plan will need to be revised as part of the next variation to the permit.

Compliance – Q4

The failure to maintain leachate levels (during the Q4 monitoring period) in accordance with the limits set in the permit are a breach of conditions 2.8.1 and 3.1.2 of your permit. Compliance classification scores (ccs) of 3 will be allocated against the a1 compliance heading. In accordance with ccs scoring guidance the reported permit breaches applicable to these points have been consolidated into **one** score, covering the **Q4** reporting period i.e. one ccs score of 3 will be allocated to the breaches that occurred at these points, over the Oct to Dec (2019) reporting period.

Leachate management comment: The operator have built and commissioned a new leachate extraction system, which we have been informed started operation in early October 2019. It is understood that not all cells are pumped continuously but pumping is on a rotational basis. The following graph shows the leachate levels for 2019 (and early 2020) within the landfill cells, against the compliance limit of 1m.



A recent permit variation also included a new improvement condition requiring the capping of the bio cells – this will need to be completed by Dec 2021. It is expected that a CQA plan for the capping works will be submitted this year. The operator will need to update their leachate level action plan **Action**.

Reporting

It appears that there are some deficiencies in the quarterly returns which need to be addressed.

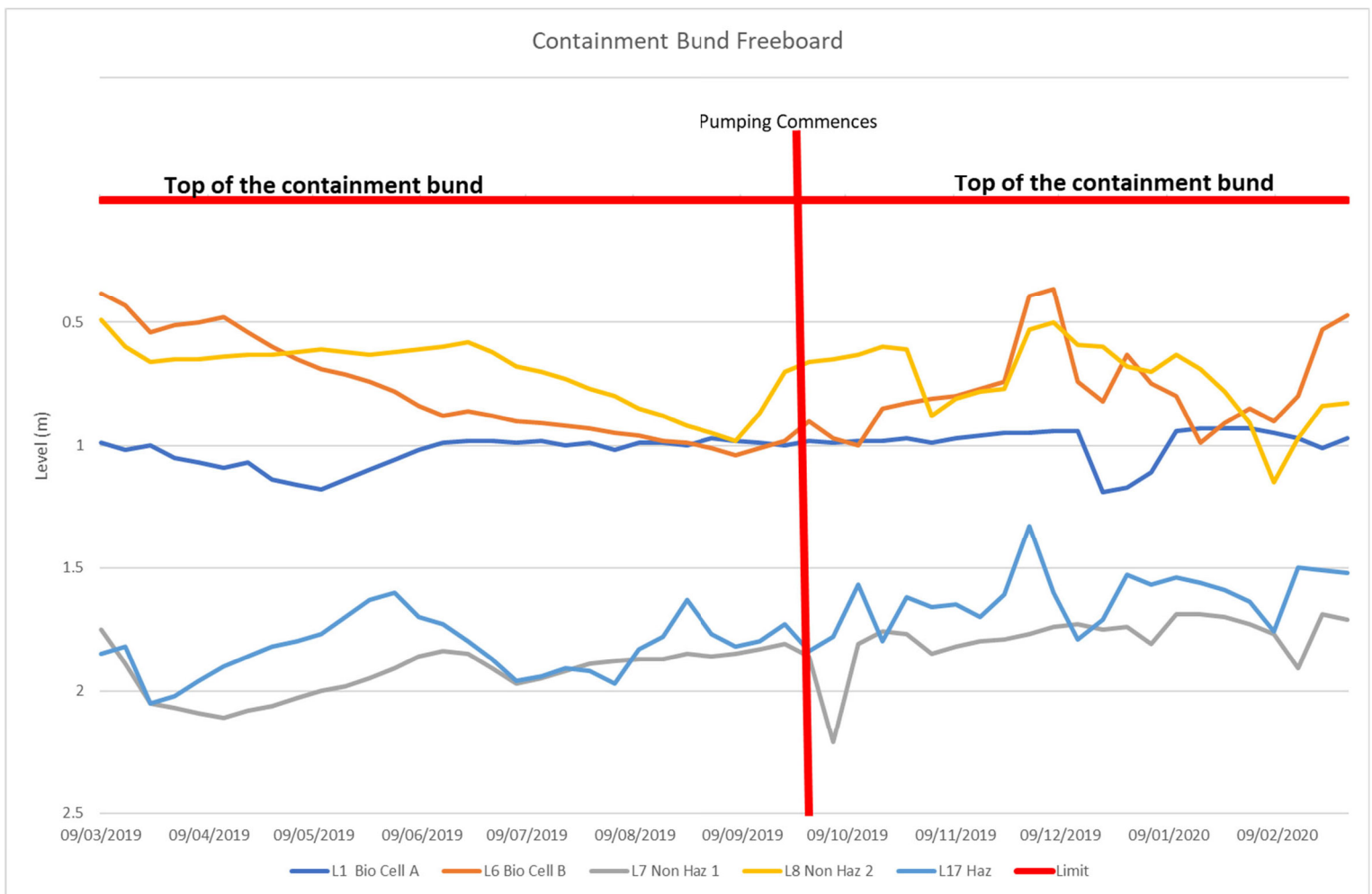
These include:

- inconsistent or differing monitoring point identifications – please where possible use the identification used in the permit and please ensure they are applied consistently over each quarter;
- the sampling date is not included on the reports, the full date need to be included;
- data is missing for some locations, however other tabs in the report suggest that some monitoring was indeed undertaken but not reported;
- where there has been an emission limit failure the operator should undertake a repeat test immediately (if the sample is still available) and schedule a re-sampling exercise (you should not be waiting for the next monitoring period);
- the operator is repeatedly failing to submit schedule 5 notifications for emission limit exceedances (although we have been receiving S5 leachate level notifications since January 2020).

Conclusion

As noted previously, it is increasingly apparent that the current monitoring framework set out in Schedule 3 of this permit (and the equivalent schedules in the sister landfills) need to be reviewed and updated. The operator has been asked to submit a permit application to vary all three permits to update or revise the permit's monitoring schedule. NRW and TATA have scheduled a meeting at the end of March to start discussions on the scope of this work.

Progress with leachate management control is difficult to assess as the new leachate extraction system only commenced in October 2019 and heavy rainfall over the winter makes an assessment difficult. Based on the data submitted there is no evidence to indicate that the containment bund was over-topped in any of the cells due to elevated leachate levels (see graph below). However, in December the level in bio-cell B was within 36cm of overtopping the containment bund. A smaller spike was also seen in February 2020. It is critical TATA continue to implement their emergency measures to maintain and manage the elevated leachate levels to ensure the containment of leachate. These measures need to be reviewed in light of this winter's experiences to ensure that there is no containment failure whilst the site is attempting to bring the leachate levels back into control. NRW have inserted a new improvement condition into the site's permit that will require the capping of most of the bio-cells to be completed by December 2021. It should be noted that NRW reserve the right to require⁵ interim measures (e.g. temporary capping etc.) sooner if there is evidence that the current interim controls are not adequate to maintain leachate containment. The operator need to review and update their leachate level action plan.



2019 Annual Monitoring Report

Whilst this CAR report was being compiled, the operator submitted the 2019 monitoring interpretation report (received February 2020⁶). We have undertaken a cursory review of this submission.

The report provides a detailed and thorough assessment and trending of the 2019 data collected for the non-hazardous landfill. The report make several recommendations including:

- Continued implementation of measures to reduce leachate levels as soon as practical
NRW comment: This action is fully endorsed by NRW - see comments on improved leachate management above.

⁵ e.g. through the issue of enforcement notices.

⁶ Extension previously agreed with the operator

- *Many of the borehole headworks require repair due to corrosion to enable them to be closed. Specifically, BH1, BH2, BH3, BH4, BH6, BH9, BH10, BH12, BH15, BH16, BH17, BH18 and BH19 require improvement. Vegetation near several sampling points requires routine clearance to enable continual safe access. Site weather stations should be routinely maintained to ensure they continue to operate satisfactorily.*
NRW comment: The permit requires that all monitoring infrastructure is maintained and if damaged repaired or replaced promptly. Safe access to all monitoring points must always be maintained. These need to be actioned immediately.

The 2019 Annual report also refers to a previous annual report (2017), which included proposed changes to some of the permit's emission monitoring frequencies, parameters and in some cases emission limits. **These have not been accepted by NRW** and any changes will need to be addressed and agreed as part of the forthcoming permit variation exercise.

2017 Hydrogeological Risk Assessment (HRA) review

It has come to light that the 2017 HRA review for the non-hazardous landfill has not been assessed by NRW. I have therefore asked NRW's geoscience team to start an assessment shortly and will provide feedback as soon as possible to the operator.

Permit variation – consolidation

As noted above, the deficiencies in this and the other landfill permits⁷ can only be satisfactorily addressed through a revision and update of all three landfill permits. As part of these variation applications the operator is invited to now consider whether this would be an opportune moment to consolidate the permits.

End of section 2

Note: Novel Coronavirus (COVID -19)

During the compiling of this report an escalation in the threat posed by the novel coronavirus (COVID – 19) pandemic, has resulted in the imposition of several stringent measures across the United Kingdom. These measures to control and reduce the spread and impact of the disease are having an impact on both NRW's and the operator's normal operating practices. At the time of writing all routine regulatory visits have been suspended by the regulator. The situation is dynamic and extremely fluid however these restrictions are expected to remain in place for several weeks if not longer. During this pandemic there will be a continued expectation that operators continue to meet the conditions of their permits. Where the operator has identified an issue that is likely to result in permit non-compliance or increased environmental risk, the operator is expected to speak to the regulator at the earliest opportunity.

⁷ Morfa Closed Landfill (AP3292LT) – Morfa Non-Hazardous Landfill (BV7311IE) - Morfa Hazardous Landfill (BW2692IM)

Compliance Assessment Report

Report ID: CAR_NRW0036308

This form will report compliance with your permit as determined by an NRW officer

Site	Morfa Non-Hazardous Landfill	Permit Ref	BV7311IE
Operator/Permit holder	Tata Steel UK Limited	Date	7 th February 2020

Section 3 – Enforcement Response

Only one box should be ticked

You must take immediate action to rectify any non-compliance and prevent repetition.

Non-compliance with your permit conditions constitutes an offence and can result in criminal prosecutions and/or suspension or revocation of a permit. Please read the detailed assessment in Section 2 and the steps you need to take in Section 4 below.

Other than the provision of advice and guidance, at present we do not intend to take further enforcement action in respect of the non-compliance identified above. This does not preclude us from taking enforcement action if further relevant information comes to light or advice isn't followed.

In respect of the above non-compliance you have been issued with a warning. At present we do not intend to take further enforcement action. This does not preclude us from taking additional enforcement action if further relevant information comes to light or offences continue.

x

We will now consider what enforcement action is appropriate and notify you, referencing this form.

Section 4 – Action(s)

This section summarises the actions identified during the assessment along with the timescales for when they will need to be completed.

Criteria Ref.	CCS Category	Action required/ advised	Due Date
See Section 1 above			
e2 & g1	3	Consolidate and update permit monitoring tables and submit application to vary permit.	No deadline specified at present. Timetables to be discussed at TATA/NRW skype meeting - March.
		TATA to ensure that all future monitoring submissions: • use correct and consistent monitoring identification • specify the sampling date • submit data for all monitoring points TATA to ensure that: • where there has been an emission limit failure the operator should undertake a repeat test immediately (if the sample is still available) and schedule a re-sampling exercise; • schedule 5 notifications are submitted in accordance with the permit.	Immediate (i.e. Quarter 2 (Apr 2020) onwards)
		Tata to provide missing Q3 data for BH6s	Within 14 days of the issue of this report
a1	3	Review and update leachate level action plan – considering matters covered in section 2.	Within 14 days of the issue of this report
		Submit CQA plan for capping of bio cells.	As soon as practicable but no later than December 2020
		Undertake necessary repairs and continued maintenance of monitoring infrastructure. • Specifically: repairs to the headworks of the following BH1, BH2, BH3, BH4, BH6, BH9, BH10, BH12, BH15, BH16, BH17, BH18 and BH19; • Site weather stations should be repaired and maintained	Within four weeks from the issue of this report (if not already completed). Ongoing thereafter
		Vegetation near several sampling points requires routine clearance to enable continual safe access.	Prior to next scheduled sampling exercise and ongoing thereafter.

If you are unable to meet these deadlines, please contact your inspector immediately to discuss the possibility of extensions.

Section 5 – Compliance notes for the Operator

To ensure you correct actual or potential non-compliance we may

- Advise on corrective actions verbally or in writing
- Require you to take specific actions verbally or in writing
- Issue a notice
- Require you to review your procedures or management system
- Change some of the conditions of your permit
- Decide to undertake a full review of your permit

Any breach of a permit condition is an offence and we may take legal action against you

- We will normally provide advice and guidance to assist you to come back into compliance either after an offence is committed or where we consider that an offence is likely to be committed. This is without prejudice to any other enforcement response that we consider may be required.
- Enforcement action can include the issue of a formal caution, prosecution, the service of a notice and/or suspension or revocation of the permit.

See our Enforcement and Civil Sanctions guidance for further information

Non-compliance scores and categories

CCS category	Description	Score
C1	A non-compliance that could have a major environmental effect	60
C2	A non-compliance which could have a significant environmental effect	31
C3	A non-compliance which could have a minor environmental effect	4
C4	A non-compliance which has no potential environmental effect	0.1

Operational Risk Appraisal (Opra) - Compliance assessment findings may affect your Opra score and/or your charges. This score influences the resource we use to assess permit compliance.

Section 6 – General information

Data protection notice

The information on this form will be processed by the Natural Resources Wales (NRW) to fulfil its regulatory and monitoring functions and to maintain the relevant public register(s). The NRW may also use and/or disclose it in connection with:

- Offering/providing you with its literature/services relating to environmental matters
- Consulting with the public, public bodies and other organisations (e.g. Health and Safety Executive, local authorities) on environmental issues
- Carrying out statistical analysis, research and development on environmental issues
- Providing public register information to enquirers
- Investigating possible breaches of environmental law
- Assessing customer service satisfaction and improving its service
- Freedom of Information Act/Environmental Regulations request

The NRW may pass it on to its agents/representatives to do these things on its behalf. You should ensure that any persons named on this form are informed of the contents of this data protection notice.

Disclosure of information

The NRW will provide a copy of this report to the public register(s). However, if you consider that any information contained in this reports should not be released to the public register(s) on the grounds of commercial confidentiality, you must write to your local area office within twenty working days of receipt of this form indicating which information it concerns and why it should not be released, giving your reasons in full.

Customer charter

What can I do if I disagree with this compliance assessment report?

If you are unable to resolve the issue with your site officer, you should firstly discuss the matter with officer's line managers using the informal appeals procedure. If you wish to raise your dispute further through our official Complaints and Commendations procedure, phone our general enquiry number 0300 065 3000 (Mon to Fri 08.00 – 18.00) and ask for the Customer Contact team or send an email to enquiries@naturalresourceswales.gov.uk. If you are still dissatisfied you can make a complaint to the Public Services Ombudsman for Wales. For advice on how to complain to the Ombudsman phone their helpline on 0845 607 0987.

Welsh Language

If you would like this form in Welsh please contact your Regulatory Officer.

National Permitting Team
Natural Resources Wales

Date: 20 January 2021
Subject: Variation of Morfa Non-hazardous Landfill (EPR/BV7311IE)

Tata Steel wishes to vary its Non-hazardous landfill permit with the primary goal of creating a consolidated permit that has up to date information on monitoring frequencies, locations, analytical suites and to update some of the language in the permit to ensure on-going compliance. Over the years of operation that have been several small changes made in discussion with the regulator in order to make sampling more practical or to eliminate unnecessary monitoring due to trends or experience from operating the landfill.

Tata steel have discussed these changes with the local area officer, Neil Herbert, and have worked in conjunction to produce Schedules that accurately represent what monitoring should be conducted across all monitoring points. Some of the emission limits have been altered but these were first suggested to NRW in 2017 as part of the HRA and annual monitoring report. There are groundwater limits for both Chloride and Arsenic but some of the old limits have been removed as they are not representative of there being an issue with the landfill. The generic carbon dioxide emission limits have also been removed but methane limits remain unaltered. It should also be noted that monitoring frequency has been adjusted from monthly to quarterly. Although the waste mass has a potential to produce landfill gas, monitoring has shown that gas levels are low and do not exceed trigger levels. This, coupled with the remote location and lack of nearby receptors, means the risk of gas is very low.

Due to changes in how the Recharge trench system works across the Morfa landfills the monitoring frequency in the recharge chambers is required to be altered. The non-hazardous landfill is not currently capped and therefore this system is not currently active. However once capping has been completed the requirements in Table S4.2 will be put into operation. Due to the change from an active to a passive system it is no longer possible to monitoring on a continual basis as there is no power available on the site. Tata Steel will propose updated targets and monitoring frequency prior to commissioning the system. Once this has been done and we have consistent monitoring data the frequency will be reduced.

Tata Steel has requirements to monitor the surface emissions of methane in Table S4.5. We wish to ask that the wording of this requirement be examined. As mentioned previously, the site is currently not capped but will begin to be in the near future and

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therefore this monitoring is not currently undertaken. However, as written it is not possible to comply with this requirement using conventional technique or incurring significant cost. The standard technique for a survey of this kind is a gazmat survey, which allow for specific detection of methane emitted from the surface of the landfill. The output of this type of survey gives a number of readings across the site in ppm of methane. It does not however give a flux value e.g. ppm per m² per second as required by the permit. The only way to do this is via flux box monitoring, which is an antiquated form of monitoring and when conducted as per the guidance is a very expensive operation given the number of samples and time required to do each test. Tata steel wish to conduct a Gazmat/FID walkover as suggested in the text but wish to find a method where the results would be valid in the permit. Either by removal of flux values or a methodology that allows the calculation of flux from a FID walkover, which is the industry standard.

Table S4.6 has been removed in discussion with the local officer, which details additional monitoring requirements in the internal landfill cells. The final table has also removed which detailed the dust deposition monitoring. This was because the dust deposition could not be linked directly to the landfill. The site is located in a very sandy area and there are multiple sources of dust. It has been decided that this monitoring does not provide any useful information and has been discontinued.

The groundwater monitoring suite has been updated primarily to move some parameters from the annual suite into the quarterly suite to concentrate on the most important chemical parameters. Some monitoring wells were on the original permit plan but were never installed and therefore the monitoring points have been updated to reflect the existing monitoring network.

Table S4.1 Leachate level limits and monitoring requirements

Monitoring point reference/ Description	Limit	Monitoring frequency	Monitoring method
L1, L2, L3, L4, L5 W10, W11, L6, L7 and L8 as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	1m above base of leachate monitoring point	Weekly (reducing to monthly when landfill is fully capped)	Accurate to 0.01m relative to Ordnance Datum. Unless otherwise agreed in writing with Natural Resources Wales, monitoring methods used shall be in accordance with Environment Agency document 'Guidance on monitoring of landfill leachate, groundwater and surface water (LFTGN02).
and all subsequent new monitoring points installed within cells			

Table S 4.2 Point source emissions to water (other than sewer) – emission limits and monitoring requirements

Emission point Ref. & Location	Parameter	Source	Limit (inc unit)	Monitoring Frequency
Recharge Chamber C as shown on drawing reference: Figure 8 Recharge Trench Alignment Revision 0, Dated 12.07	Water Level	Surface Water Ponds	In accordance with Pre-Operational Condition reference 1 of Table S1.4	In accordance with Pre-Operational Condition reference 2 of Table S1.4
Recharge Chamber D as shown on drawing reference: Figure 8 Recharge Trench Alignment Revision 0, Dated 12.07	Water Level	Surface Water Ponds	In accordance with Pre-Operational Condition reference 1 of Table S1.4	In accordance with Pre-Operational Condition reference 2 of Table S1.4
Recharge Chamber E, F1 and F2 as shown on drawing reference: Figure 8 Recharge Trench Alignment Revision 0, Dated 12.07	Water Level	Surface Water Ponds	In accordance with Pre-Operational Condition reference 2 of Table S1.4	In accordance with Pre-Operational Condition reference 2 of Table S1.4
Recharge Chamber C, D, E, F1 and F2 as shown on drawing reference: Figure 8 Recharge Trench Alignment Revision 0, Dated 12.07	Chemical Parameters as outlined with Pre-Operational Condition reference 2 of Table S1.4	Surface Water Ponds	In accordance with Pre-Operational Condition reference 3 of Table S1.4	In accordance with Pre-Operational Condition reference 2 of Table S1.4

* Unless otherwise agreed in writing with Natural Resources Wales

Table S4.3: Trigger levels for emissions into groundwater

Monitoring point reference	Parameter	Limit (including unit)	Reference Period	Monitoring frequency
BH3S, BH4S, BH6S, BH30S (Shallow Aquifer) as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	Chloride	200 (mg/l)	Spot Sample	Quarterly
	Arsenic	50 (ug/l)		

Table S4.4 Landfill gas in external monitoring boreholes – limits and monitoring requirements

Monitoring point Ref. /description	Parameter	Limit (including units)	Monitoring frequency	Monitoring standard or method
Boreholes GA 7 to 12 and 15 as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	Methane	1.0%	Quarterly	Monitoring to be carried out in accordance with Environment Agency Document 'LFTGN03: Guidance on Management of Landfill Gas' unless otherwise agreed with Natural Resources Wales
Borehole GA 16 as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	Methane	6%		
GA 7 to 12, 15 and 16 as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	Carbon Dioxide	No Limit		
	Oxygen	No Limit		
	Hydrogen Sulphide	No Limit		
	Atmospheric pressure	No Limit		
	Differential Pressure	No Limit		
	Temperature	No Limit		
	Meteorological data	No Limit		

Table S4.5 Landfill gas from capped surfaces – limits and monitoring requirements

Monitoring point Ref. /description	Parameter	Limit (including unit)	Monitoring frequency	Monitoring Standard or method
Permanently capped zone	Average methane flux and total methane emission	Average zone emission rate of 0.001 mg/m ² /second	Annually	Flame ionisation detector walkover, flux box or as otherwise agreed in writing with Natural Resources Wales. Alternatively as per LFTGN 07 Version 2, March 2011
Temporarily capped zone	Average methane flux and total methane emission	Average zone emission rate of 0.1 mg/m ² /second	Annually ¹	Flame ionisation detector walkover, flux box or as otherwise agreed in writing with Natural Resources Wales.. Alternatively as per LFTGN 07 Version 2, March 2011

Note: If a cap has previously been shown compliant and there have been no significant physical changes in the gas management during the year, a detailed walkover survey with an FID can be used to demonstrate that the surface emissions are under control. If this survey shows no change in the pattern of methane emission, it may be used as the annual survey. The values for flux and total methane emissions measured in the previous year may be reported and a fresh flux box survey is not necessary. If the zone remains stable, the results of a full walkover survey may be accepted as the site report for a period of four years before a further quantitative flux box survey is required.

Table S4. 6 Landfill gas – other monitoring requirements

Emission point reference or source or description of point of measurement	Parameter	Monitoring frequency	Monitoring standard or method	Other specifications

Table S4.7 Leachate– other monitoring requirements

Emission point reference or source or description of point of measurement	Parameter	Monitoring frequency	Monitoring standard or method
L1, L6, L7 and L8 as shown on as shown on Drawing “2110r1v1d1220 MNHL Monitoring Network December 2020” and all subsequent new monitoring points installed within cells (one per cell).	pH,	Quarterly	Unless otherwise agreed in writing with Natural Resources Wales. Monitoring methods used shall be in accordance with Environment Agency document ‘Guidance on monitoring of landfill leachate, groundwater and surface water’ (LFTGN02)
	Electrical Conductivity,		
	Ammoniacal Nitrogen,		
	Arsenic		
	Boron		
	Copper,		
	Sodium		
	Fluoride		
	Nitrates and Nitrites		
	Cadmium,		
	Phosphates		
	Total Alkalinity,		
	Potassium		
	Molybdenum		
	Selenium		
	Vanadium		
	Chloride,		
	Calcium,		
	Chromium,	Annual	
	Iron,		
	Lead,		
	Mercury		
	Zinc,		
	Magnesium,		
	Sulphate,		
	Organohalogens (volatile organic compounds),		
	Semi-volatile organic compounds		

Table S4.8 Surface water – other monitoring requirements

Emission point reference or source or description of point of measurement	Parameter	Monitoring frequency	Monitoring standard or method	Other specifications
SW Gauge 1, SW Gauge 4, SW Gauge 5, SW Gauge 6 as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	Water Level	Monthly (unless otherwise agreed in writing with the Agency).	Unless otherwise agreed in writing with Natural Resources Wales., monitoring methods	
Margam Moors: SW1, SW4, SW5 and SW6 as shown on as shown on Drawing "2110r1v1d1220 MNHL Monitoring Network December 2020"	pH	Quarterly	used shall be in accordance with Environment Agency document 'Guidance on monitoring of landfill leachate, groundwater and surface water' (LFTGN02)	
	Electrical Conductivity			
	Ammoniacal Nitrogen			
	Cadmium			
	Calcium			
	Total Alkalinity			
	Chloride			
	Arsenic			
	Boron			
	Copper			
	Fluoride			
	Phosphate			
	Molybdenum			
	Selenium			
	Vanadium			
	Nitrate			
	Nitrite			
	Sodium			
	Potassium			
Pond 1 as identified on drawing reference: Figure 6 Capping Construction Phasing (reference 629.1/0/1207, Revision 0) (specific sampling location to be agreed in writing with the Agency on completion of construction)	Water Levels	Quarterly		
	Ammoniacal Nitrogen,			
	Arsenic			
	Boron			
	Copper			
	Cadmium			
	Calcium			
	Chloride			
any additional monitoring points agreed in writing with Natural Resources Wales	Electrical Conductivity,			
	Fluoride			
	Molybdenum			
	Nitrates and Nitrites			
	pH,			
	Phosphates			
	Potassium			
	Selenium			
	Sodium			
	Total Alkalinity			
	Vanadium			
	Ammoniacal Nitrogen			
Recharge Chambers C, D, E, F1 & F2 as shown on drawing	pH	Monthly for first twelve months		
	Electrical Conductivity			

reference: Figure 8 Recharge
Trench Alignment Revision 0,
Dated 12.07

Ammoniacal Nitrogen

Arsenic

Boron

Sodium

Fluoride

Nitrates

Nitrites

Cadmium

Phosphates

Total Alkalinity

Potassium

Molybdenum

Selenium

Vanadium

Chloride

Calcium

of operation.

Quarterly
thereafter.

Table S4.9 Groundwater – other monitoring requirements

Emission point reference or source or description of point of measurement	Parameter	Monitoring frequency	Monitoring standard or method
Piezometers:- P1 to P24 as shown on as shown on Drawing “2110r1v1d1220 MNHL Monitoring Network December 2020”	Groundwater Level	Monthly	Unless otherwise agreed in writing with Natural Resources Wales, monitoring methods used shall be in accordance with Environment Agency document ‘Guidance on monitoring of landfill leachate, groundwater and surface water’ (LFTGN02)
Groundwater Boreholes: BH1, BH2,BH3S, BH4S, BH6S, GWT3a, BH17SBH18S, BH19S, BH20S, , BH30 (Shallow Aquifers) as shown on as shown on as shown on Drawing “2110r1v1d1220 MNHL Monitoring Network December 2020”	Groundwater Level	Quarterly	
	pH		
	Electrical Conductivity		
	Ammoniacal Nitrogen		
	Cadmium		
	Calcium		
	Total Alkalinity		
	Chloride		
	Arsenic		
	Sodium		
	Fluoride		
	Nitrate		
	Nitrite		
	Phosphate		
	Boron		
	Potassium		
Molybdenum			
Selenium			
Vanadium			
Groundwater Boreholes: BH1, BH2S BH2D, BH3S, BH3D, BH4S, BH4D, BH6S, BH6D, BH10S, BH10D, BH11S, BH11D, BH12S, BH12D, BH13S, BH13D, BH13S, BH14D, GWT3a, BH17S, BH17D BH18S, BH18D, BH19S, BH19D BH20S, BH20D, BH30 (Shallow Aquifers and Deep Aquifers) as shown on as shown on Drawing “2110r1v1d1220 MNHL Monitoring Network December 2020”	Chromium	Annually	
	Copper		
	Iron		
	Lead		
	Mercury		
	Zinc		
	Magnesium		
	Sulphate		
	Organohalogens (volatile organic compounds)		
	Semi-volatile organic compounds.		

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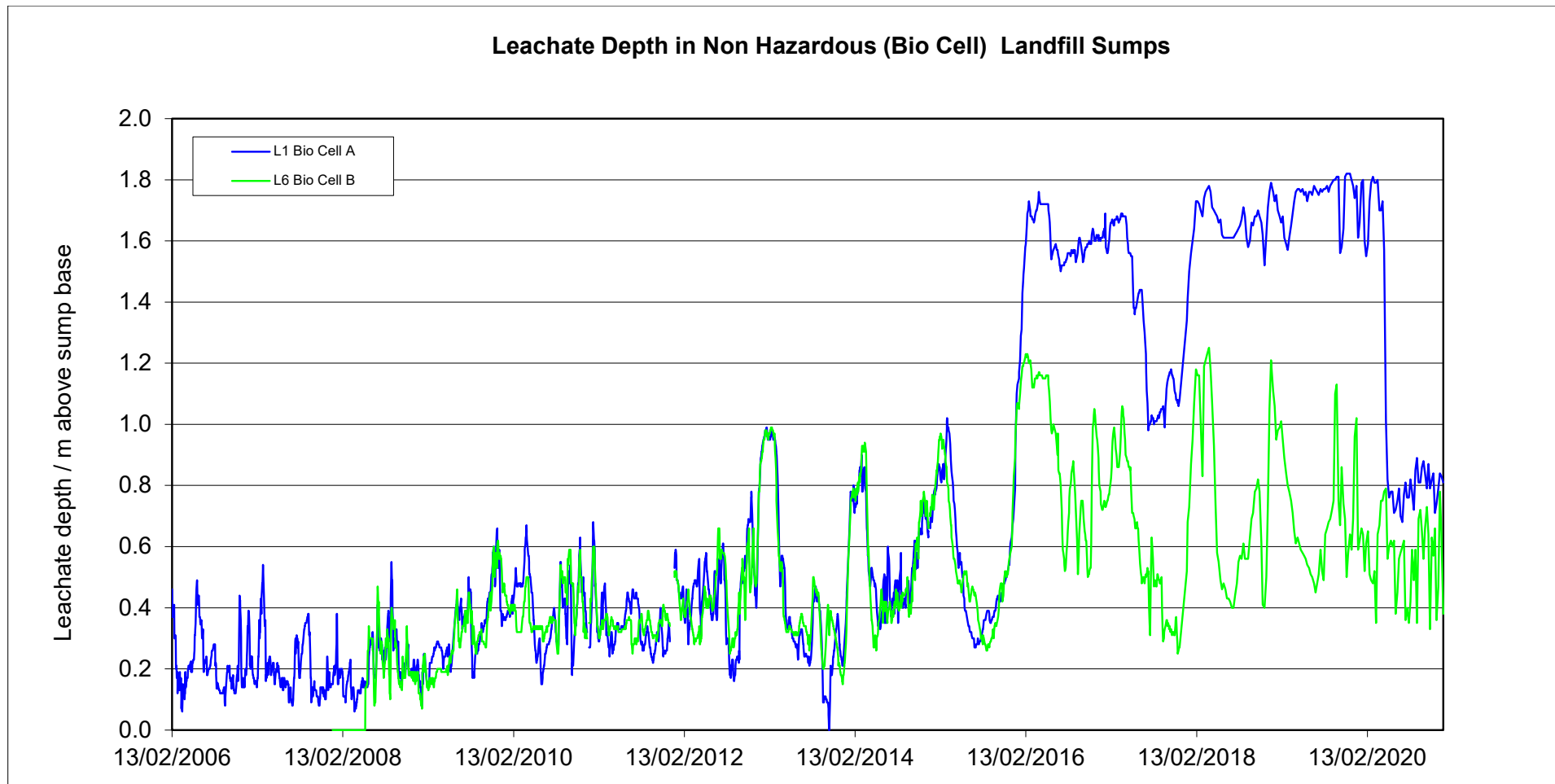
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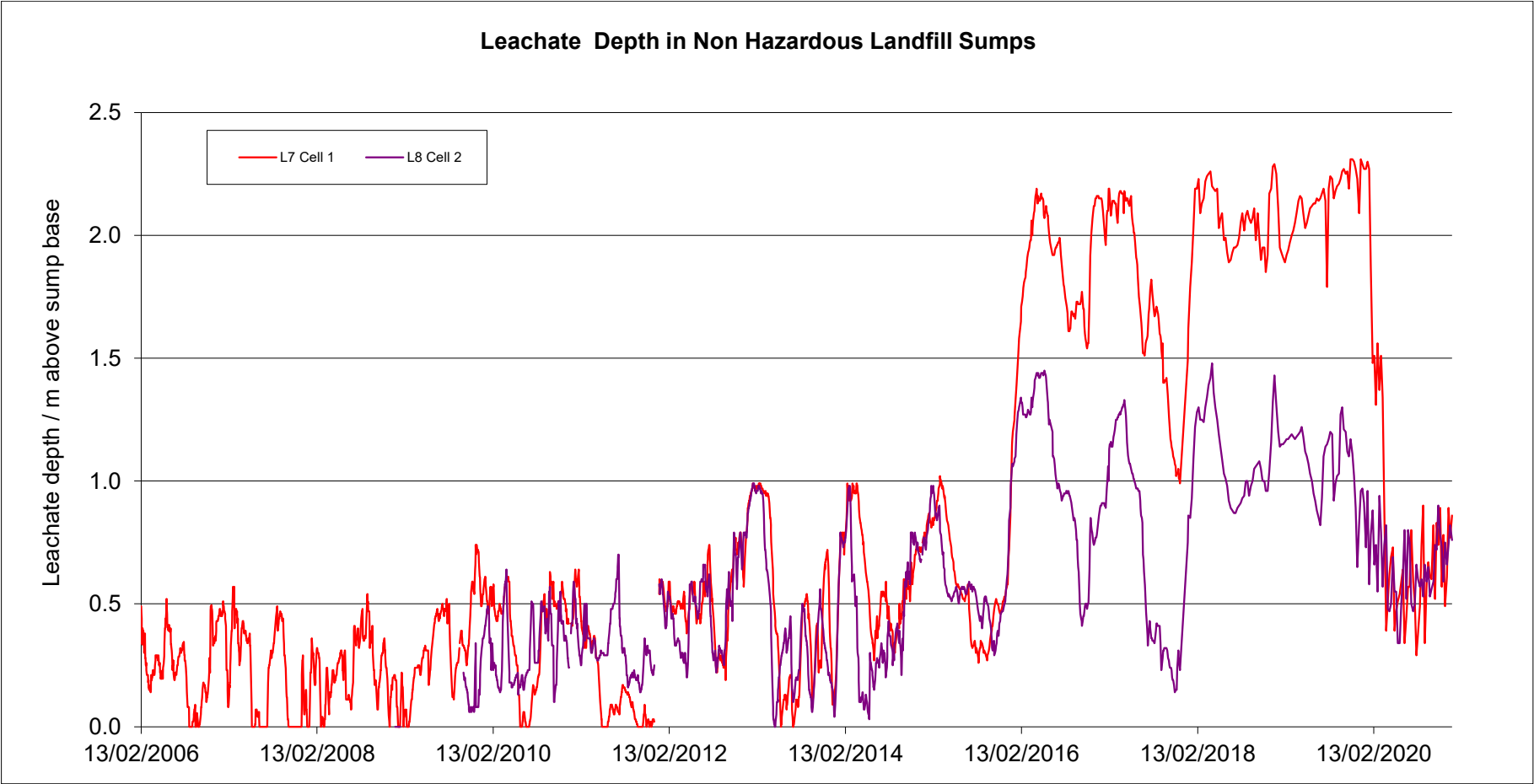
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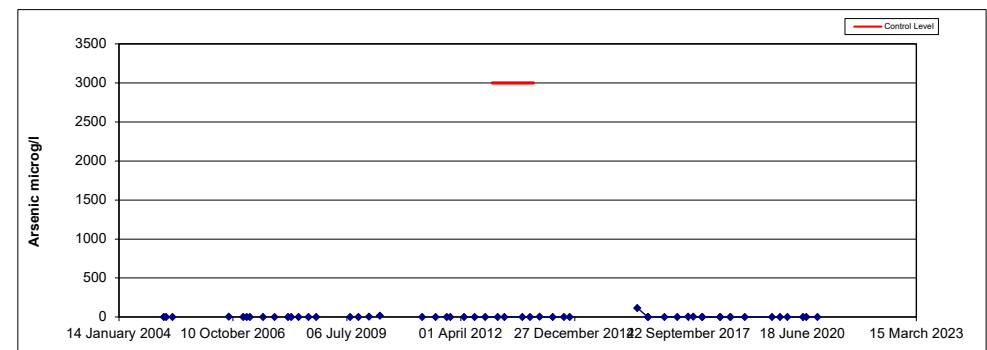
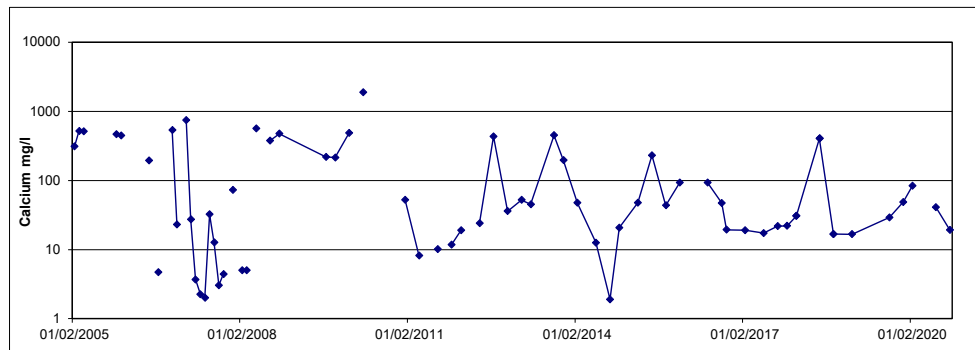
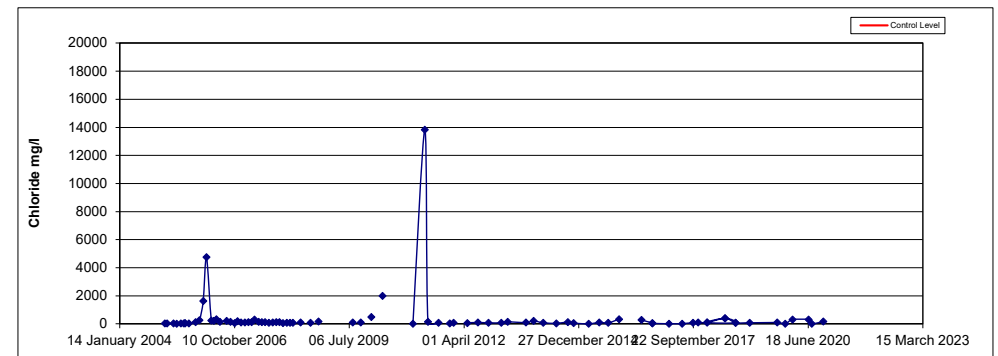
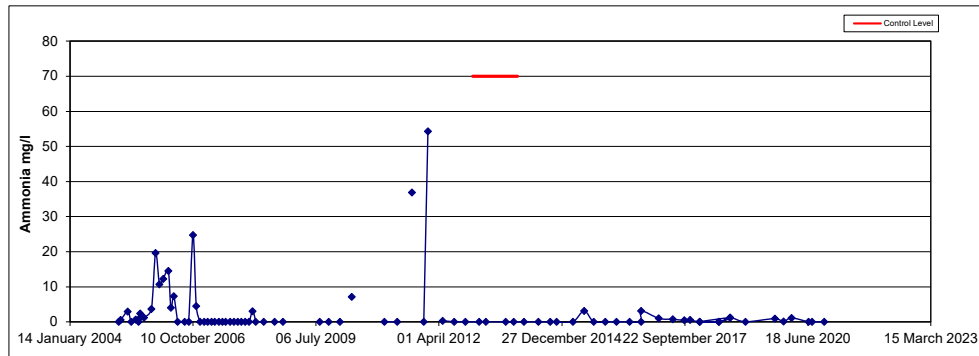
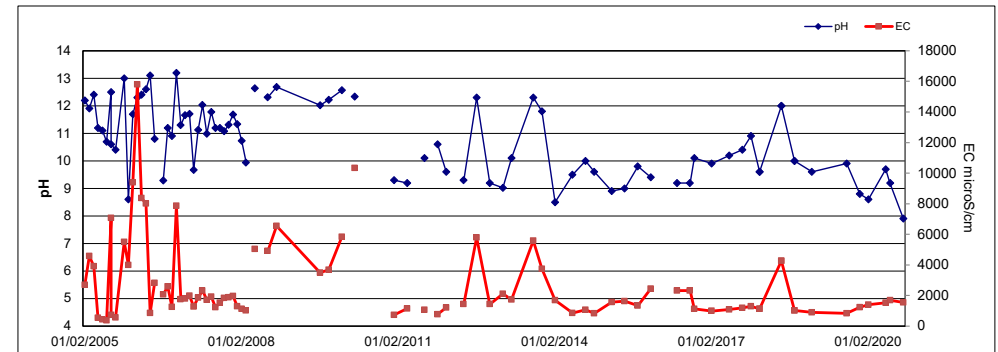
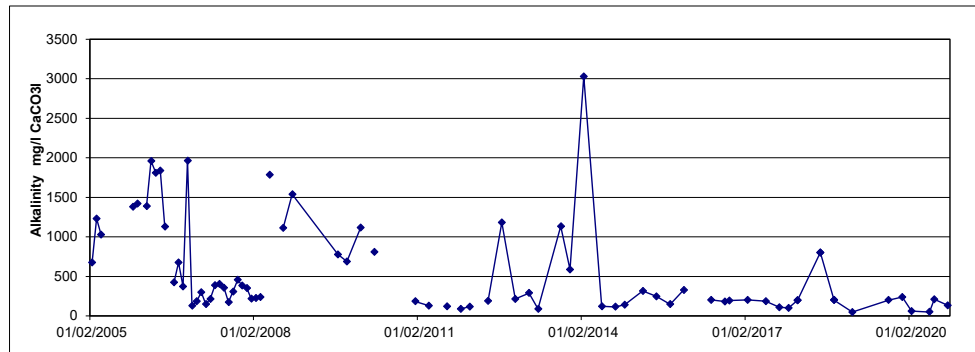
**2020 Annual Review of
Environmental
Monitoring**

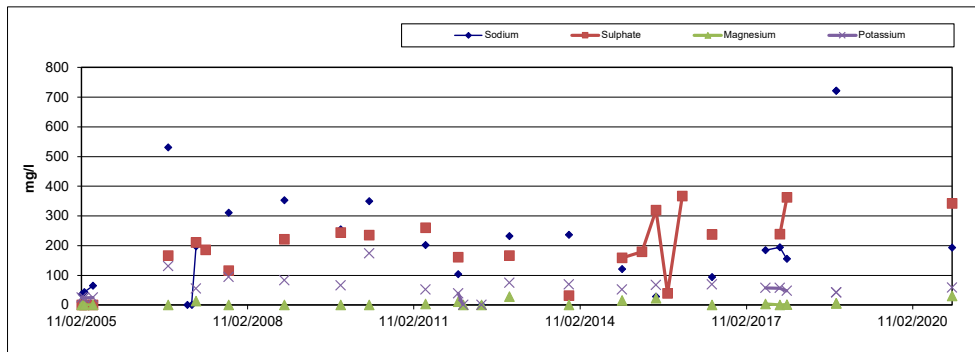
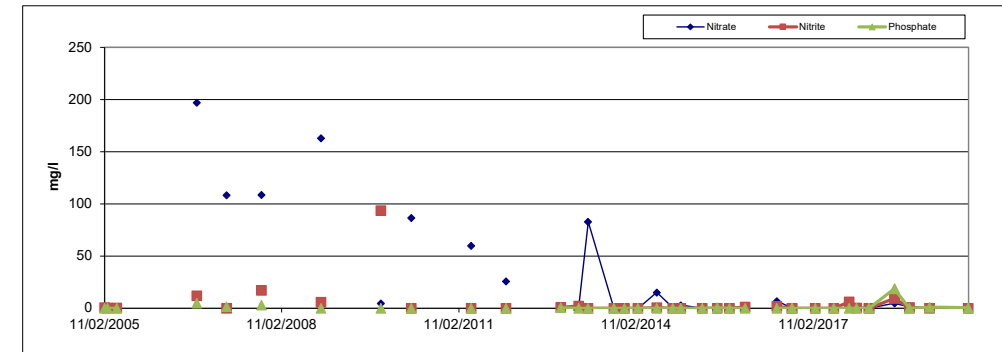
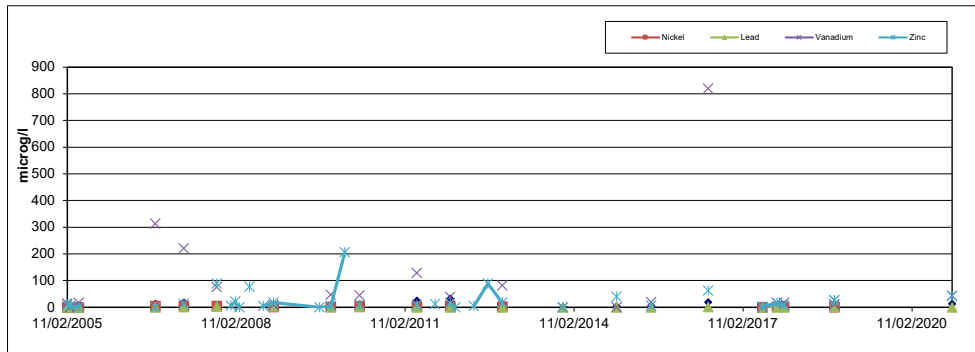
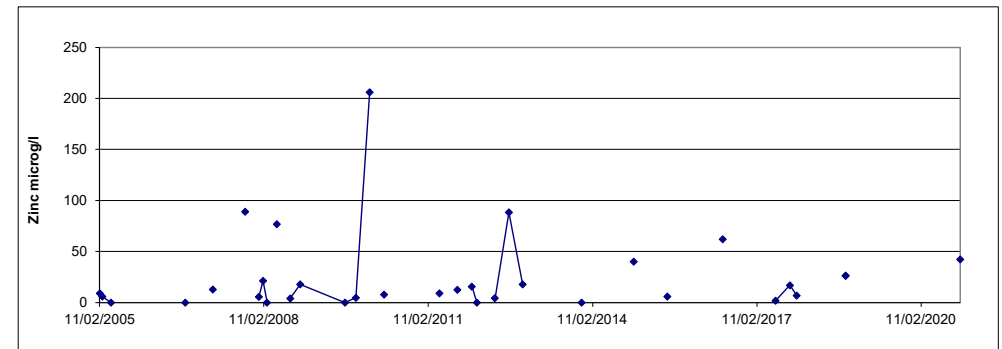
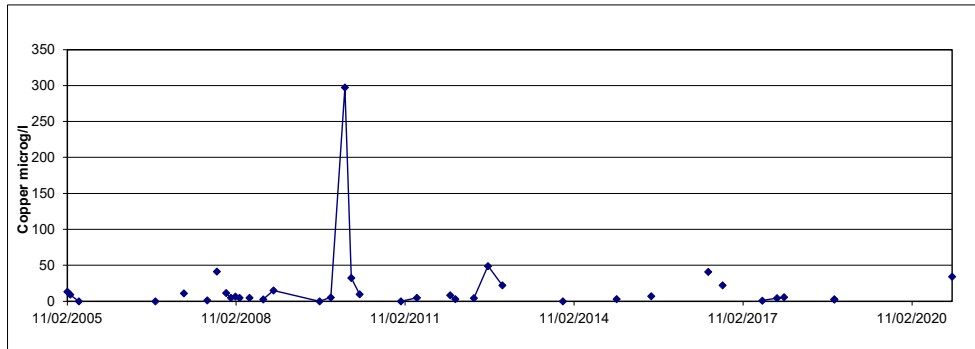
**Appendix 3
Temporal Variation of
Leachate Levels and
Leachate Pumping
Volumes**

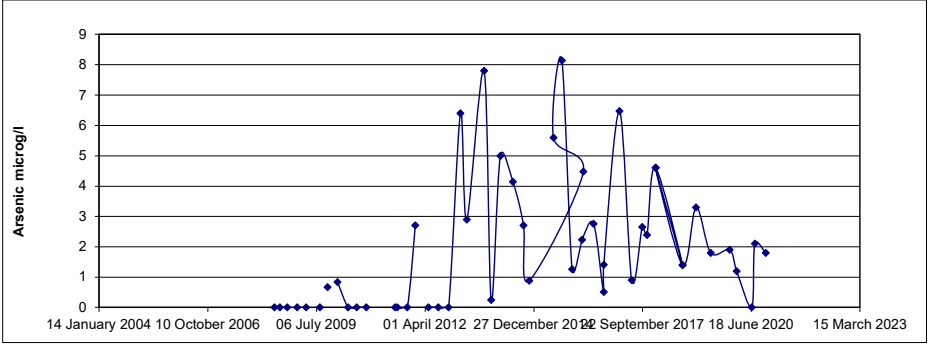
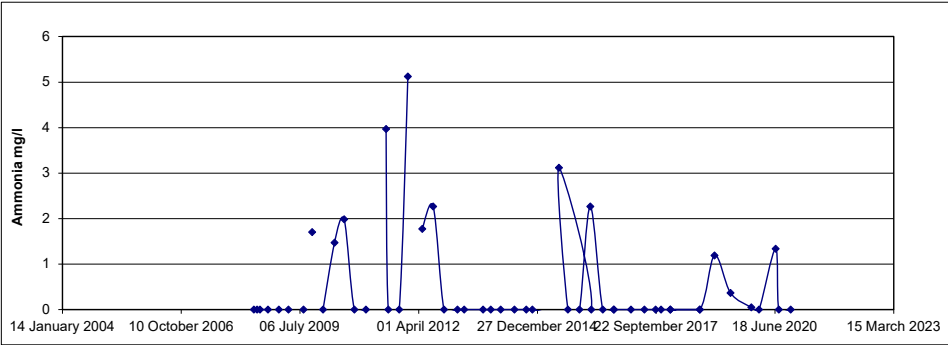
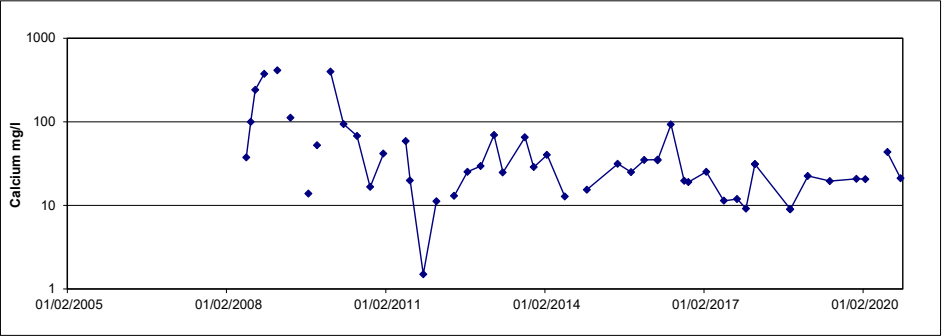
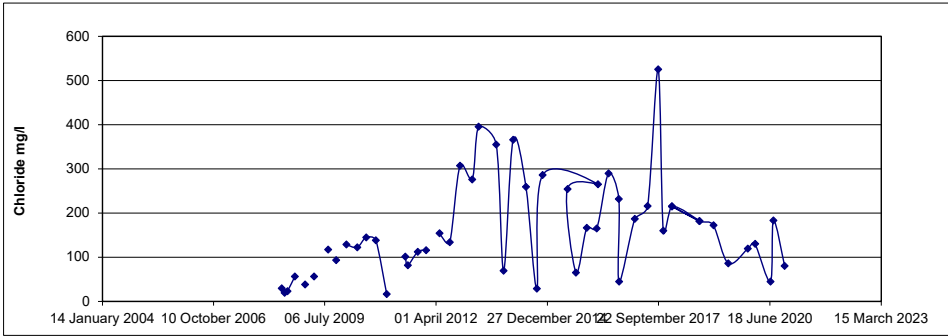
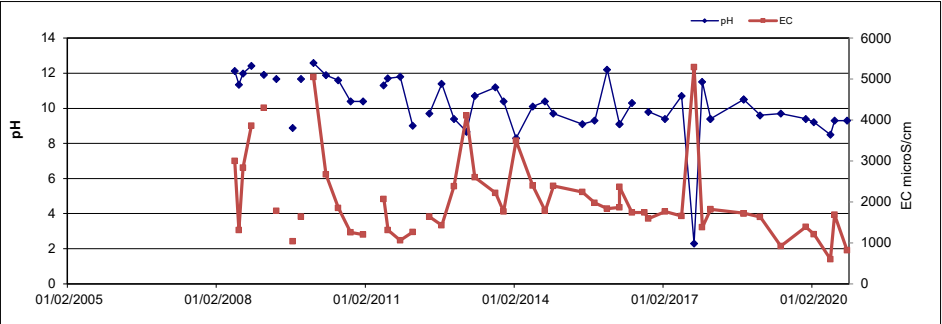
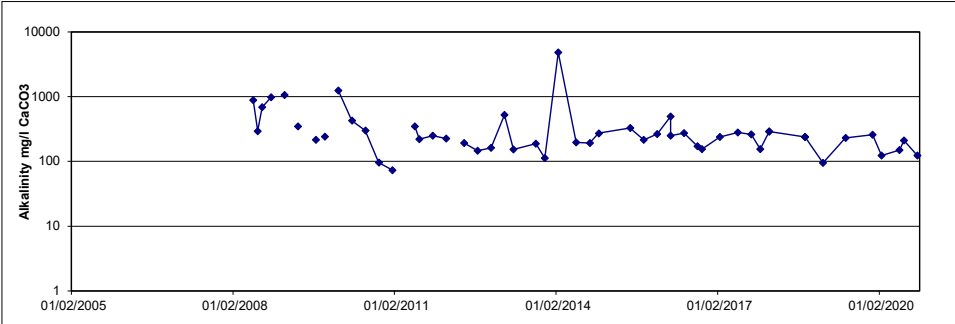
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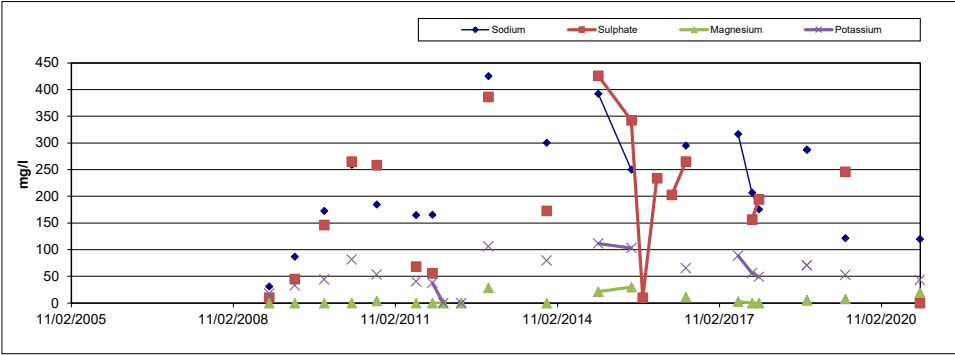
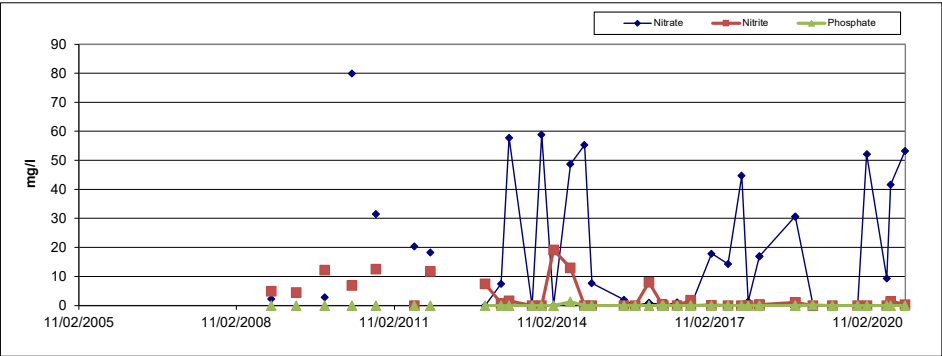
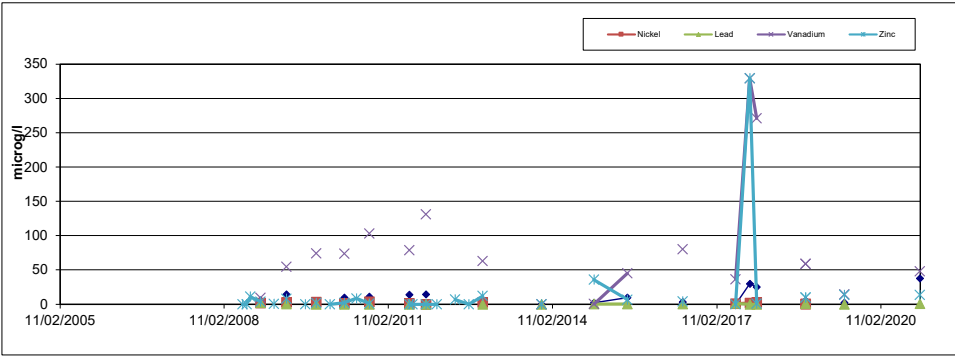
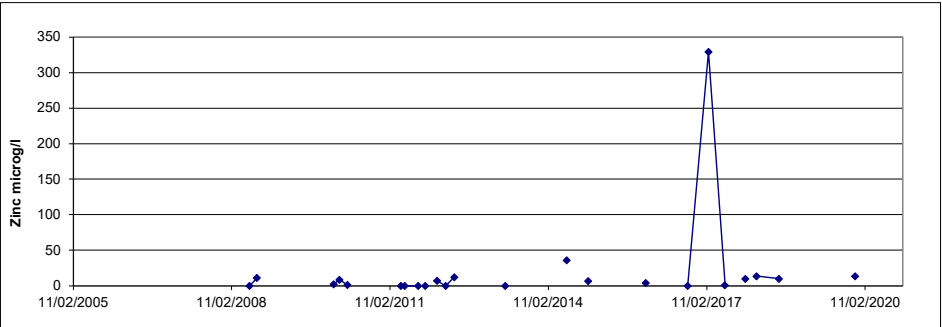
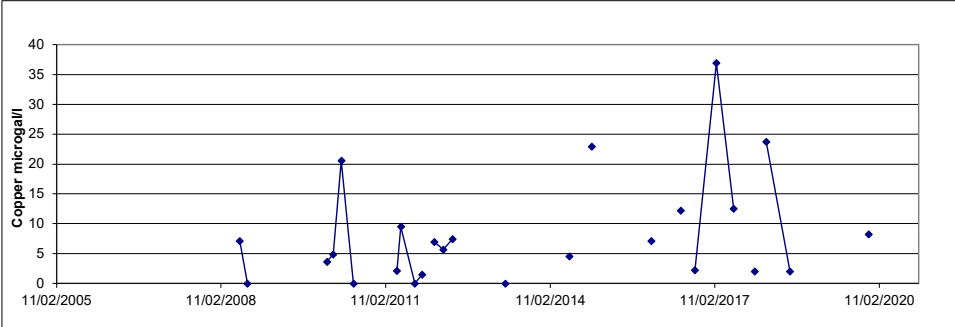


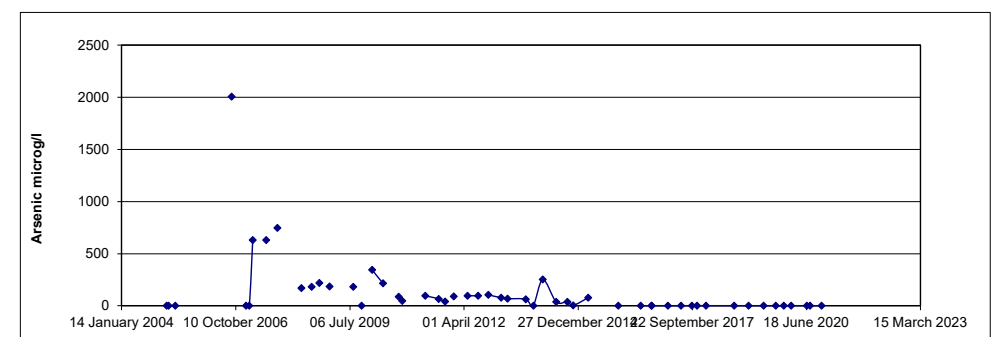
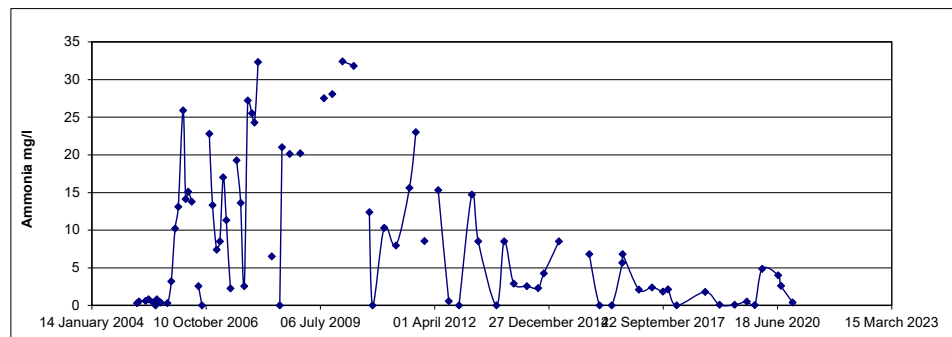
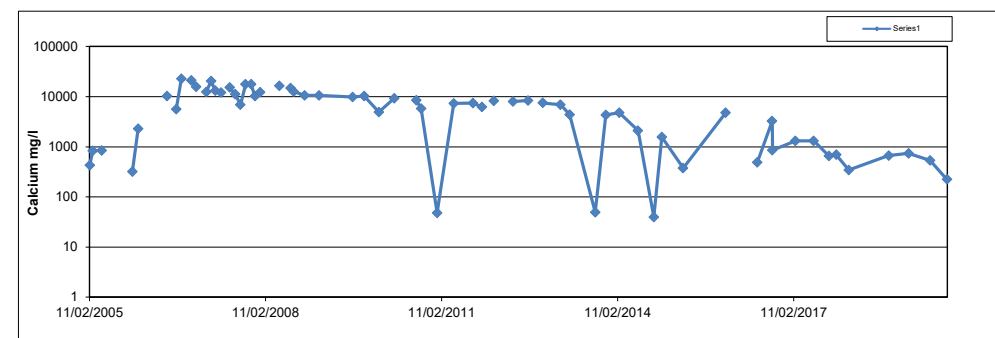
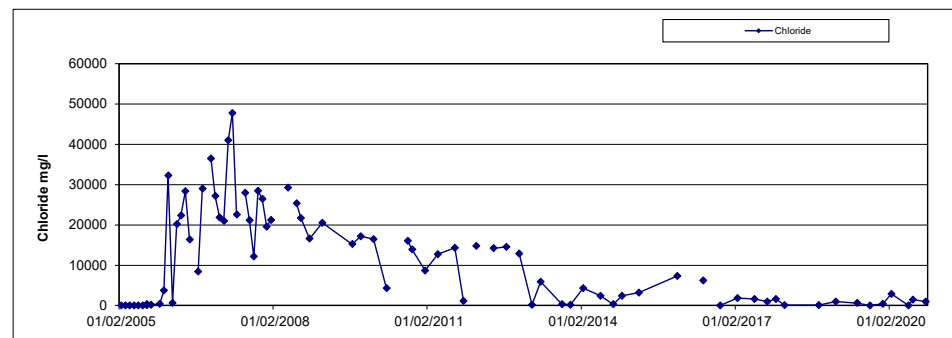
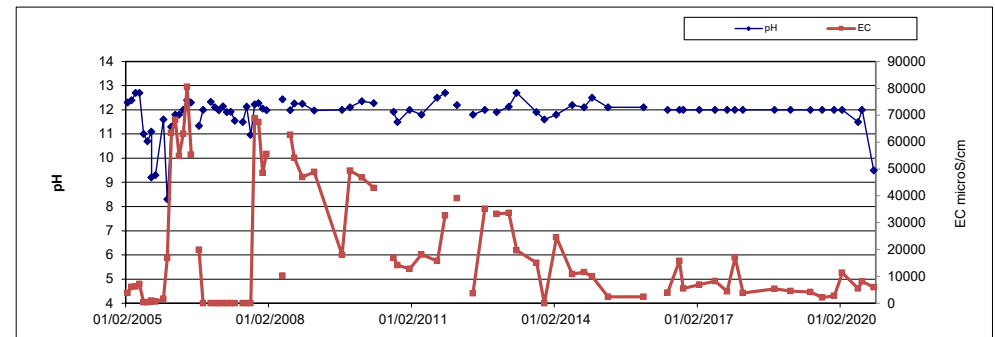
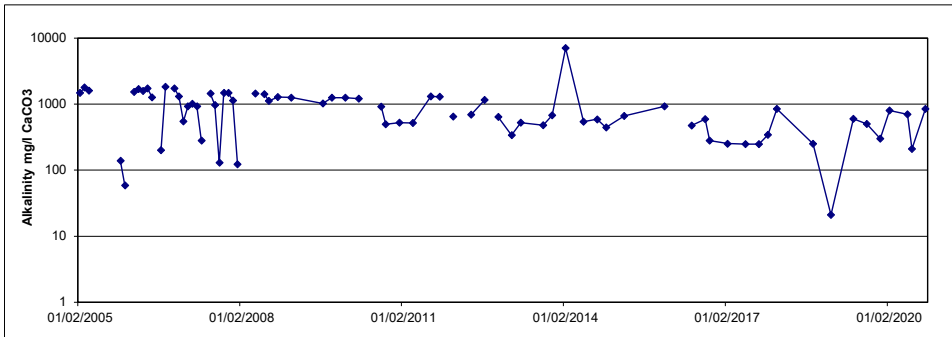


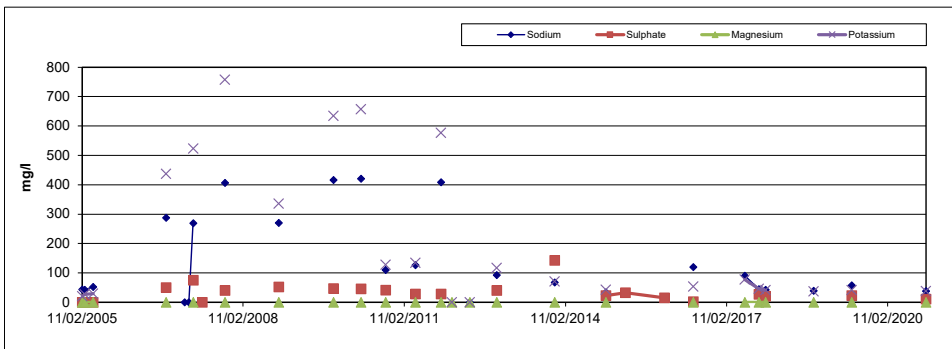
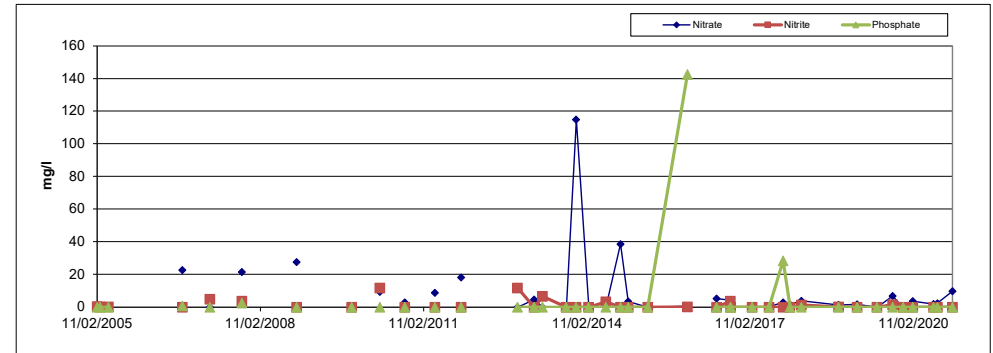
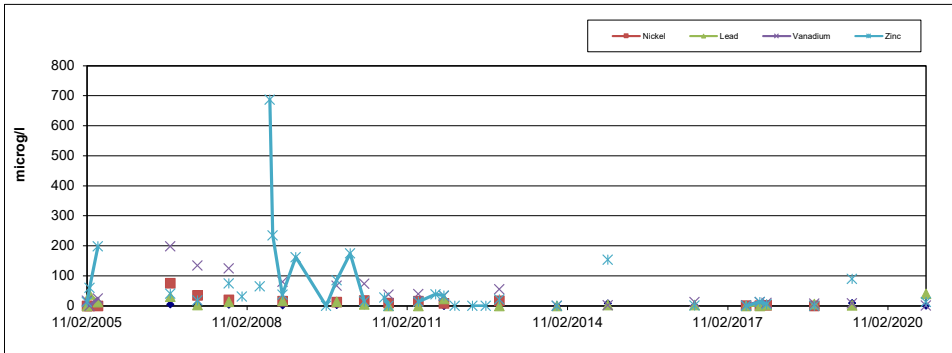
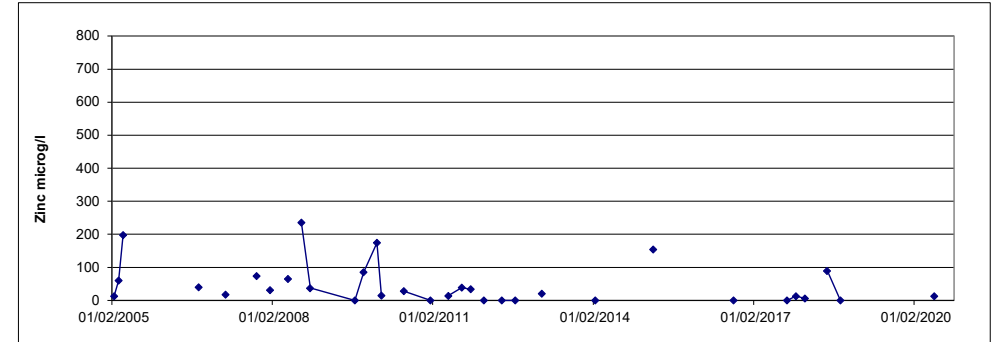
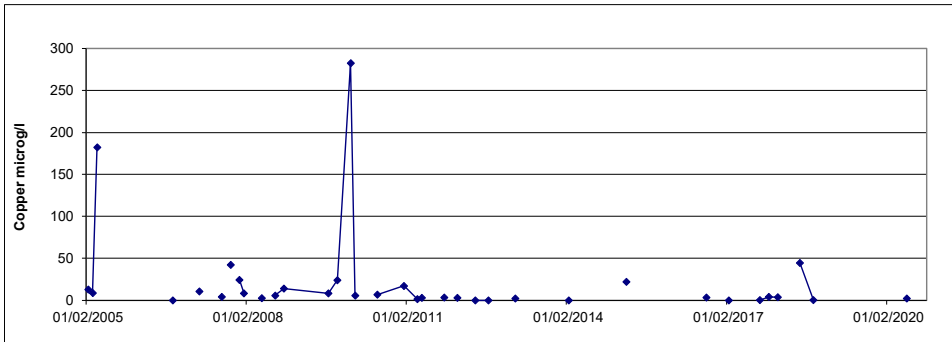


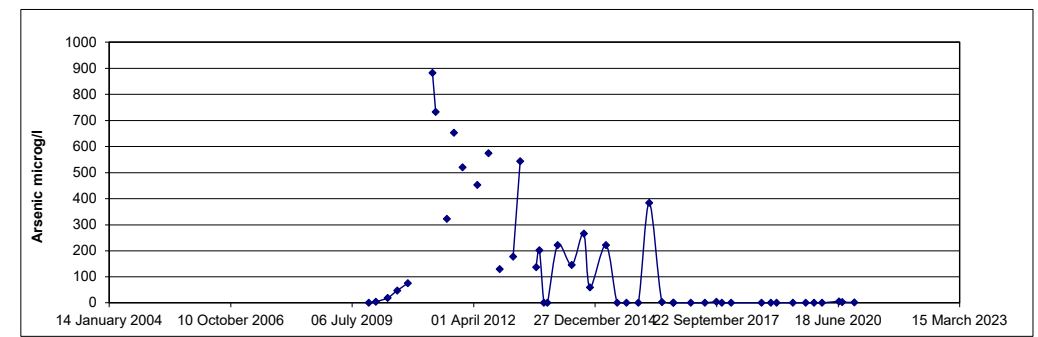
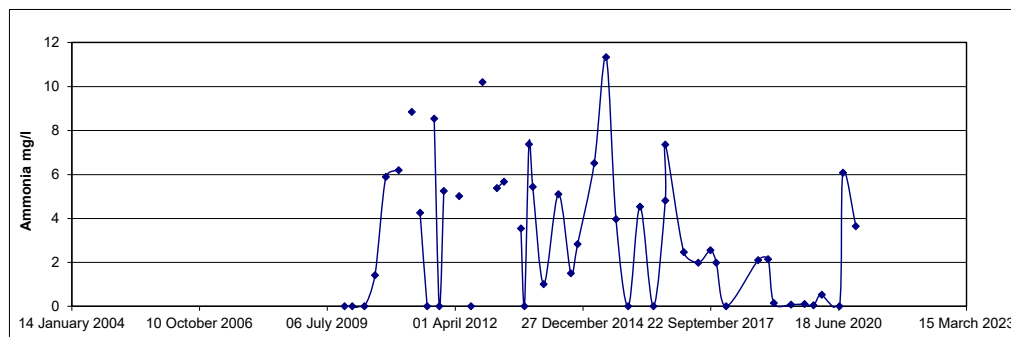
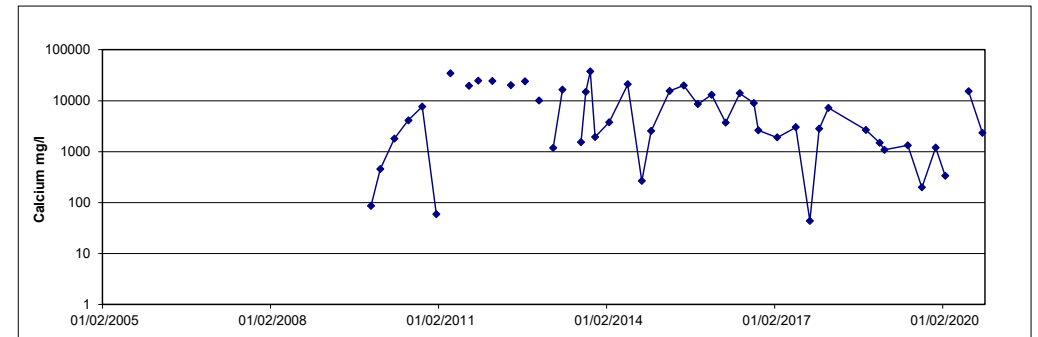
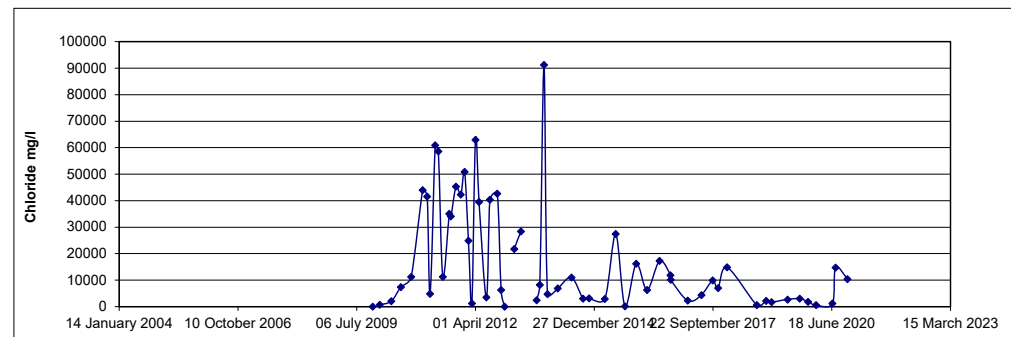
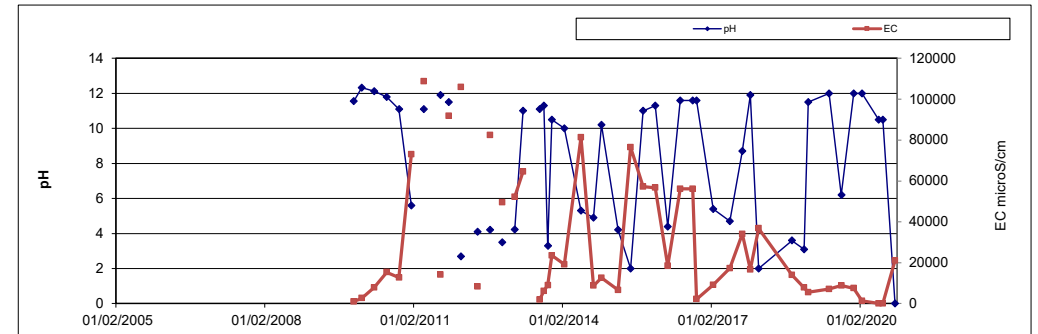
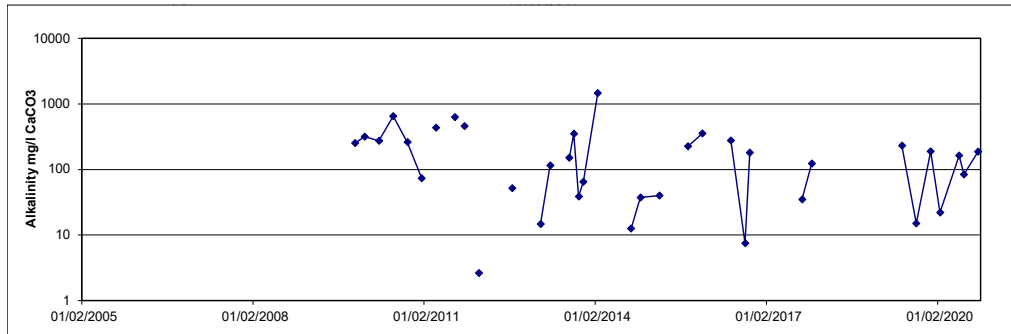


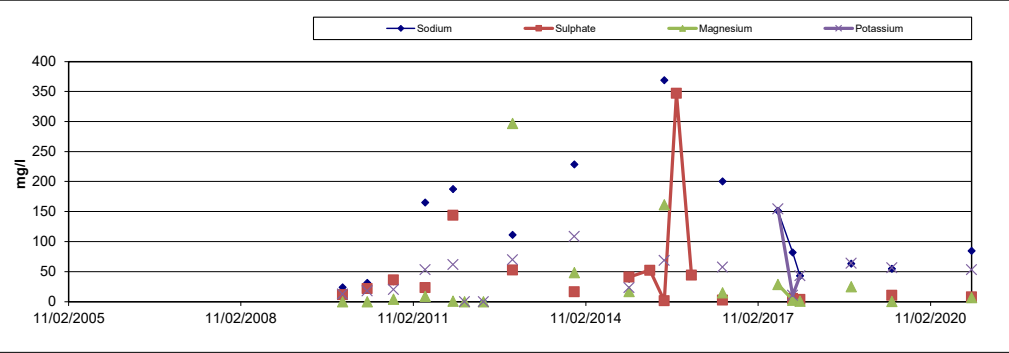
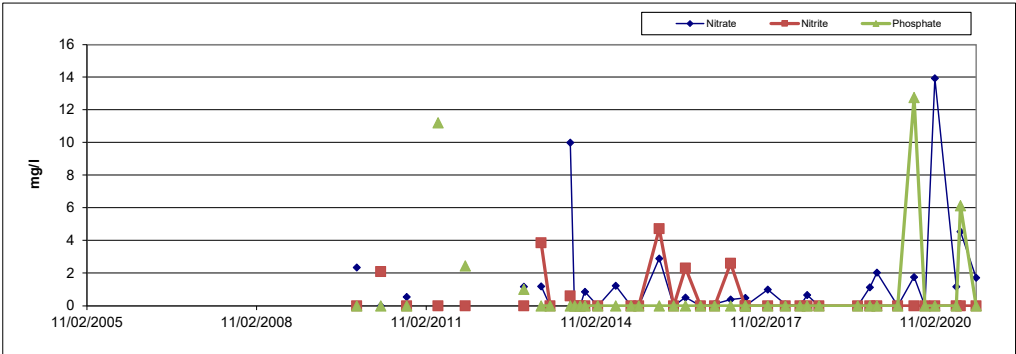
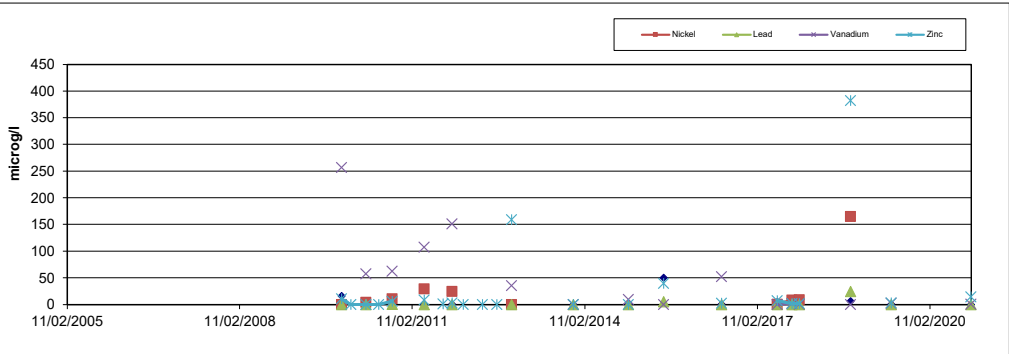
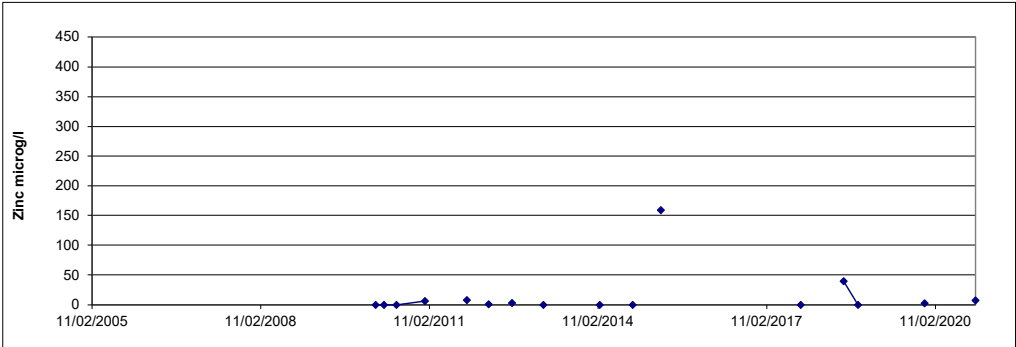
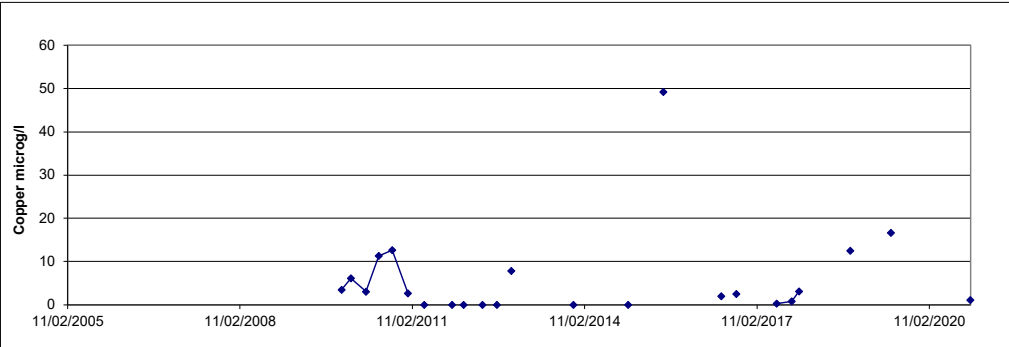












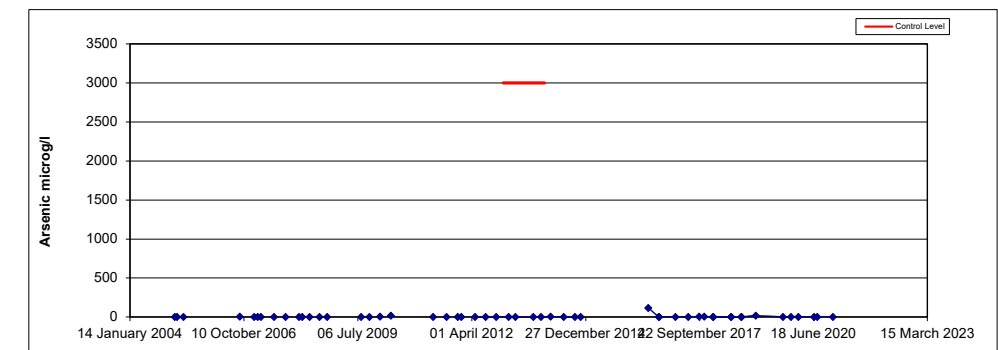
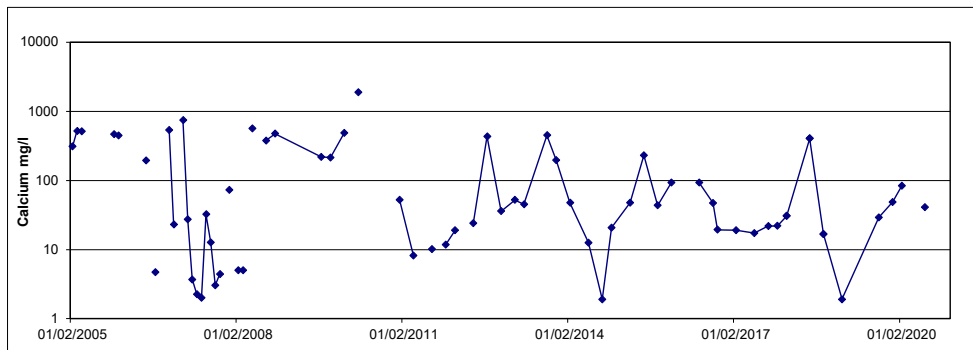
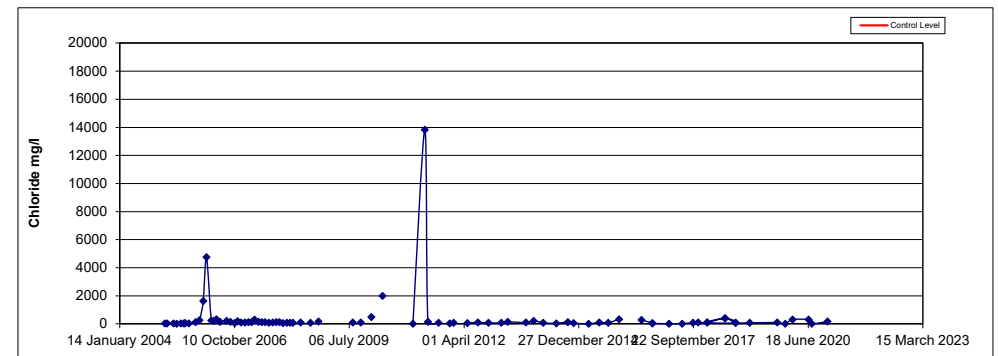
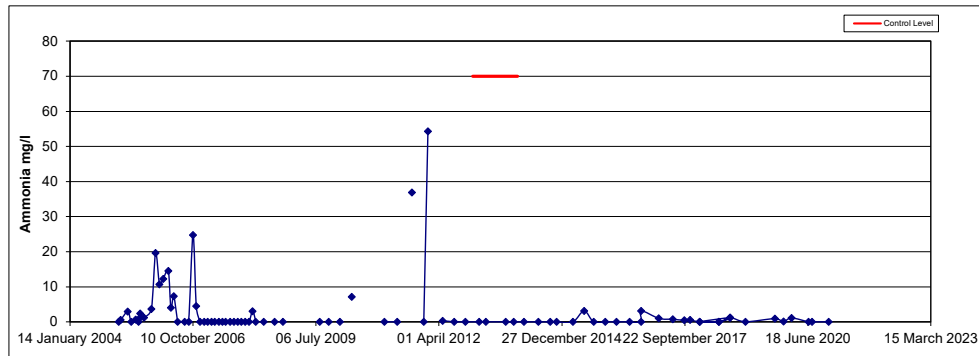
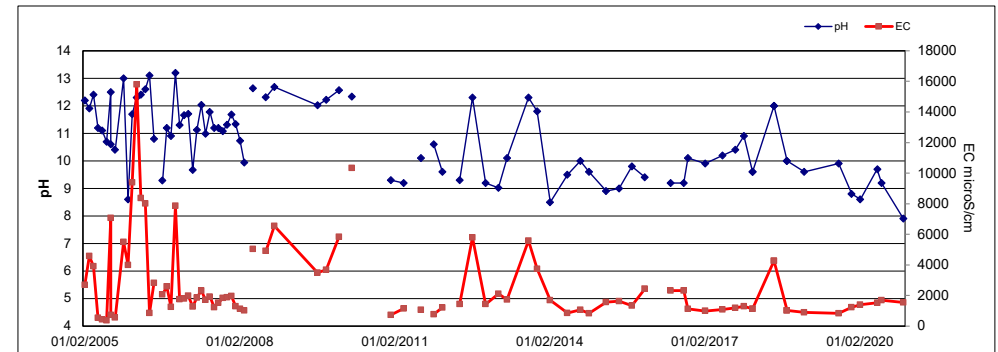
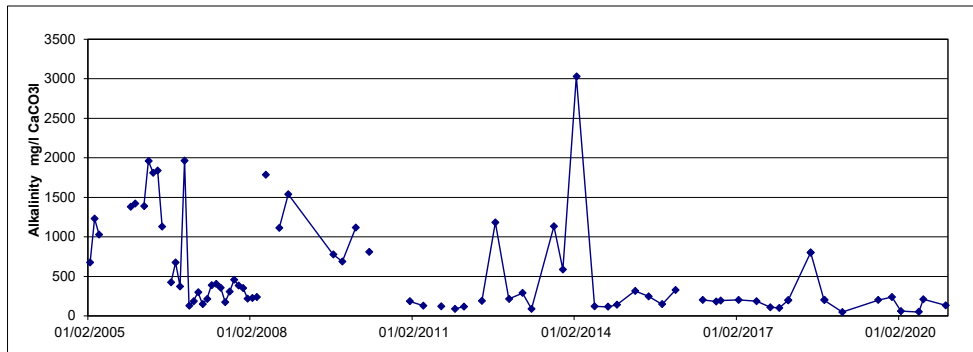
**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

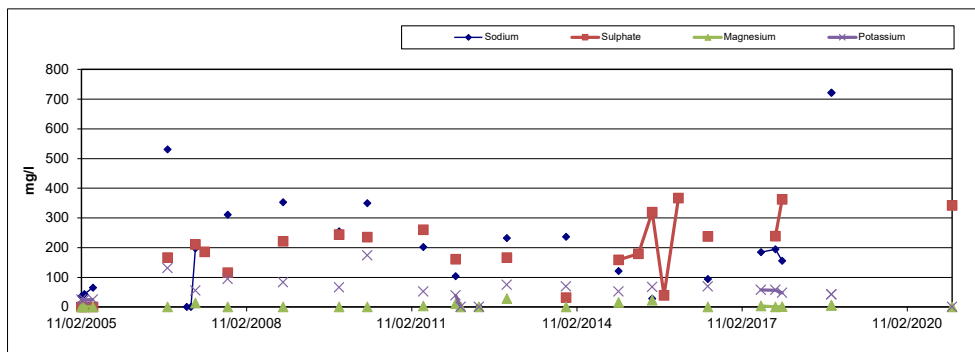
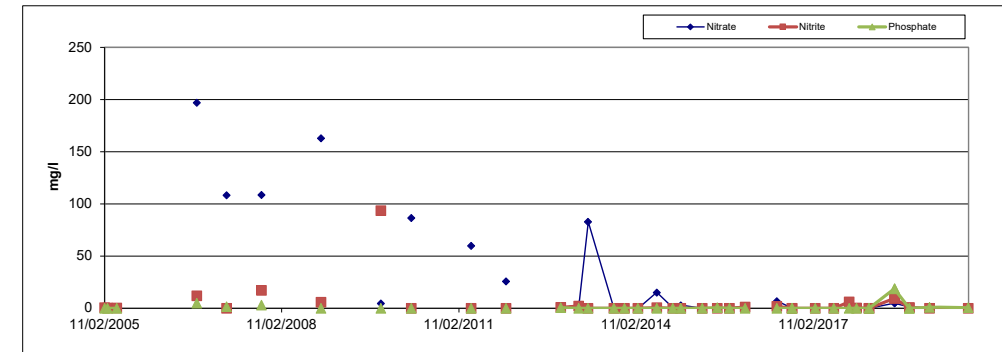
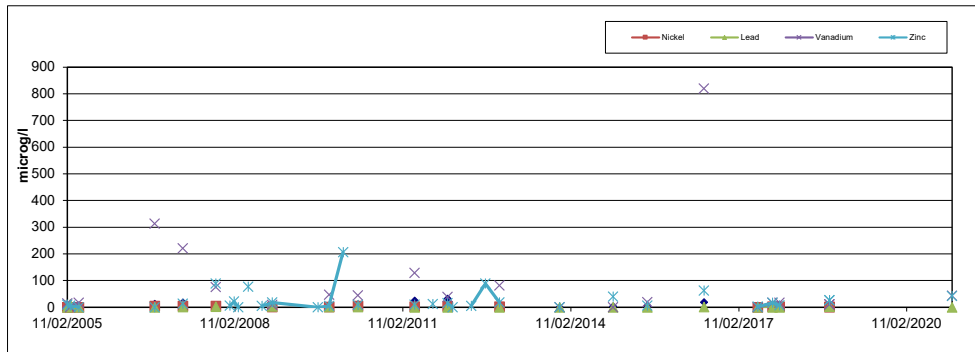
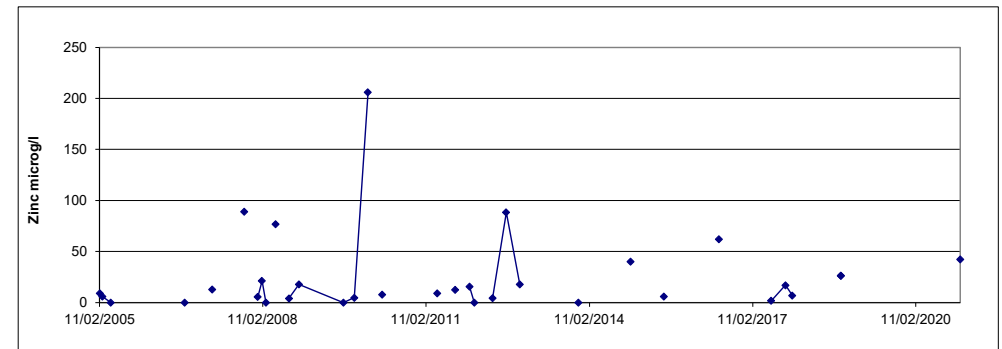
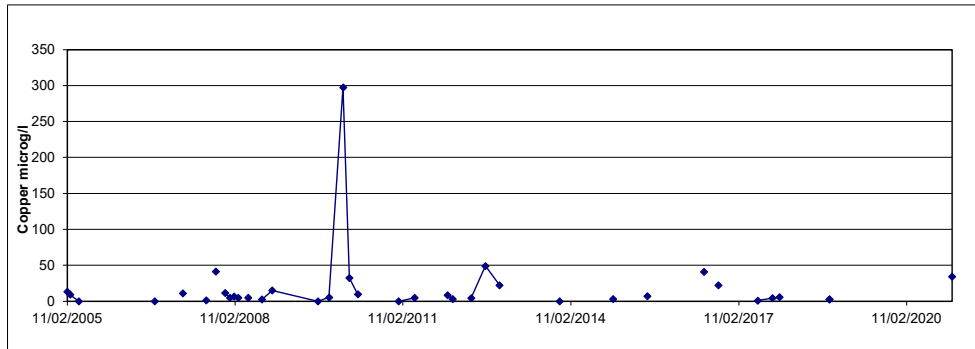
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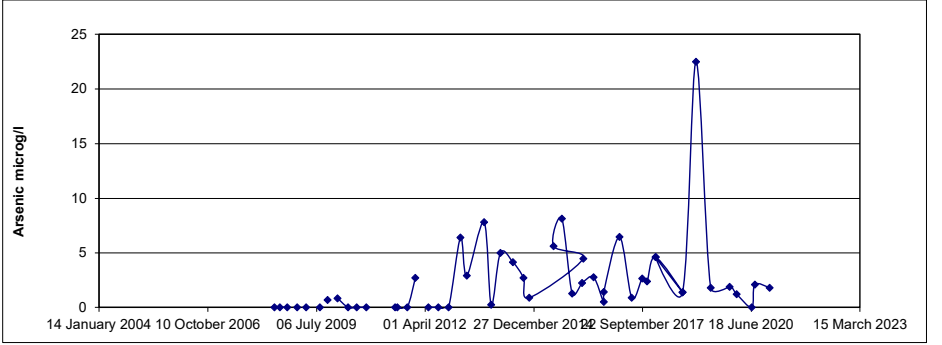
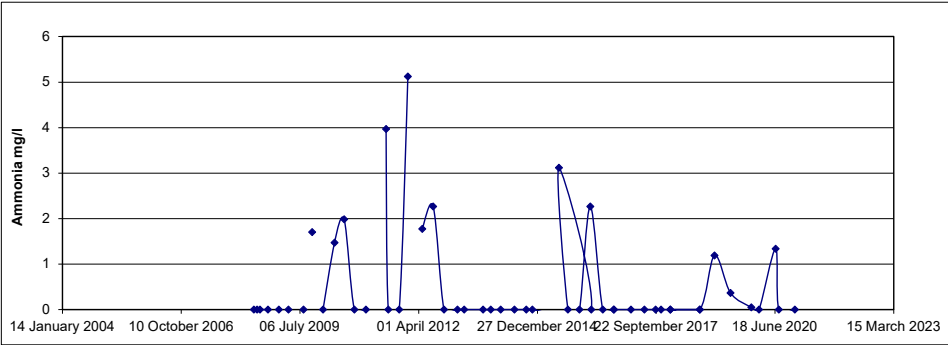
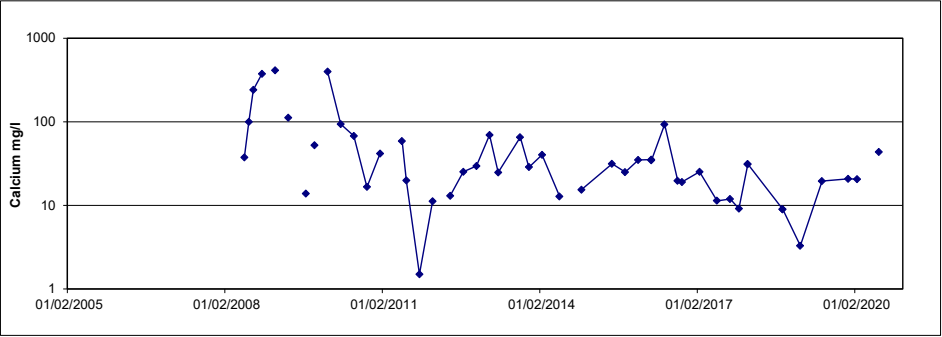
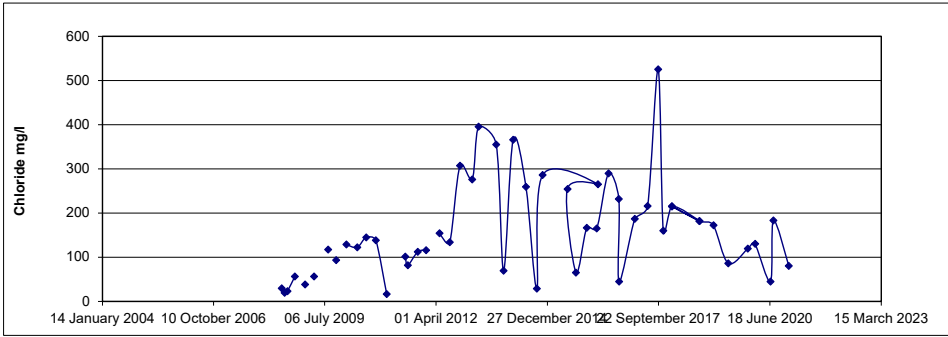
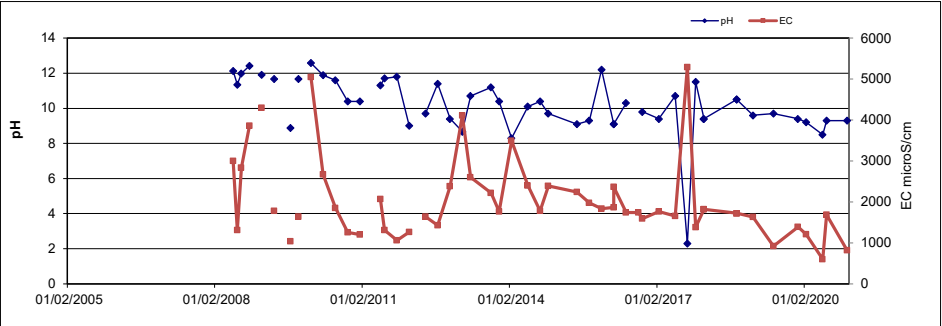
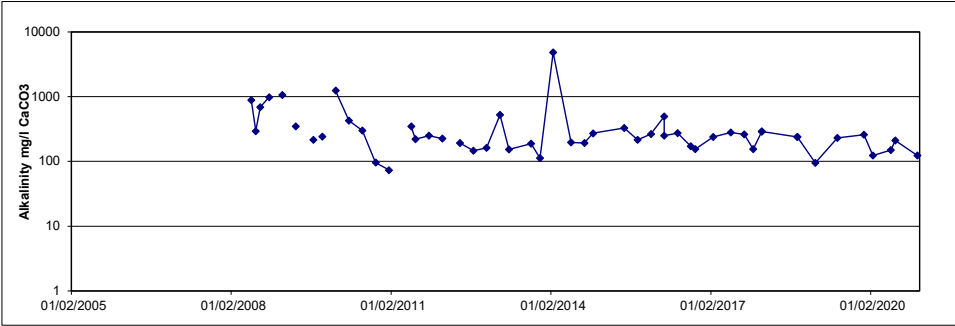
**2020 Annual Review of
Environmental
Monitoring**

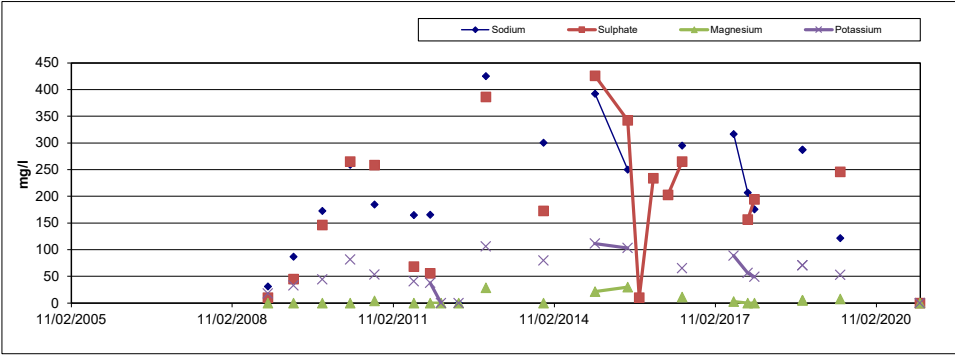
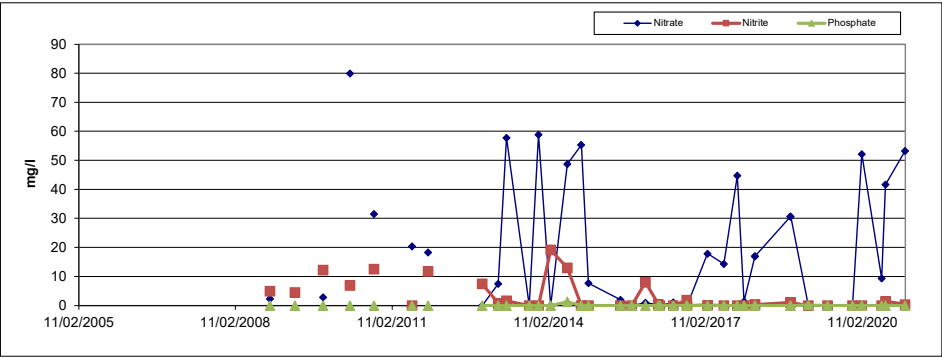
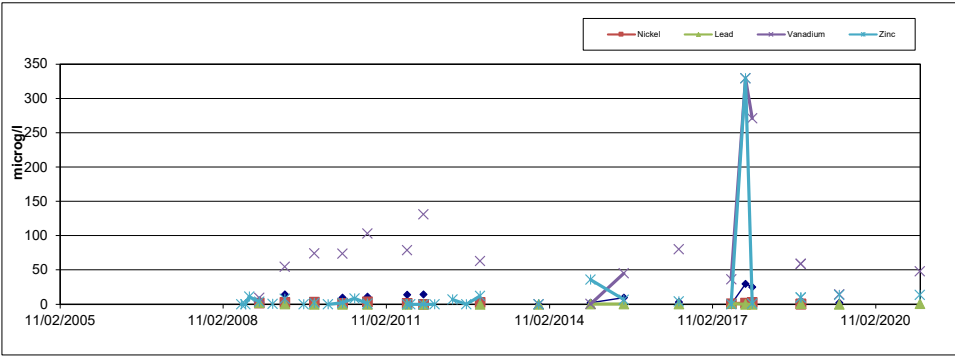
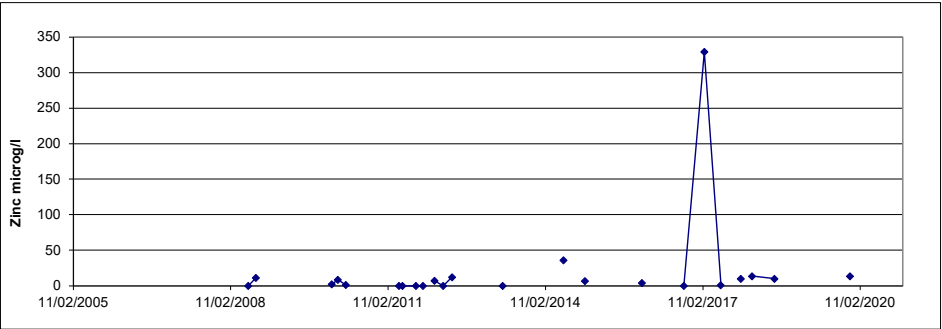
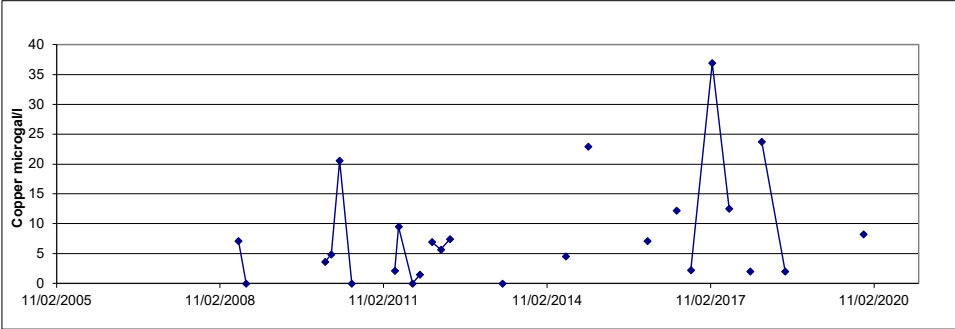
**Appendix 4
Temporal Variation of
Leachate Chemistry**

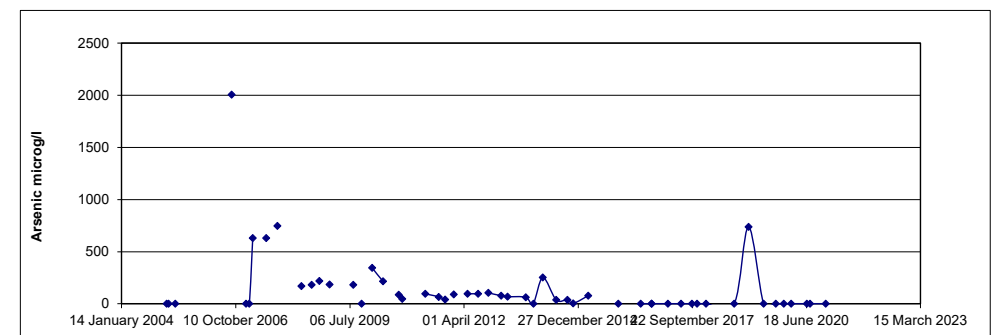
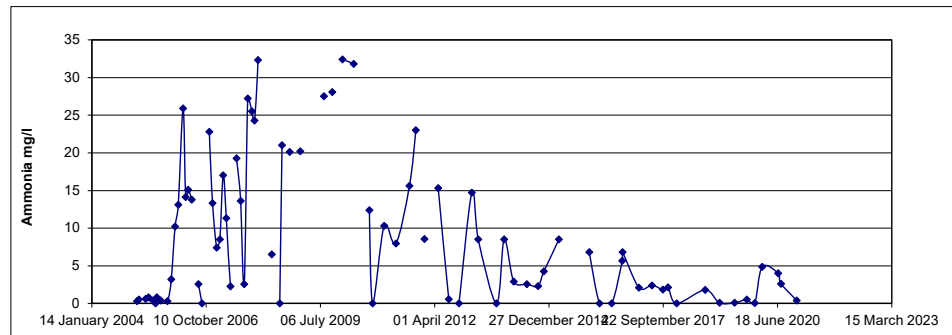
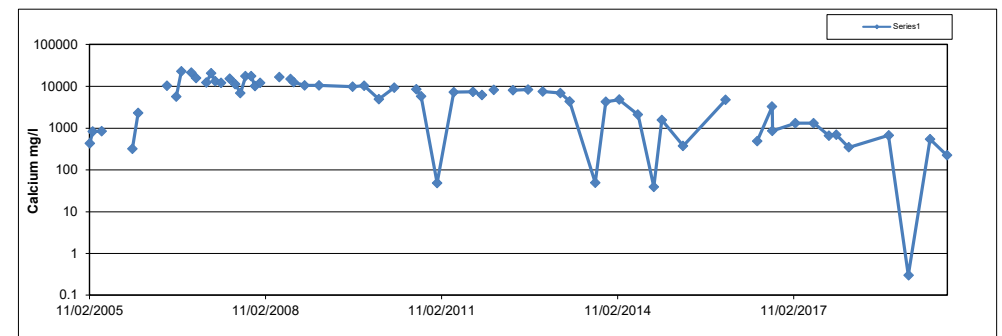
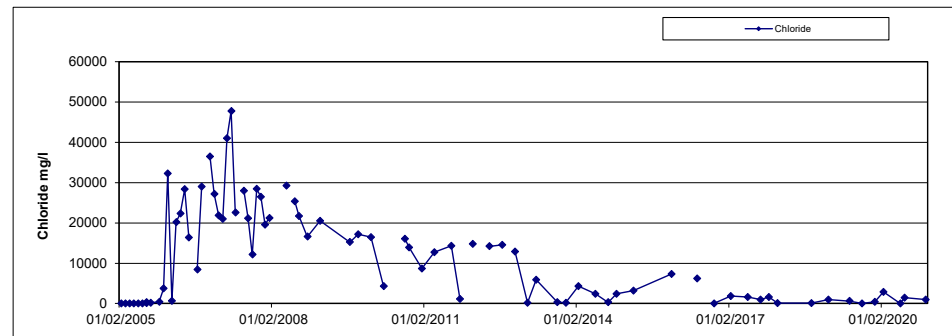
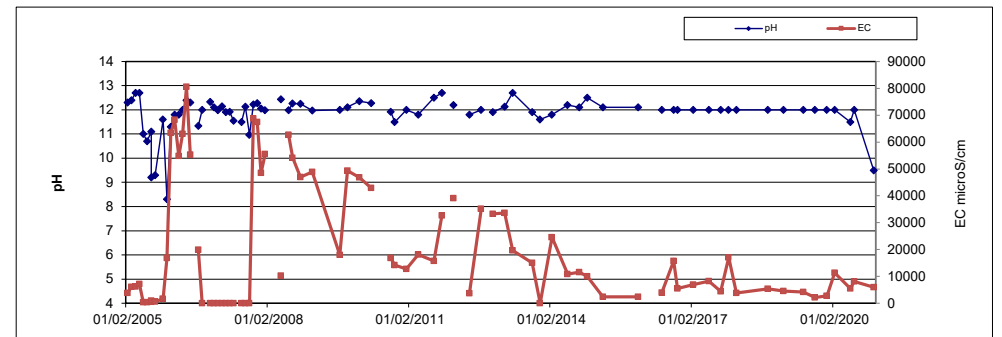
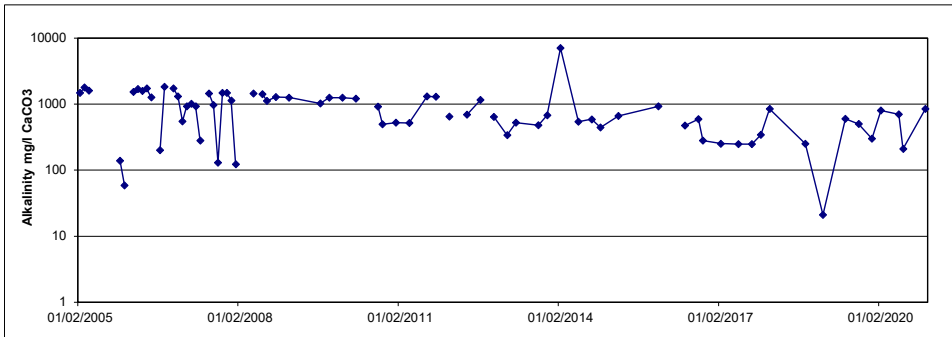
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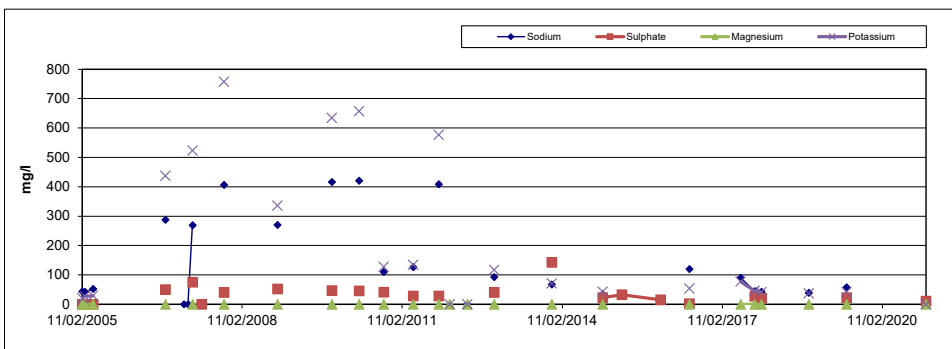
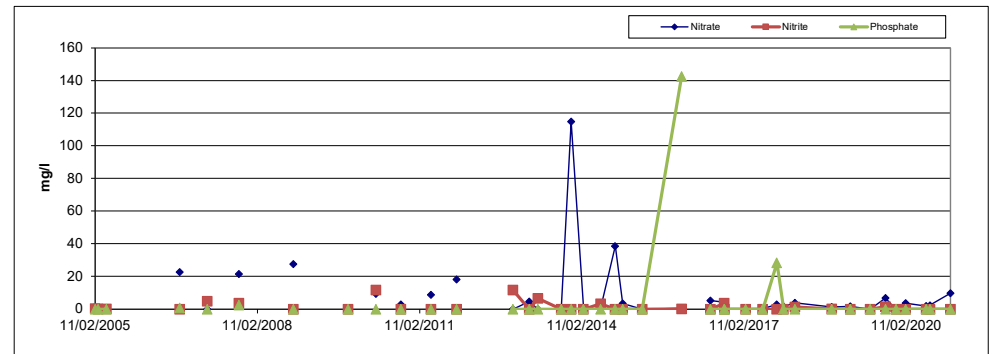
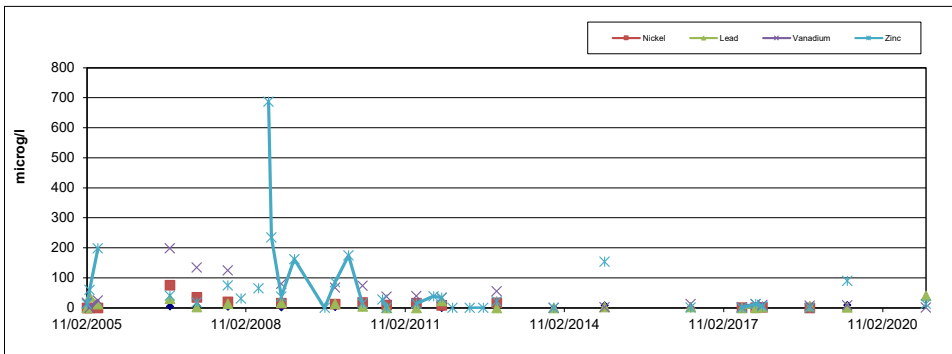
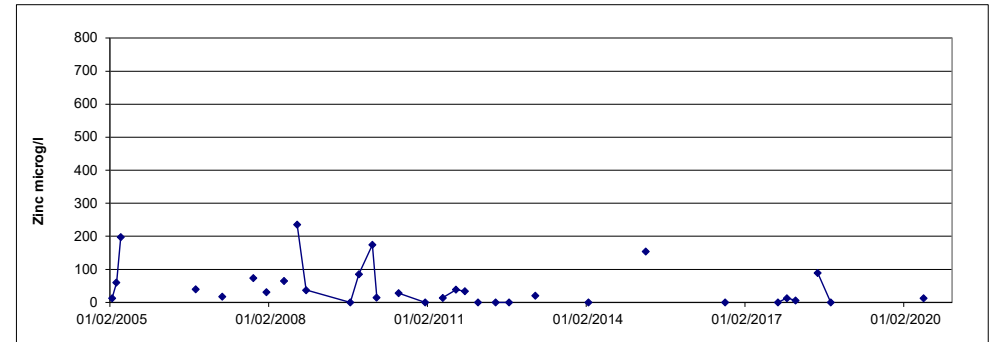
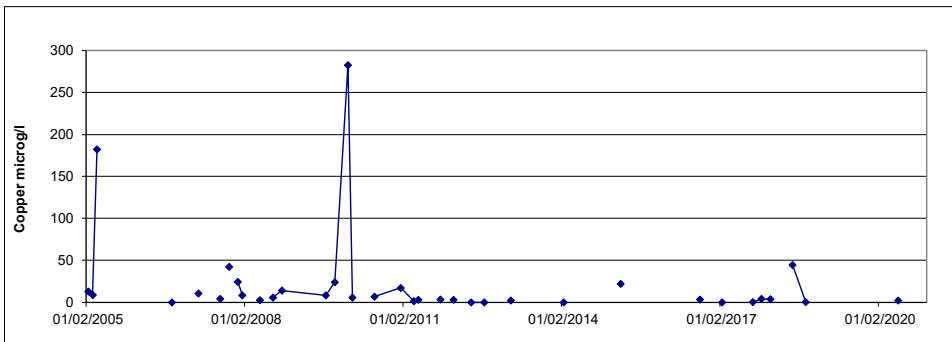


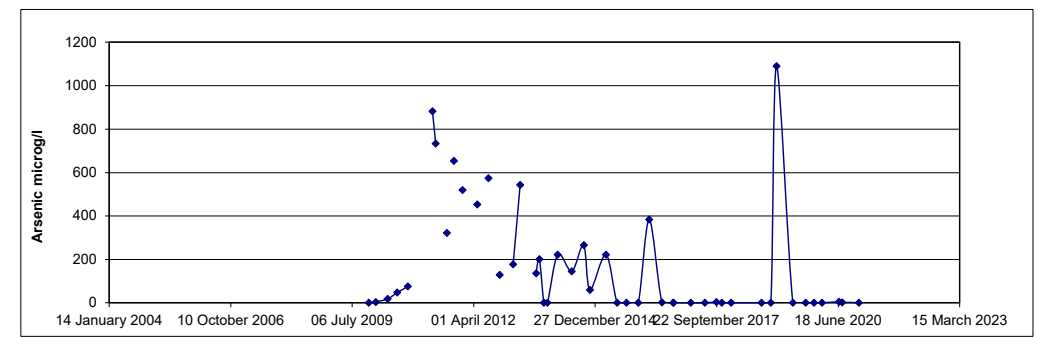
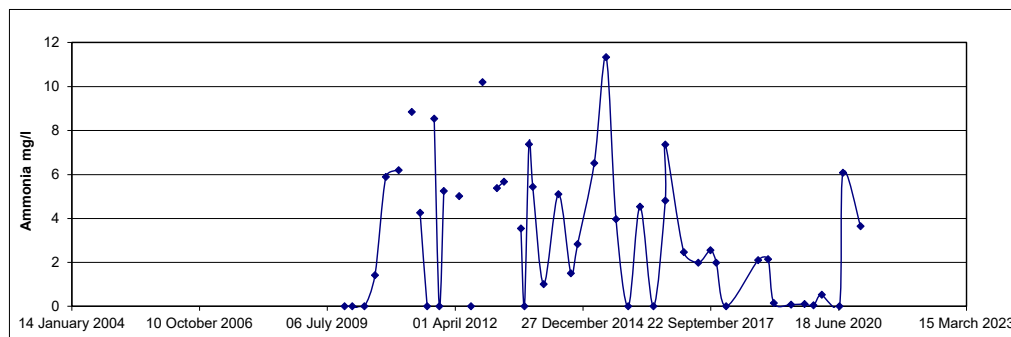
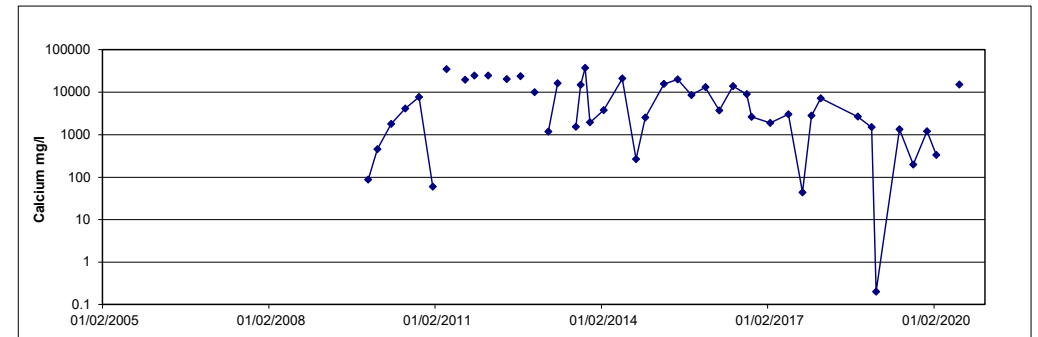
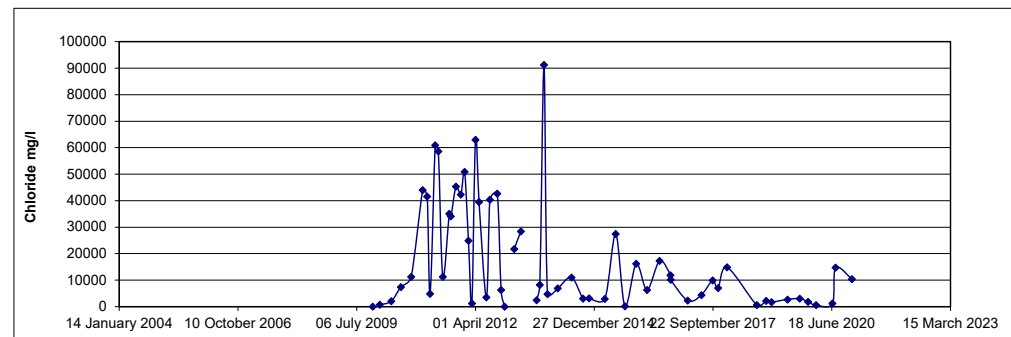
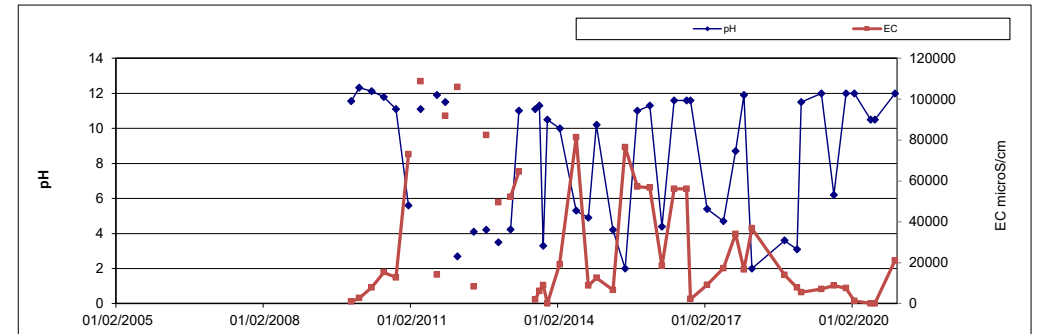
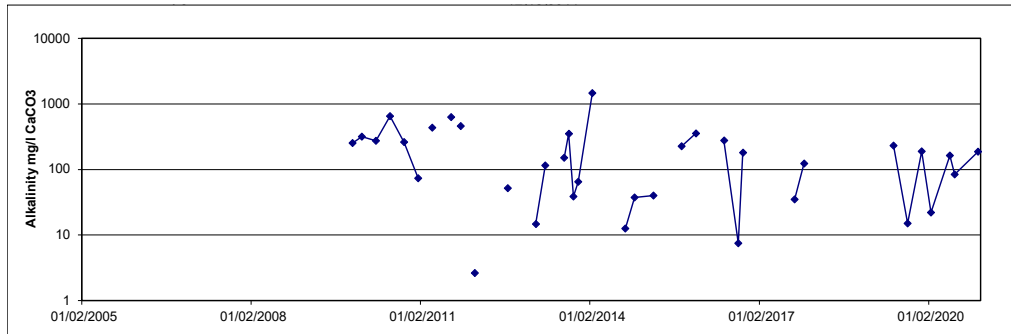


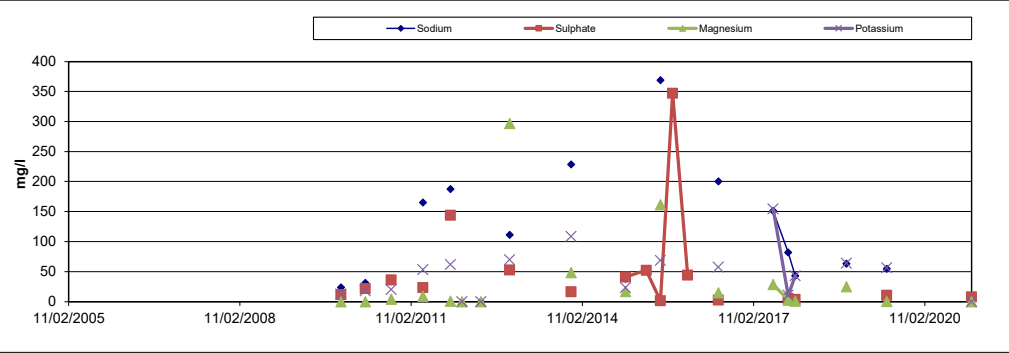
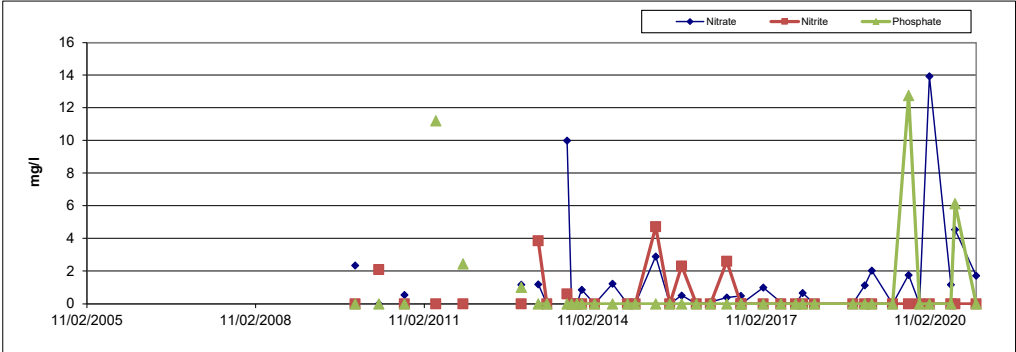
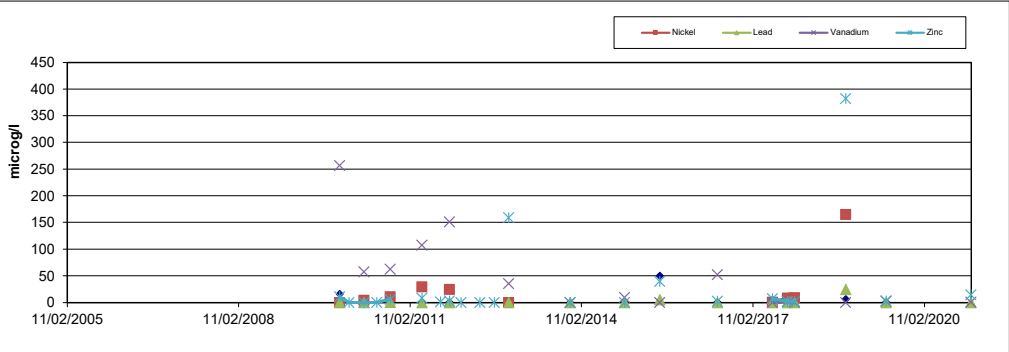
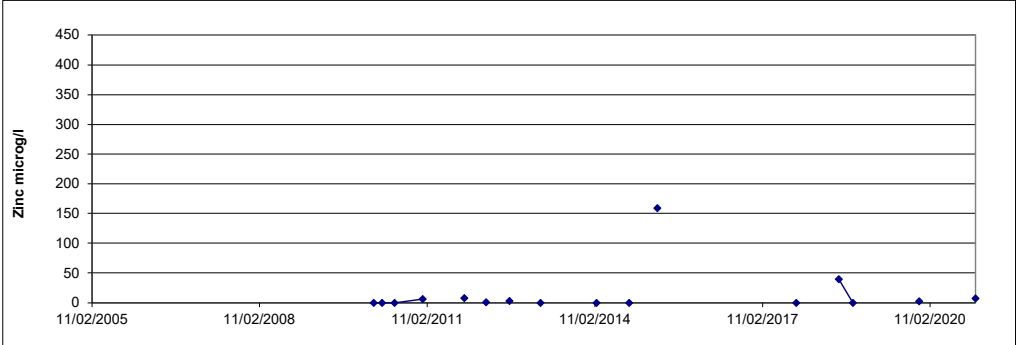
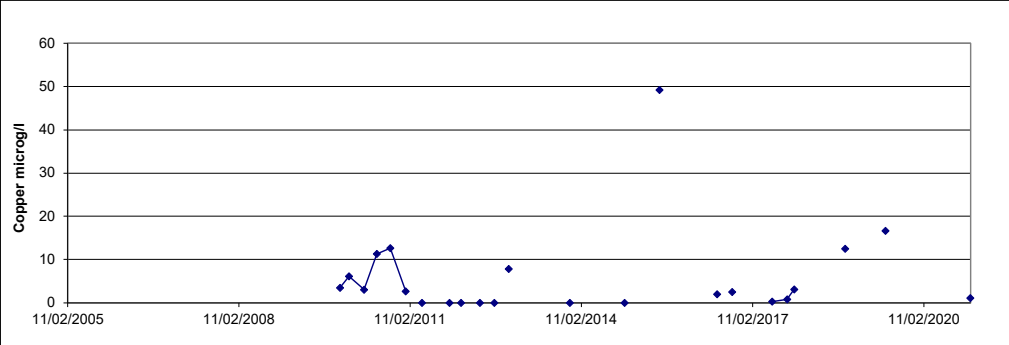












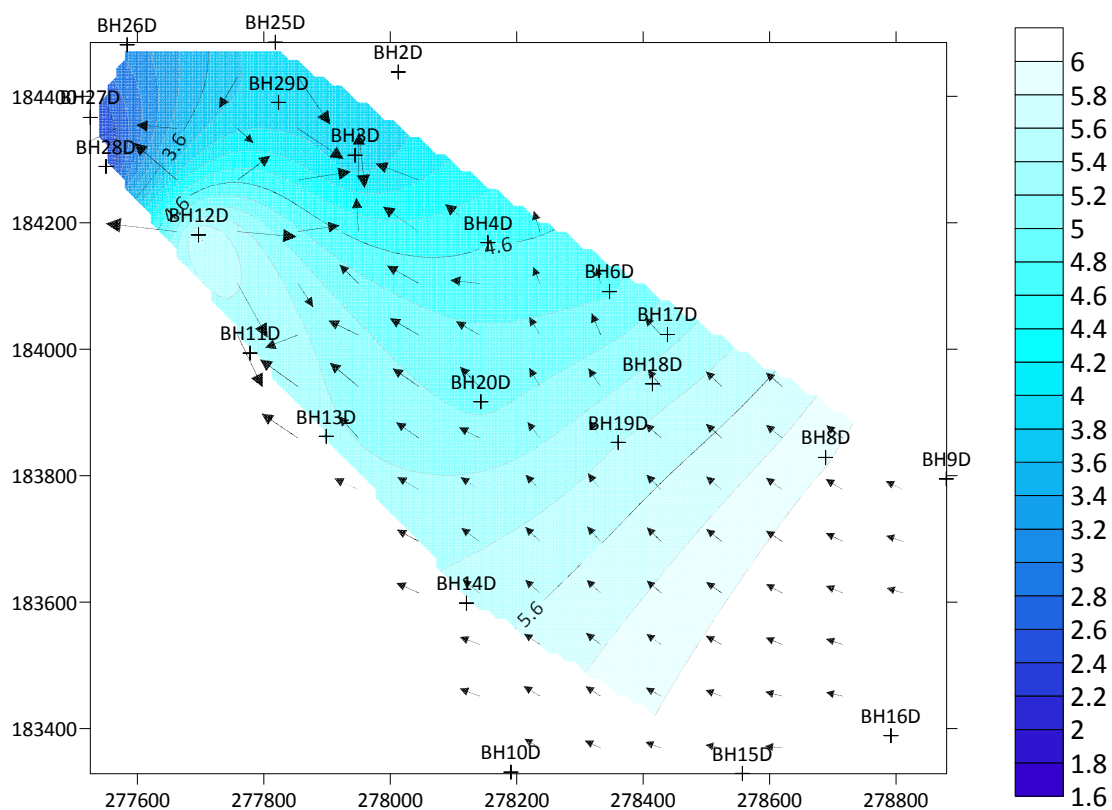
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LANDFILL, PORT
TALBOT**

PERMIT BV7311IE

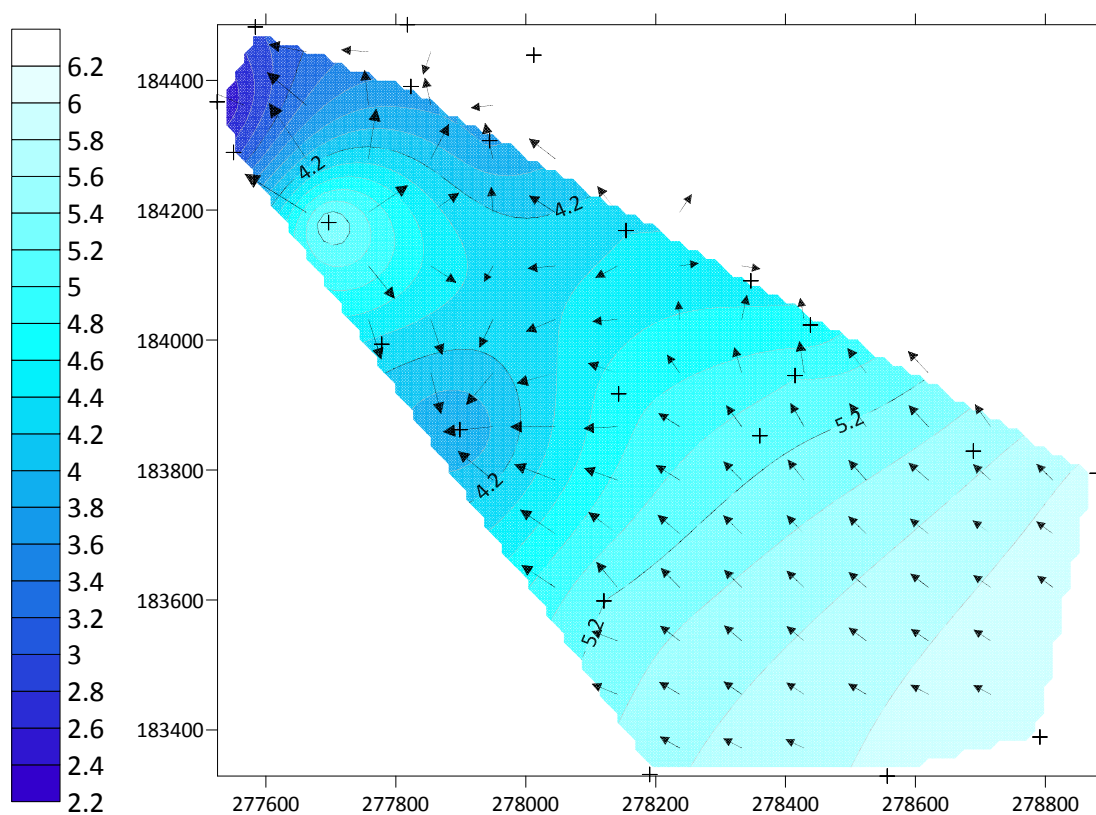
**2020 Annual Review of
Environmental
Monitoring**

**Appendix 5
Temporal Variation of
Groundwater Levels**

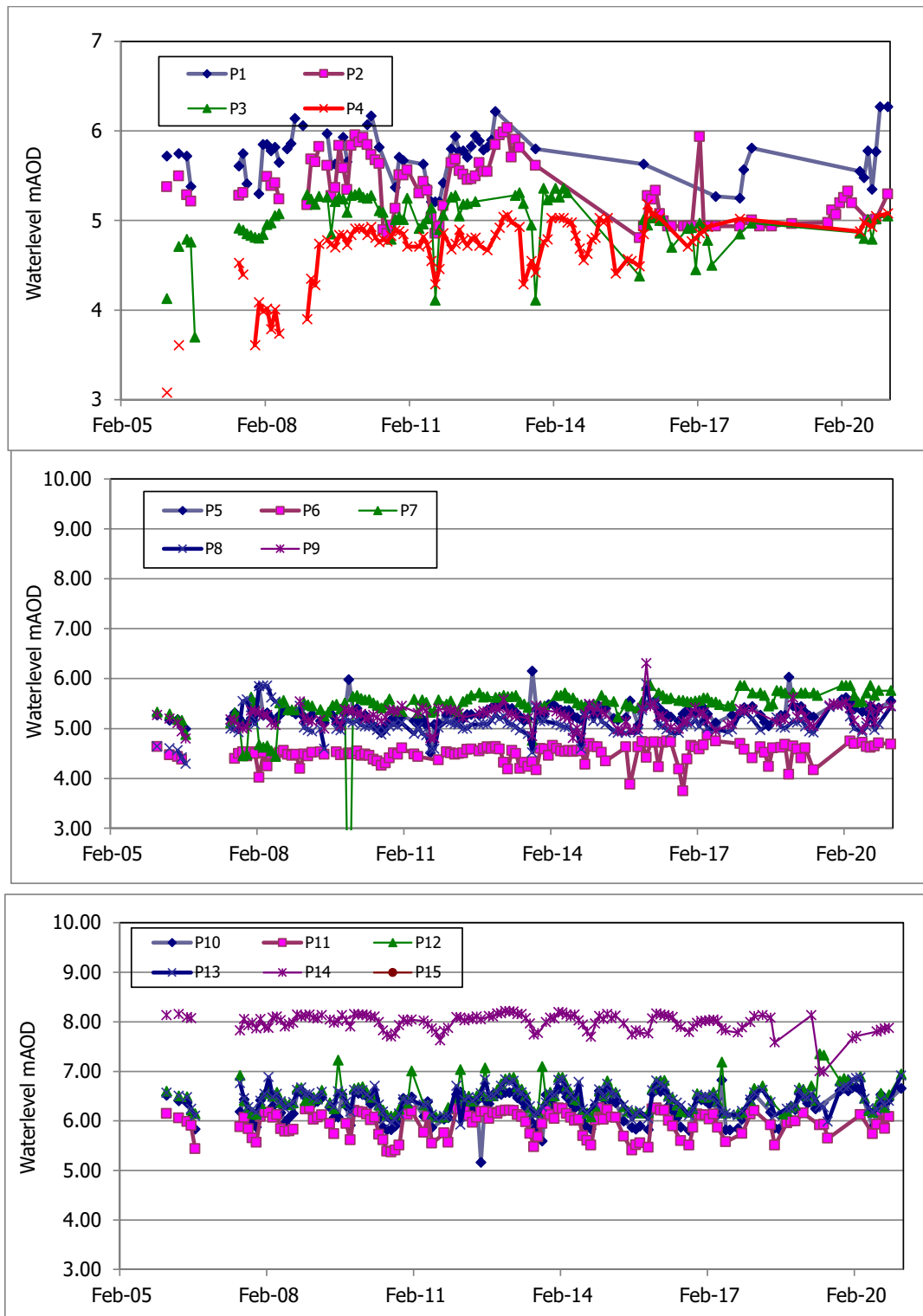
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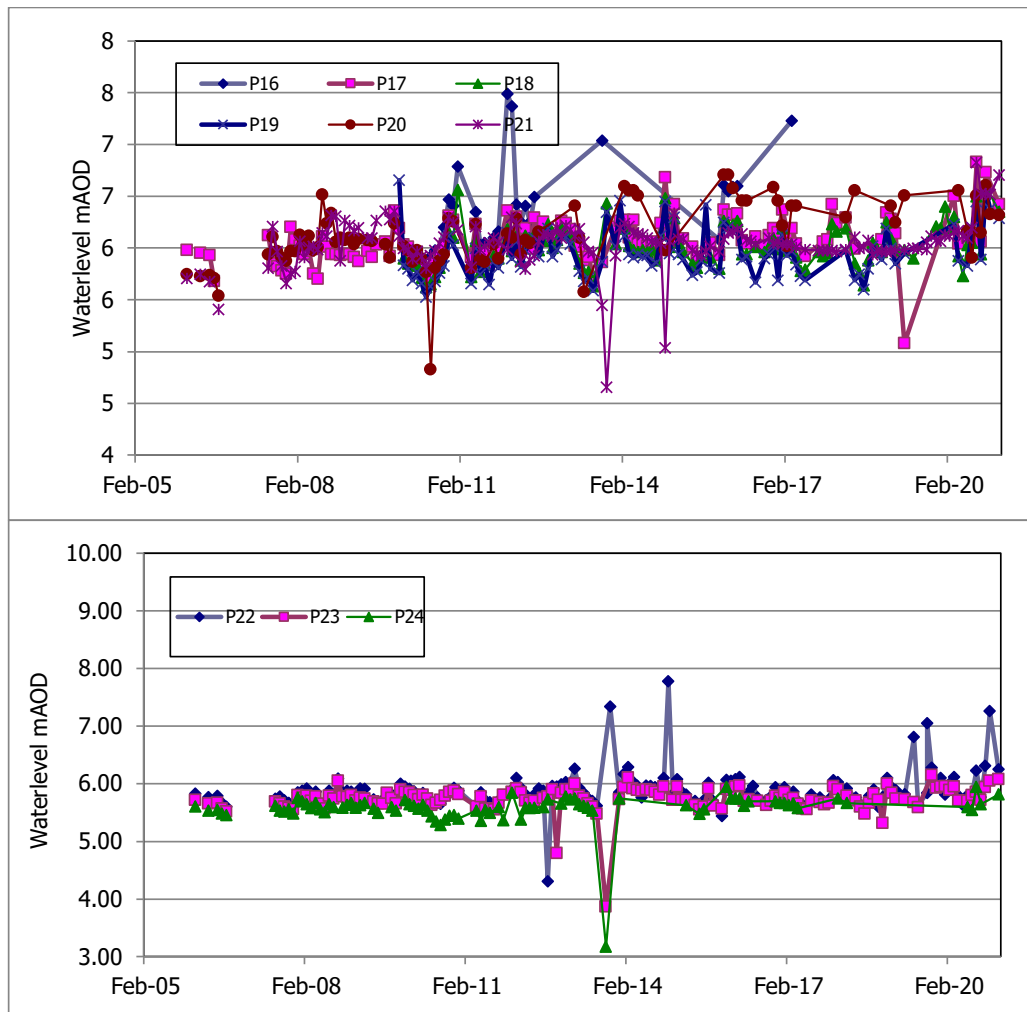


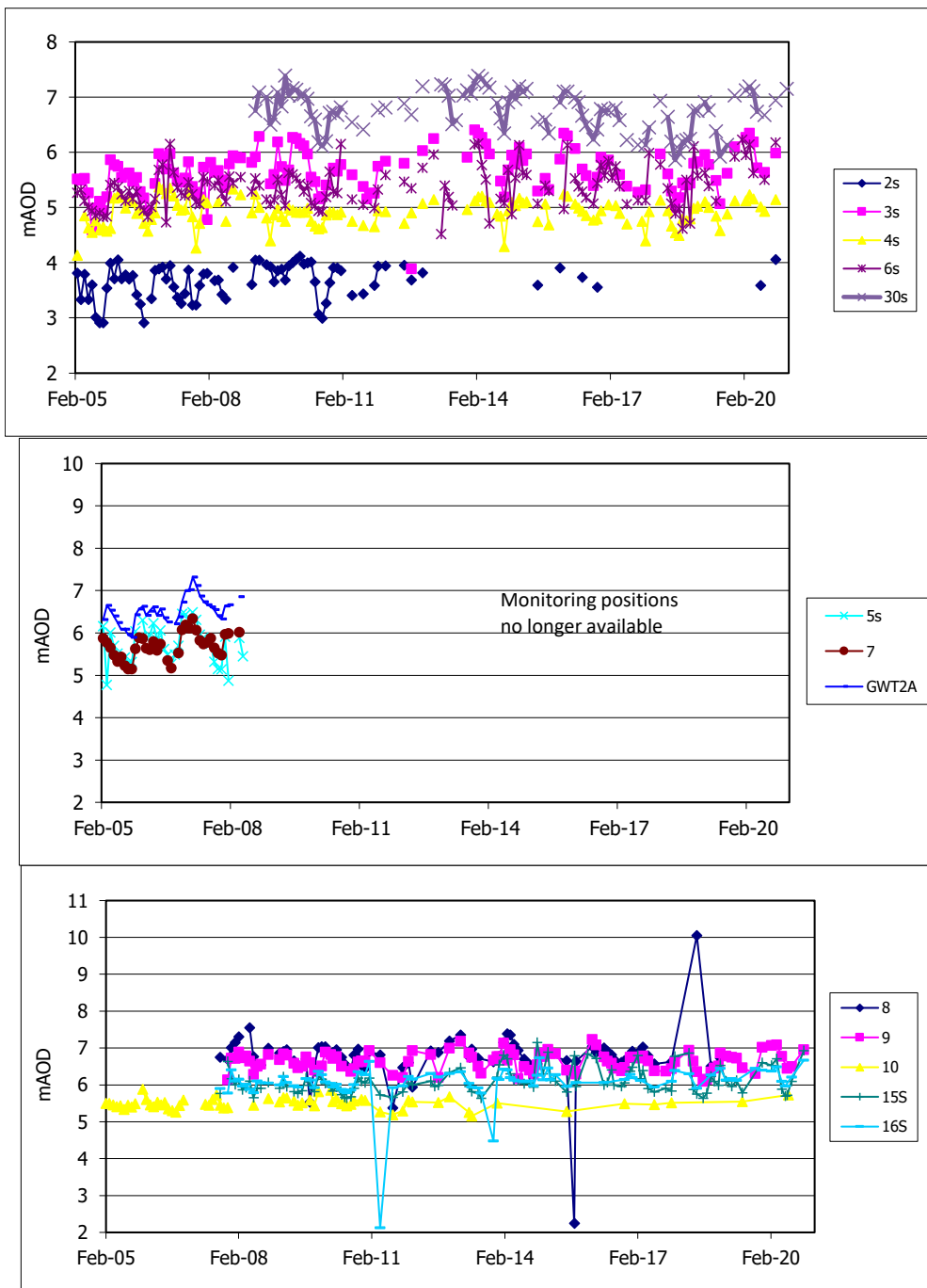
Deep Groundwater Levels, December 2018

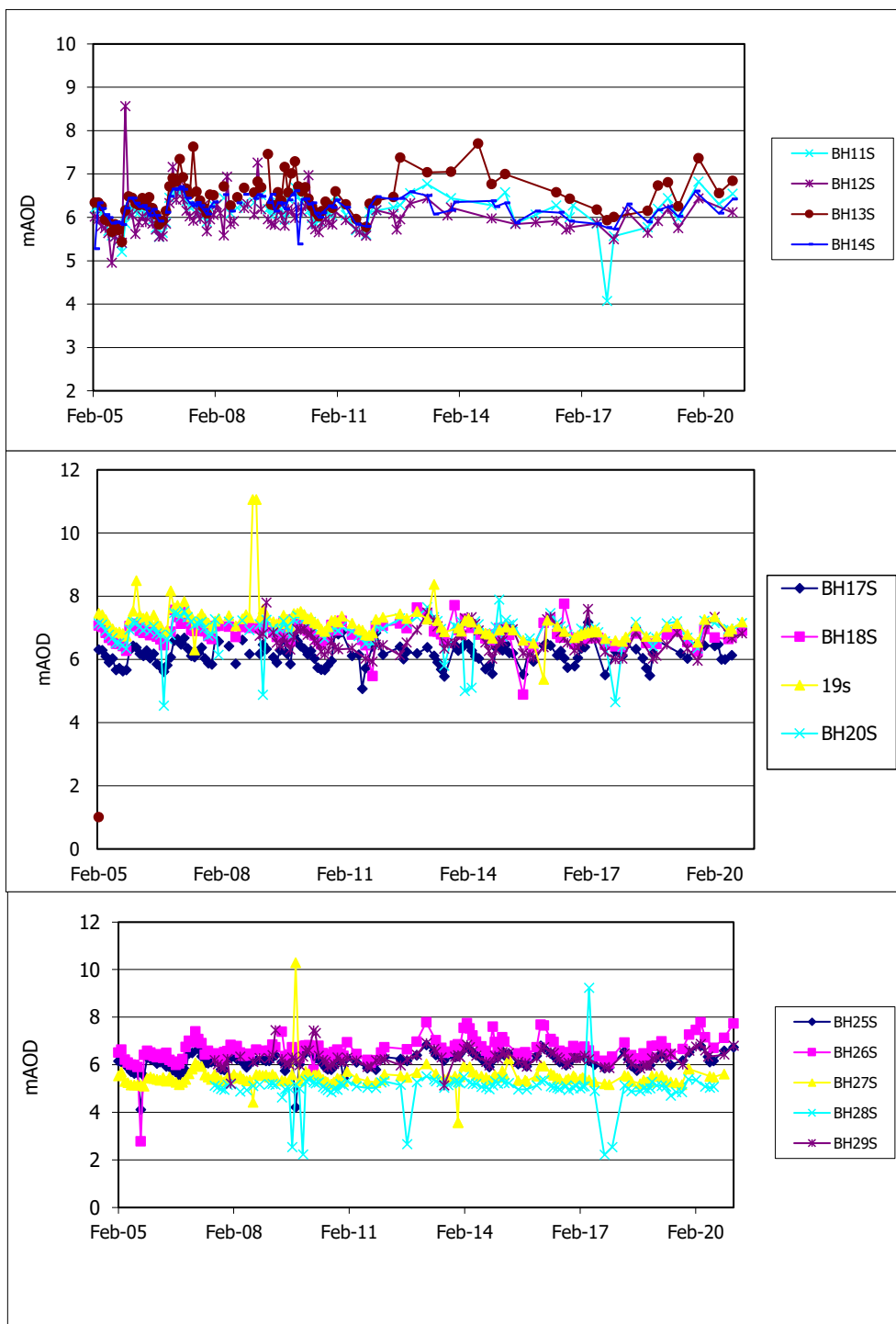


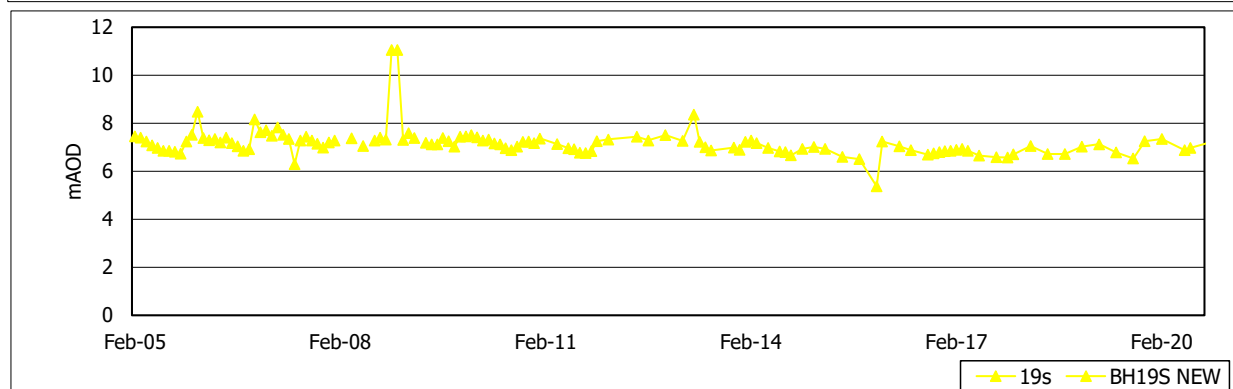
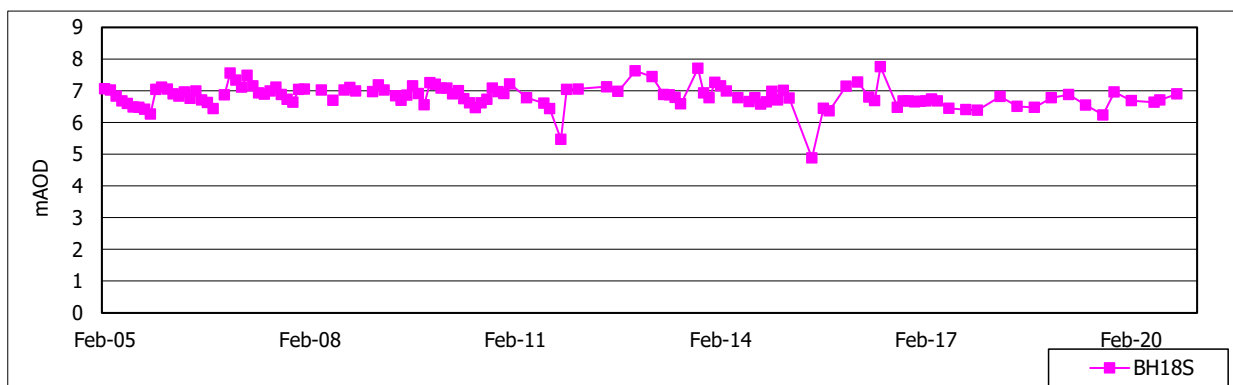
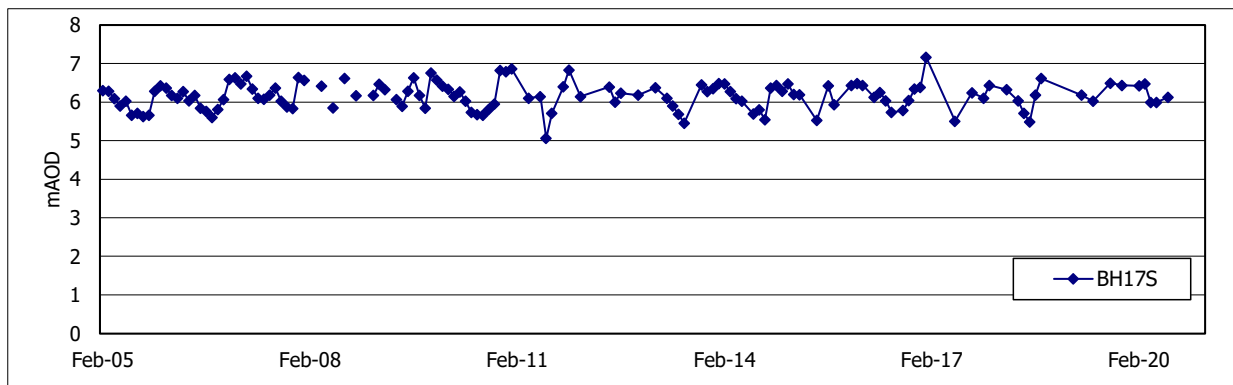
Deep Groundwater Levels, June 2019

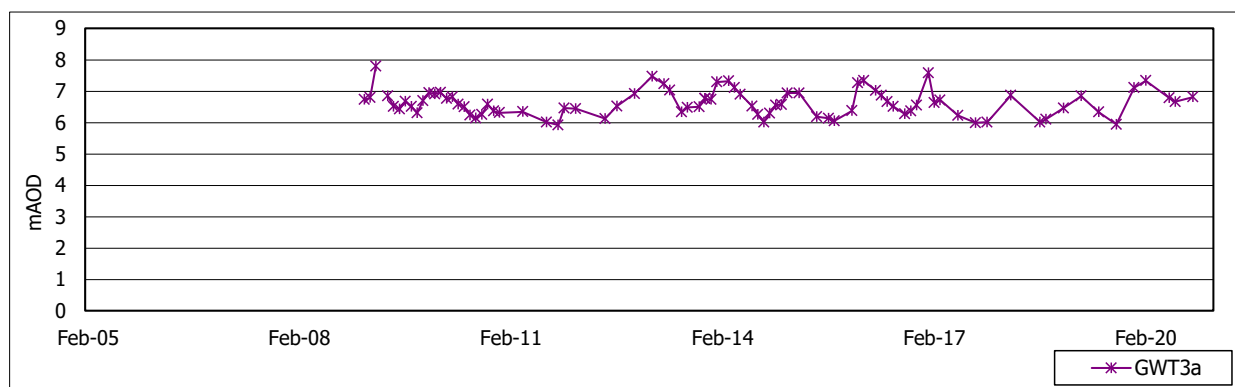
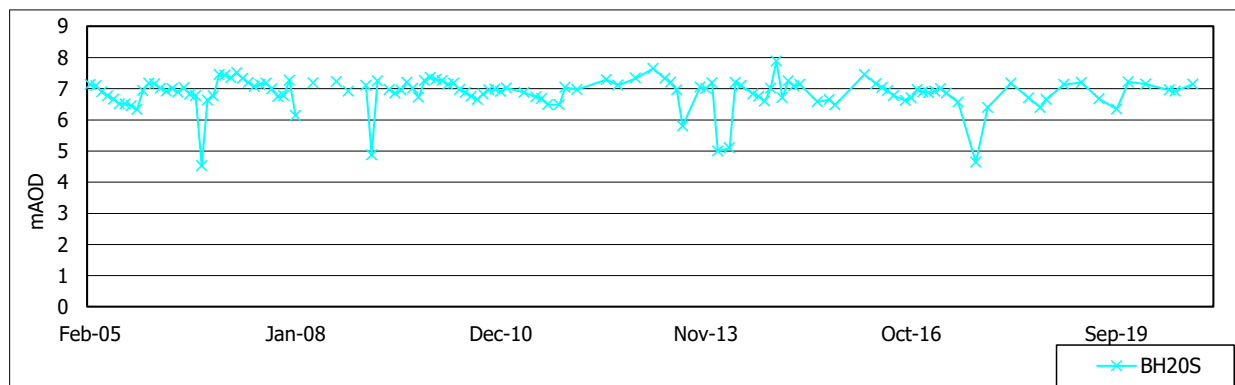


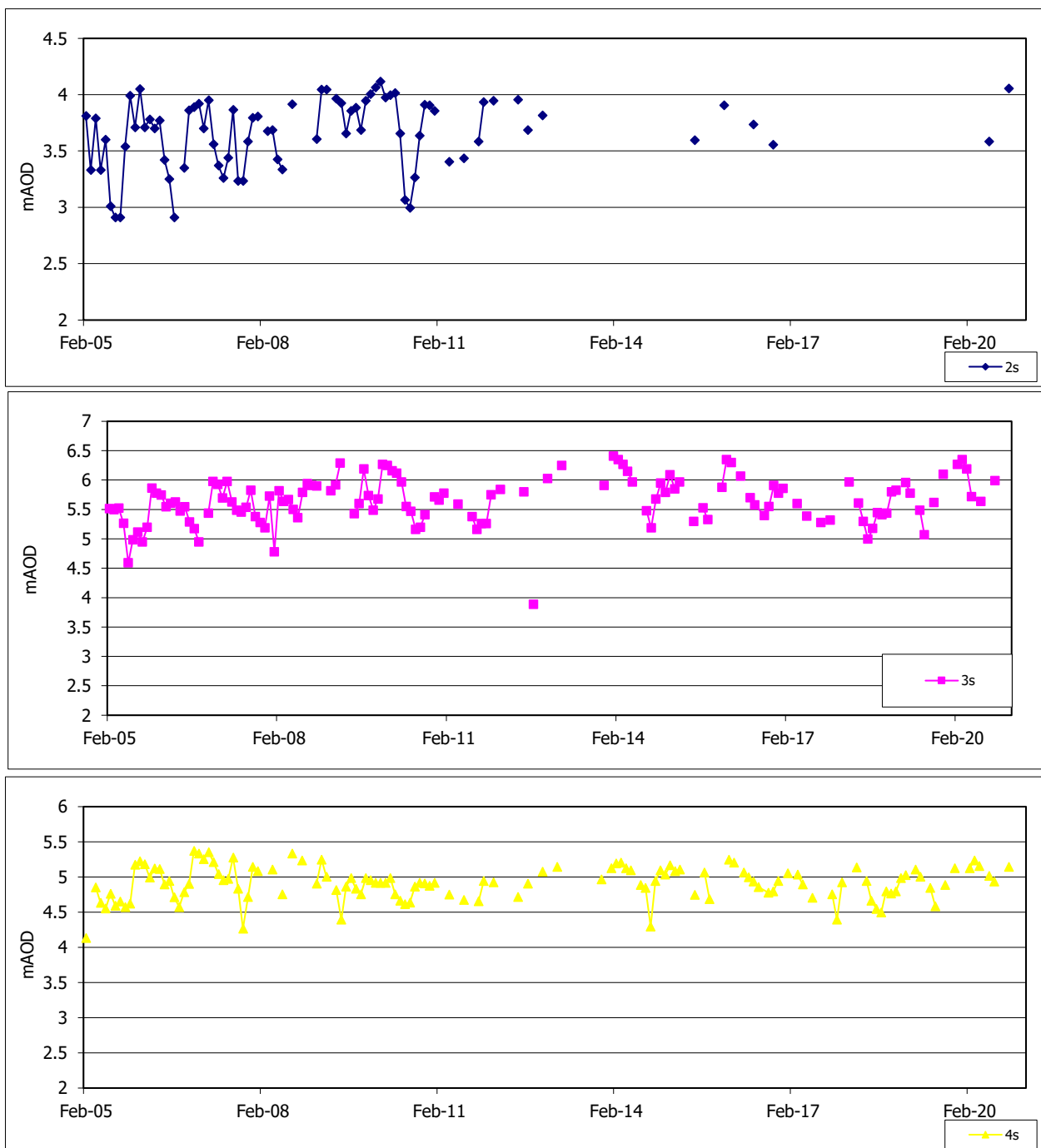


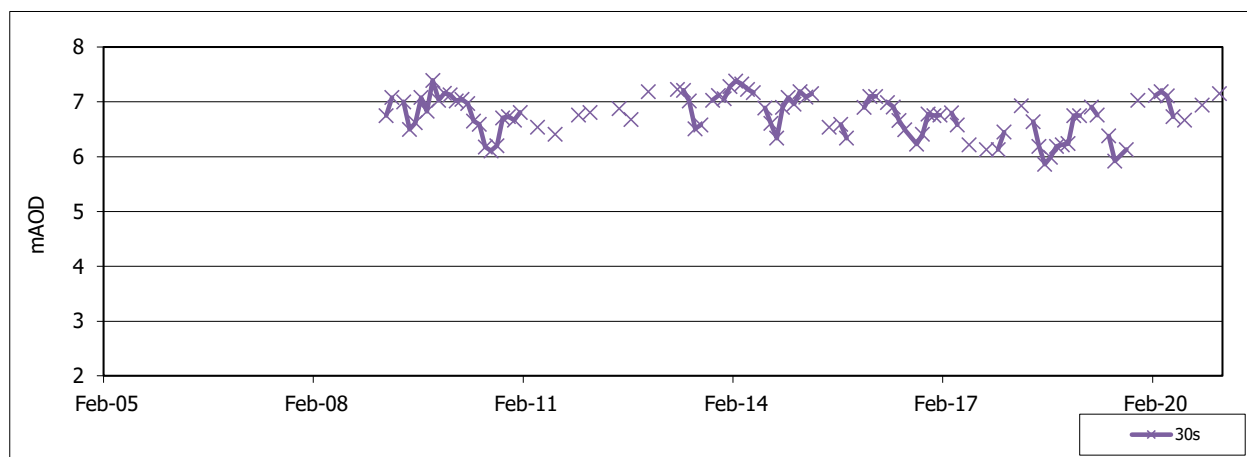
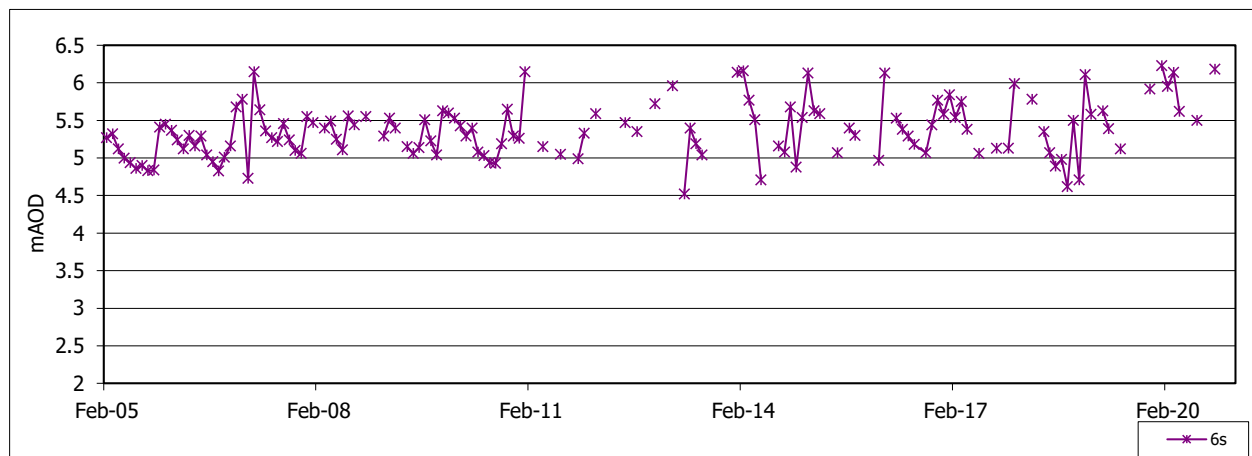


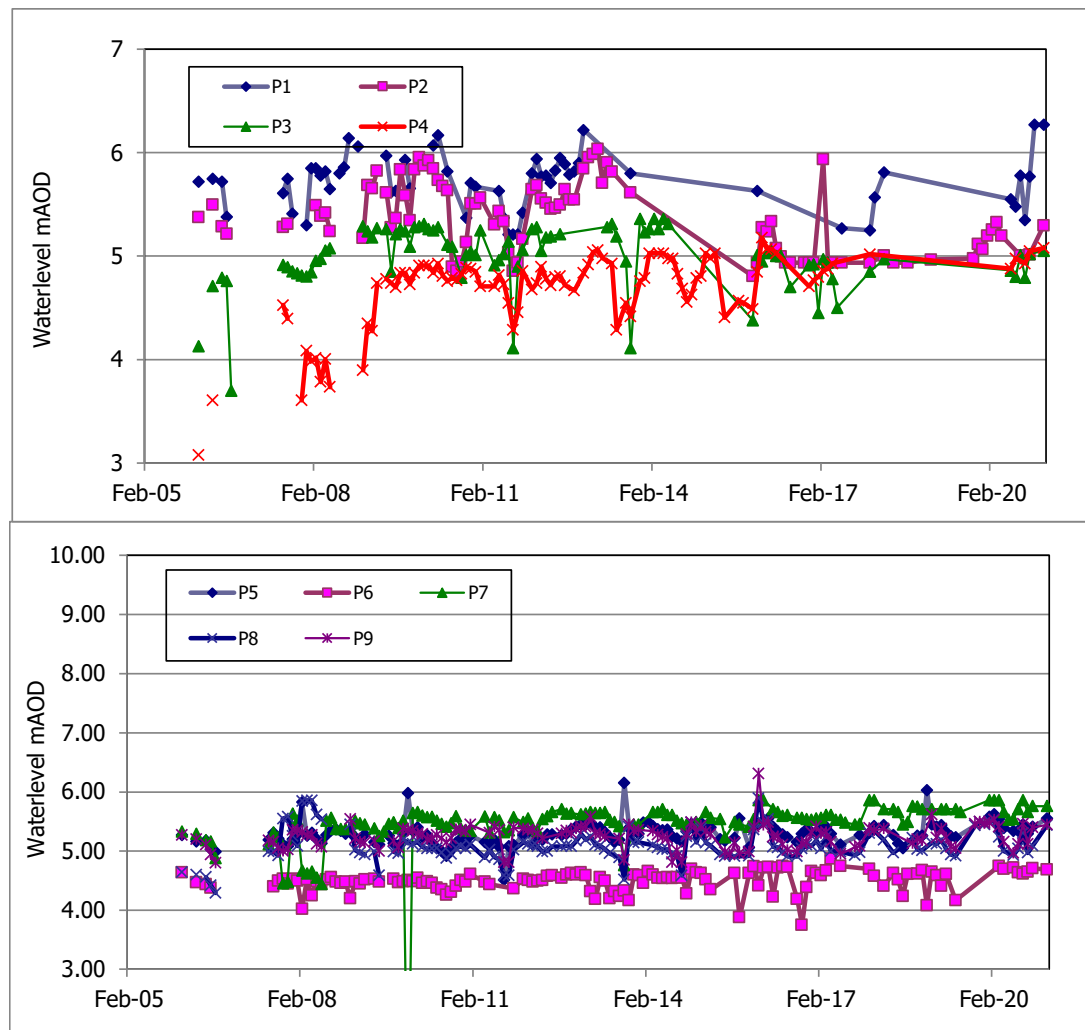


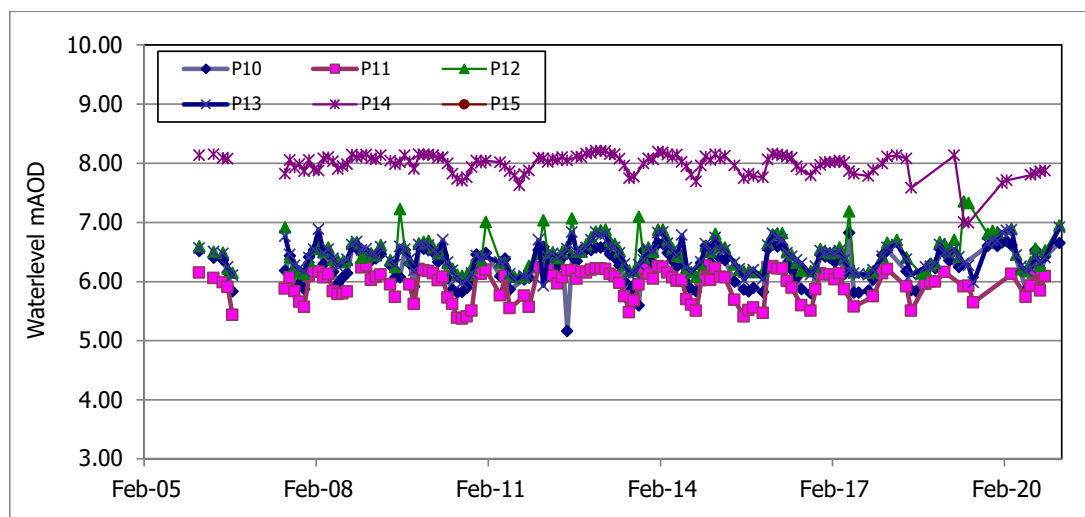


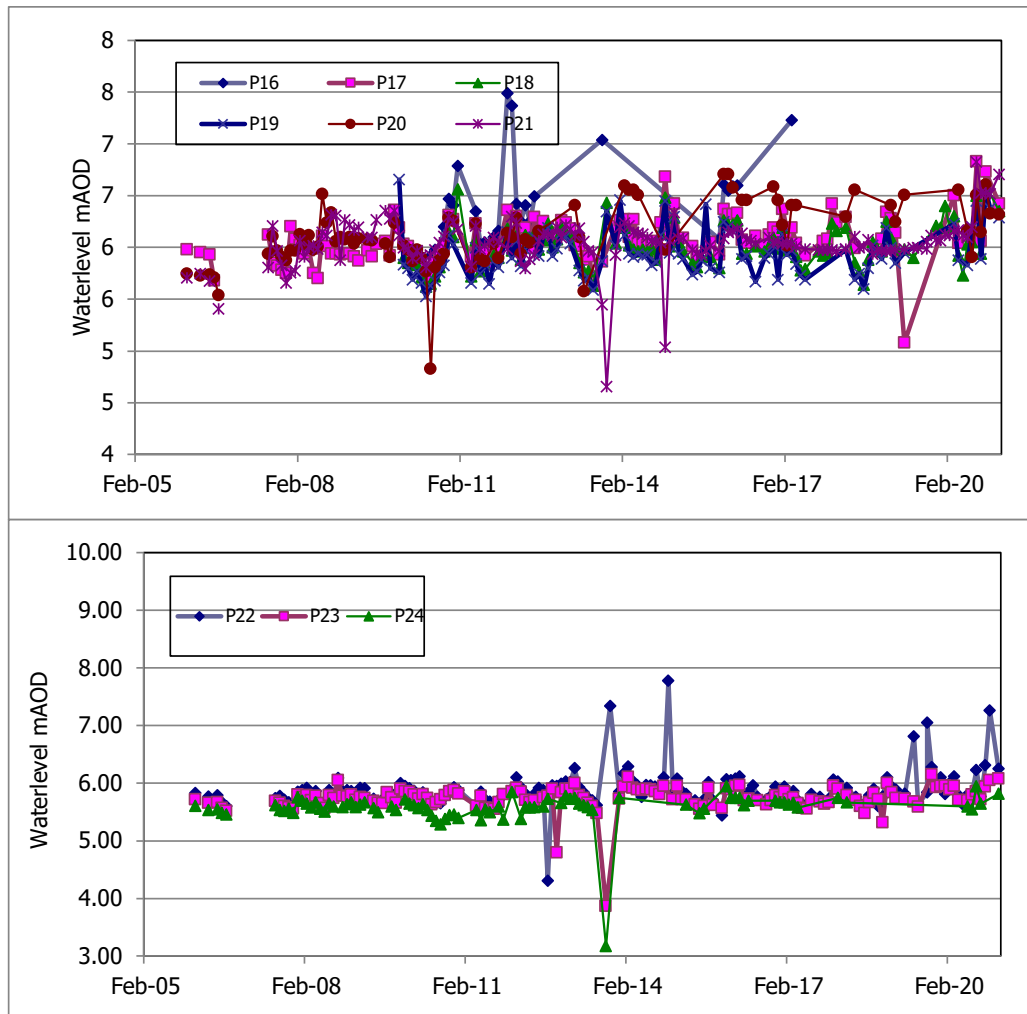


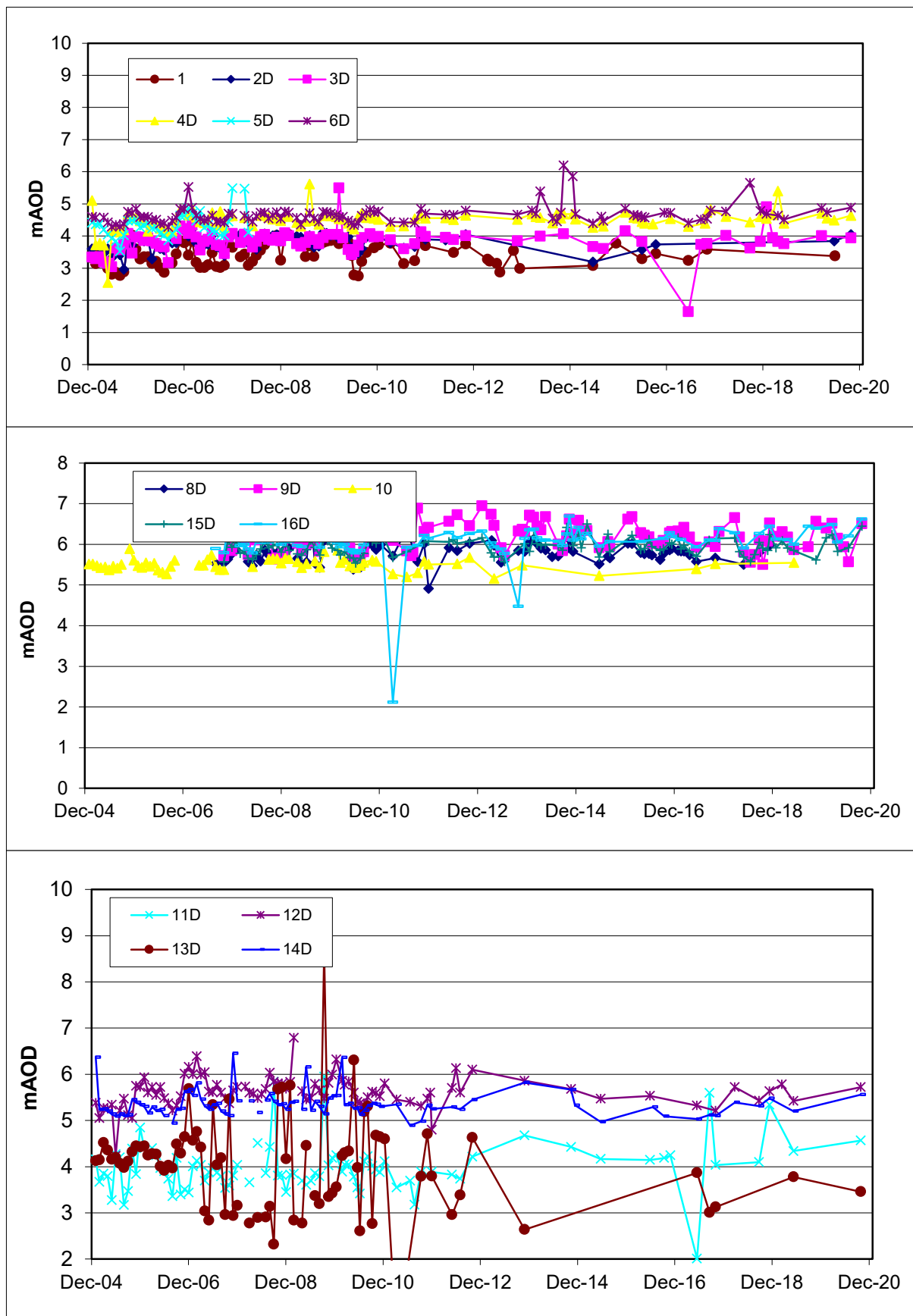


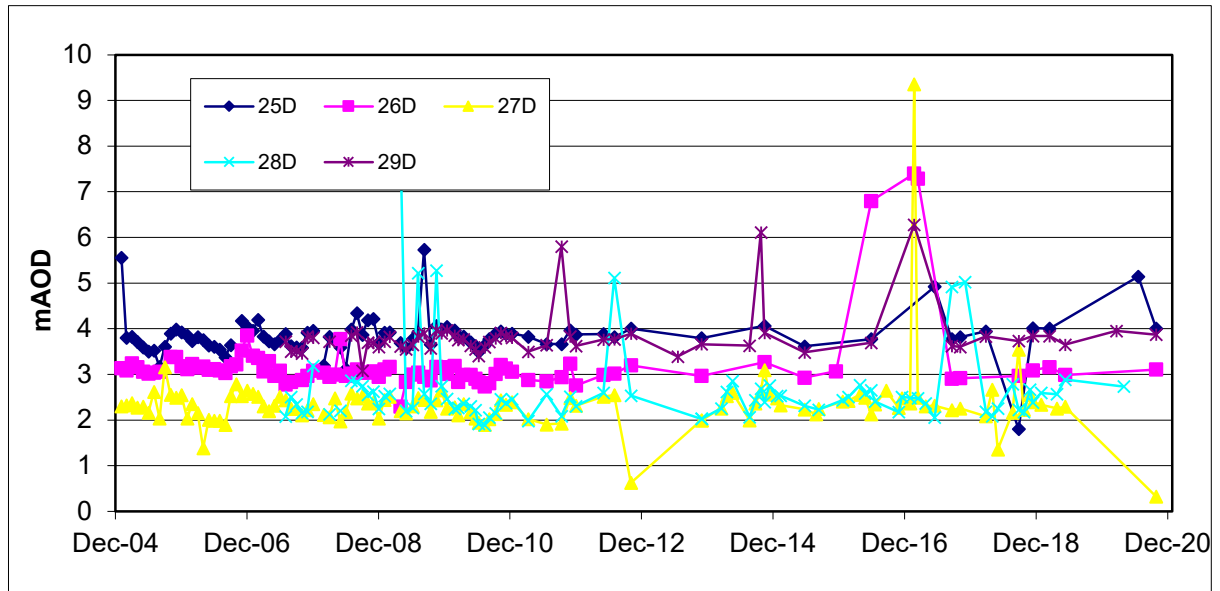
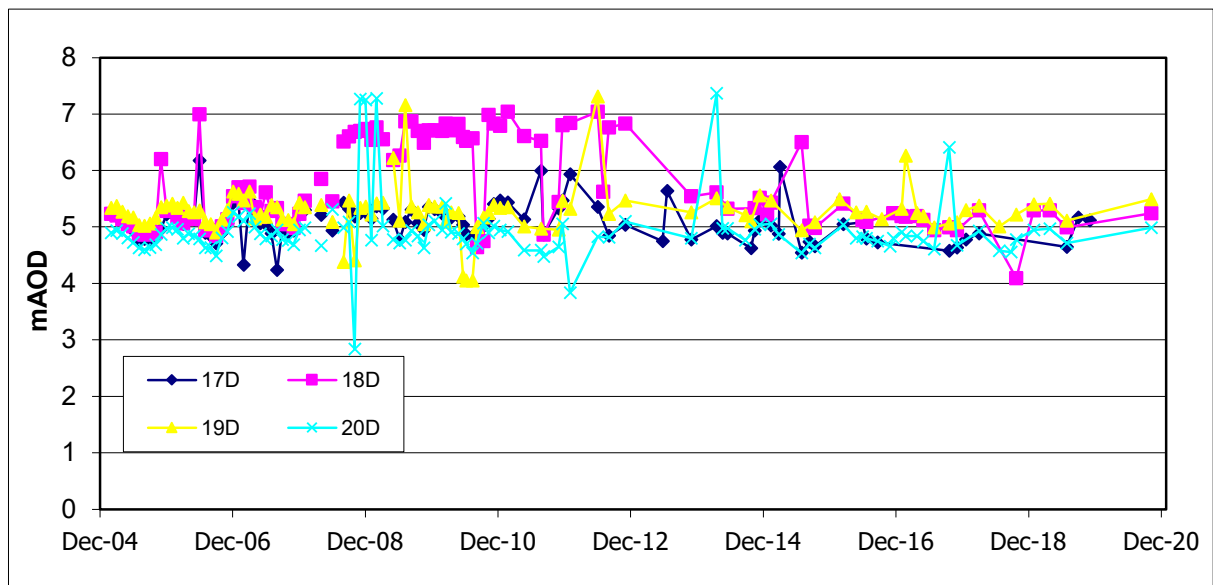












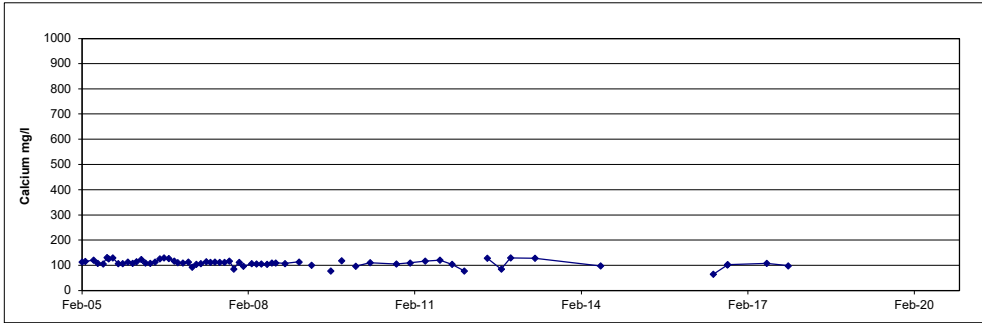
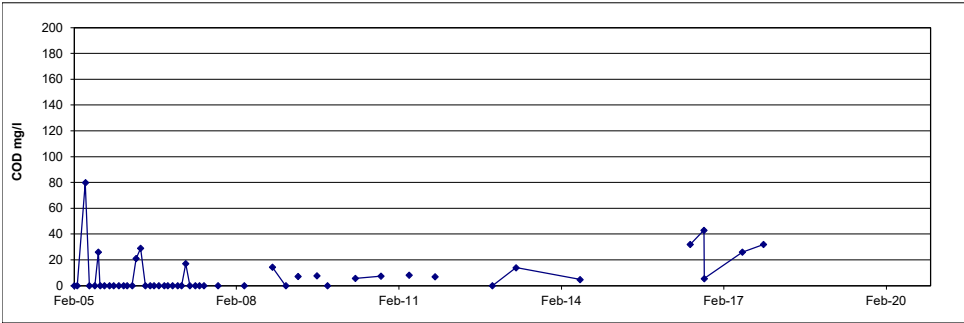
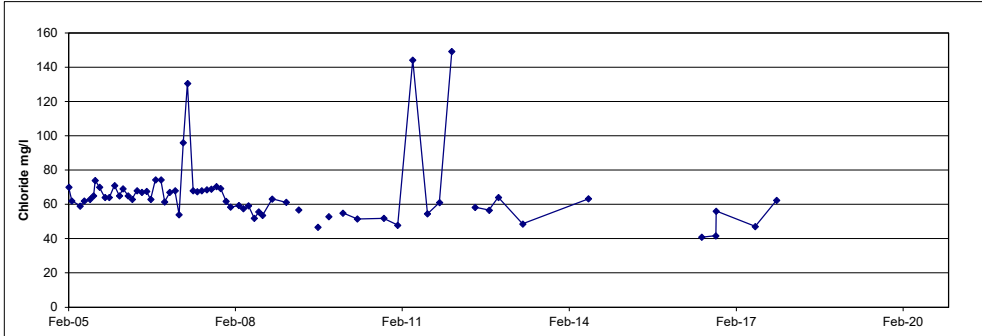
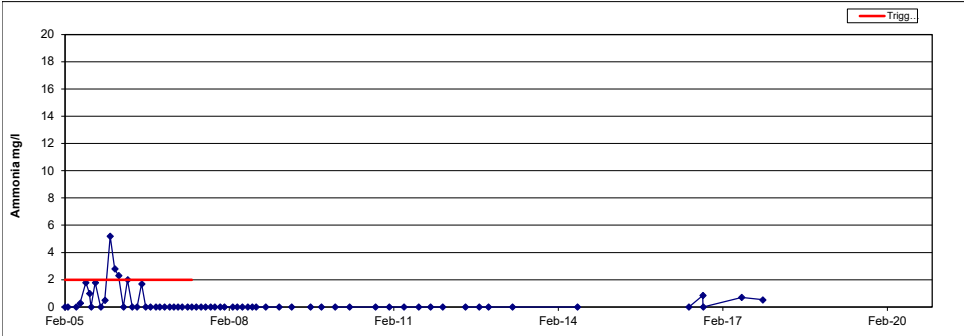
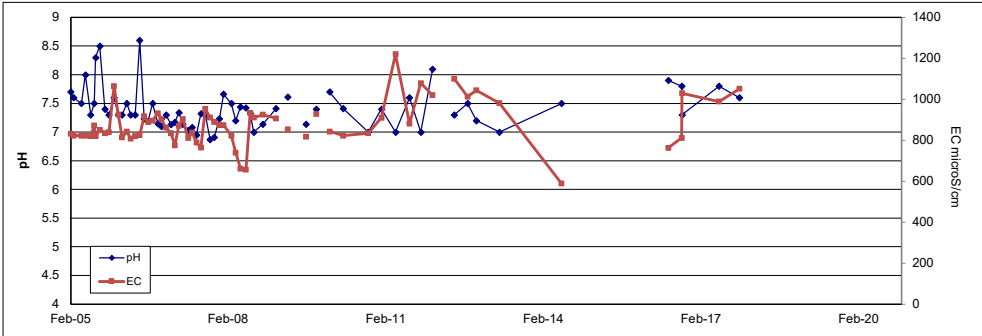
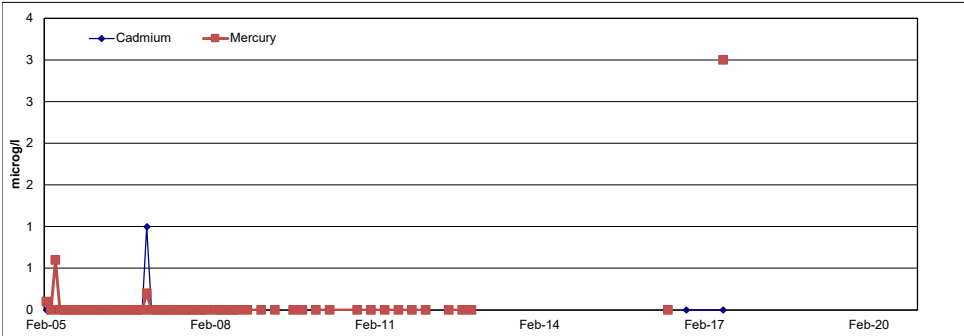
**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

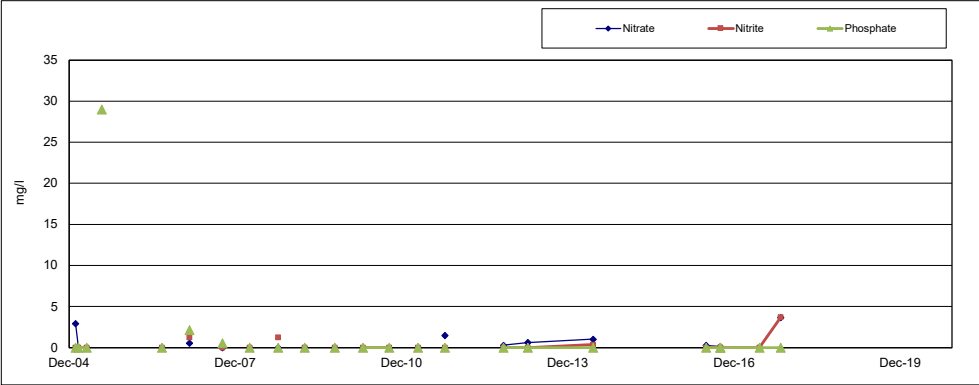
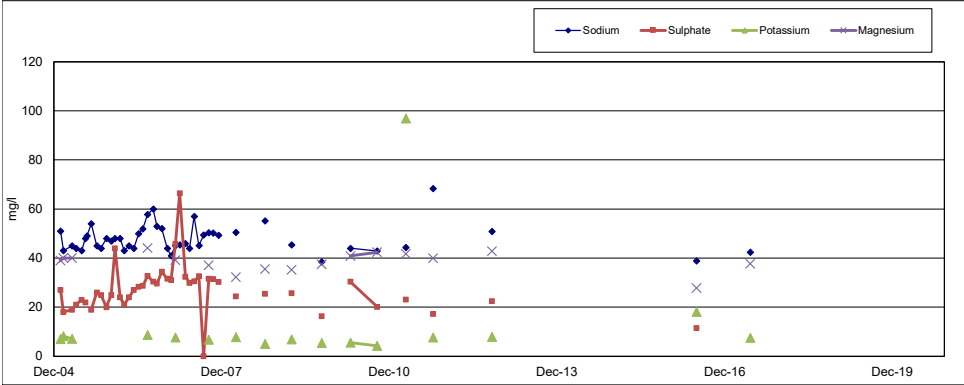
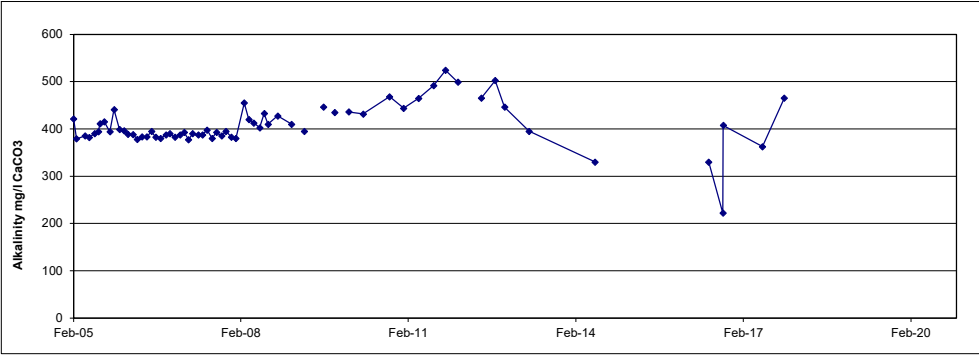
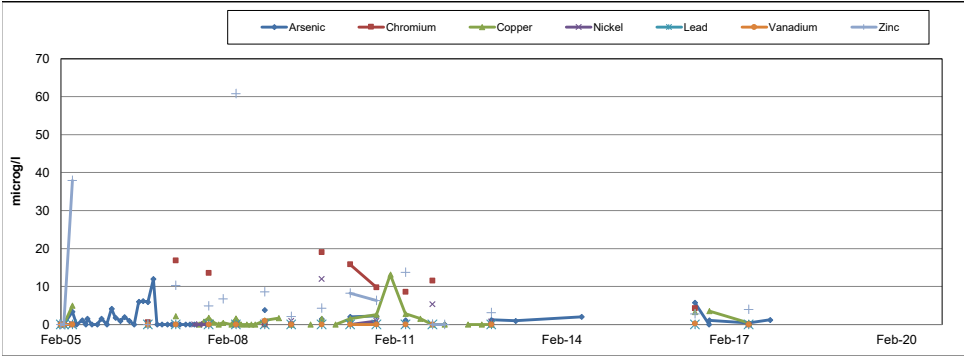
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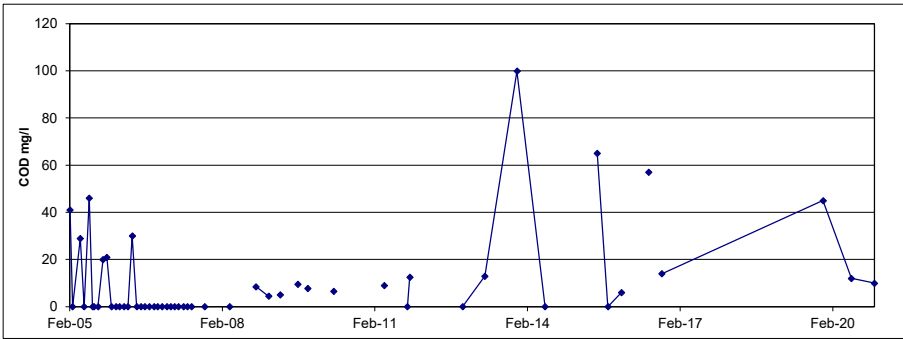
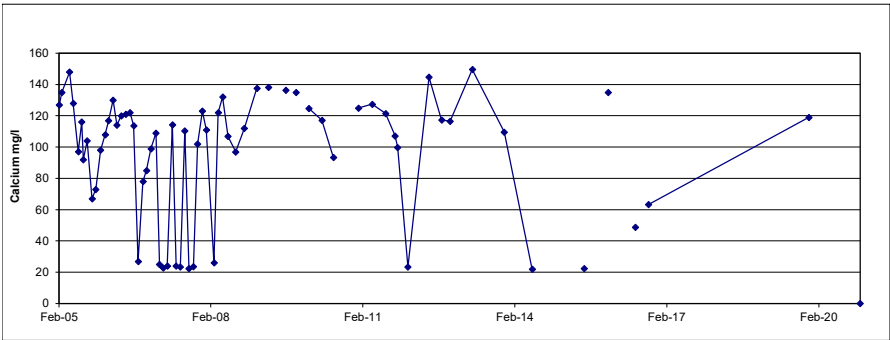
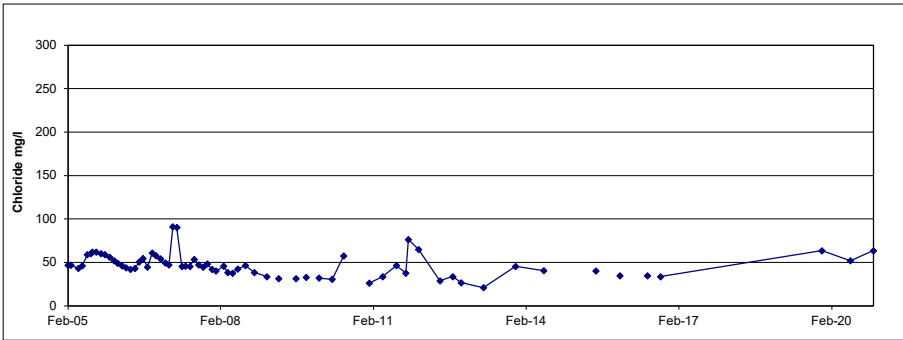
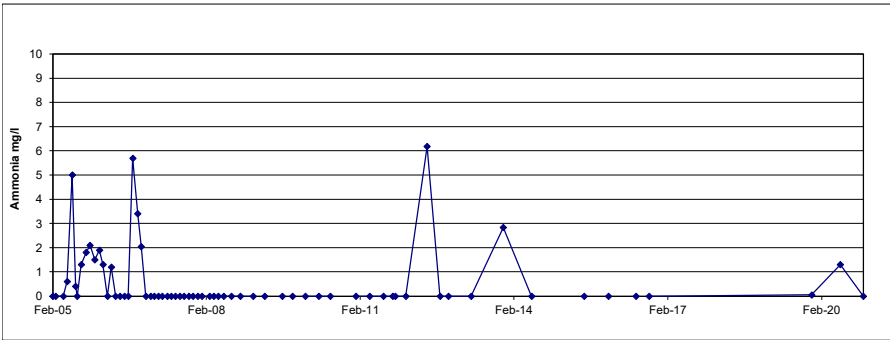
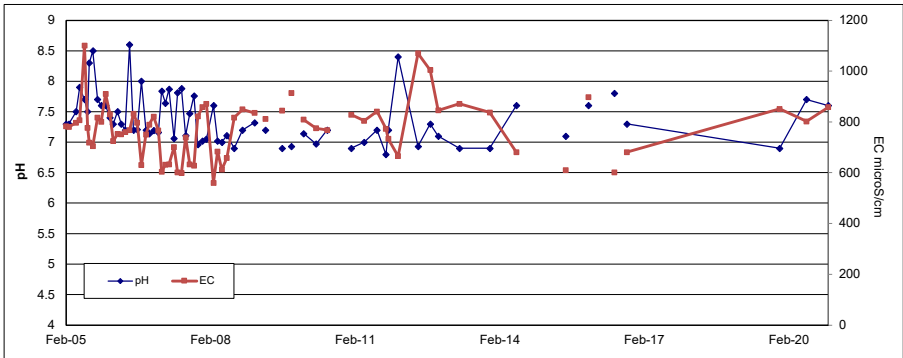
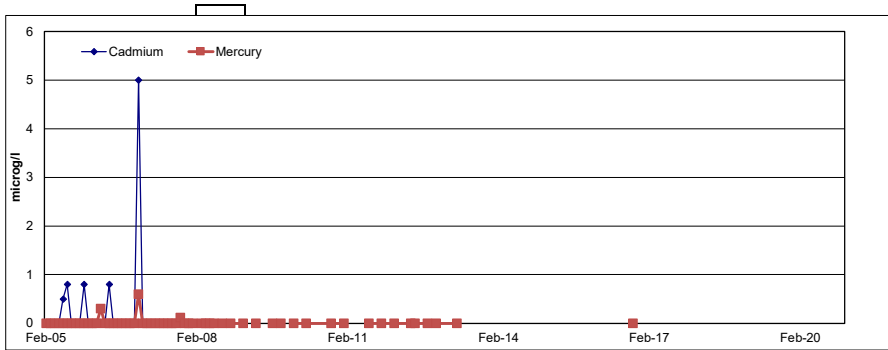
**2020 Annual Review of
Environmental
Monitoring**

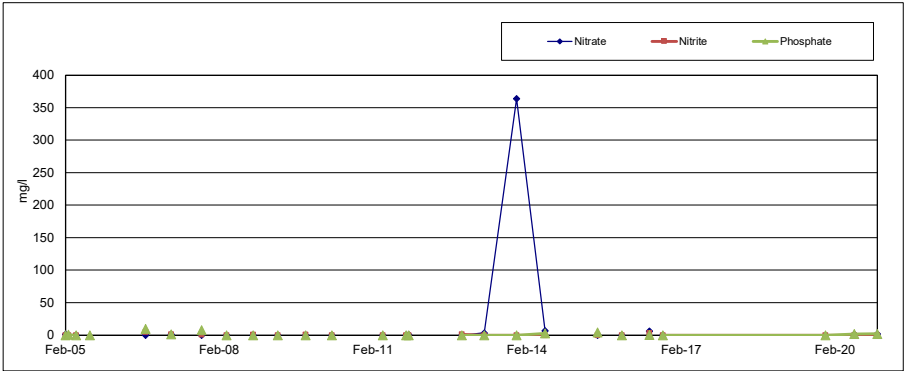
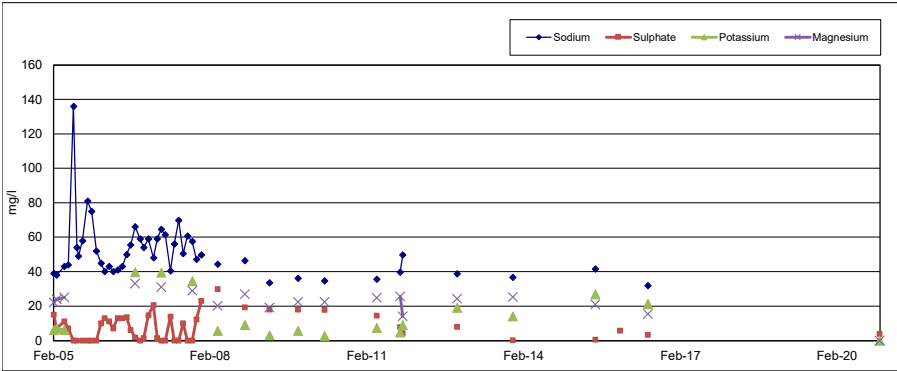
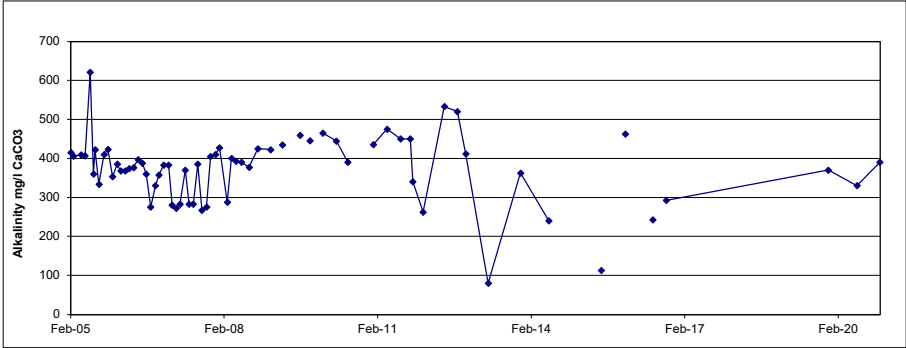
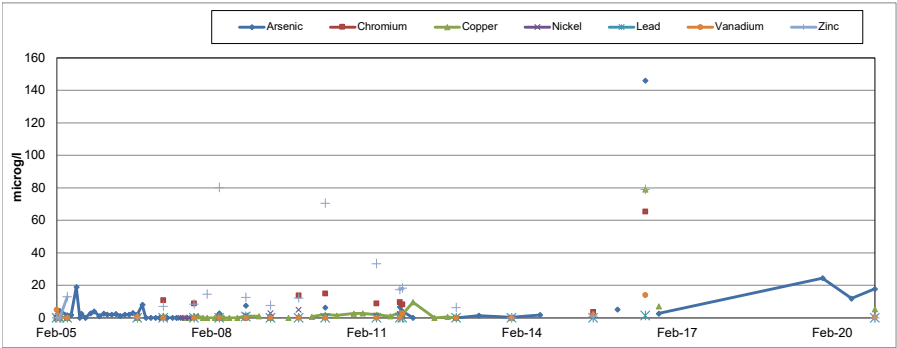
**Appendix 6
Temporal Variation of
Groundwater
Chemistry**

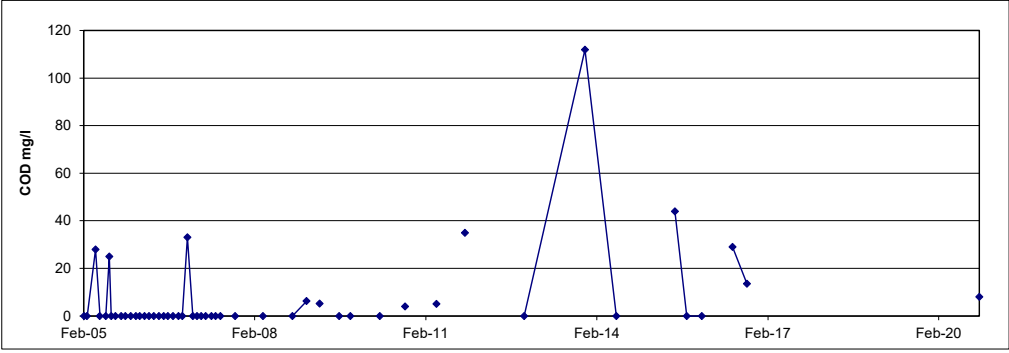
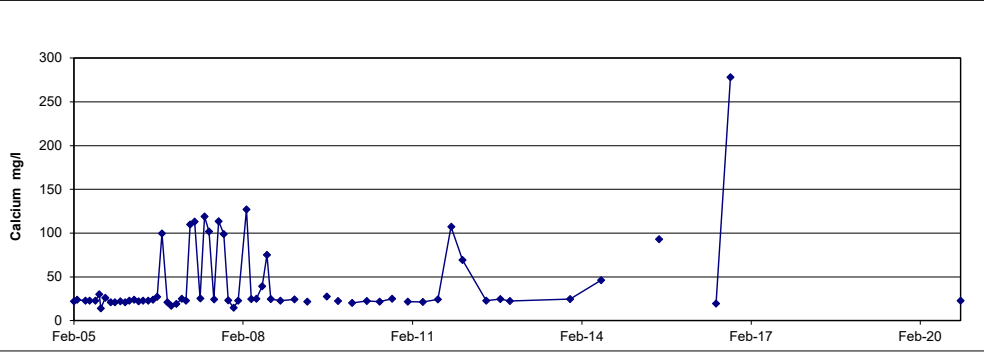
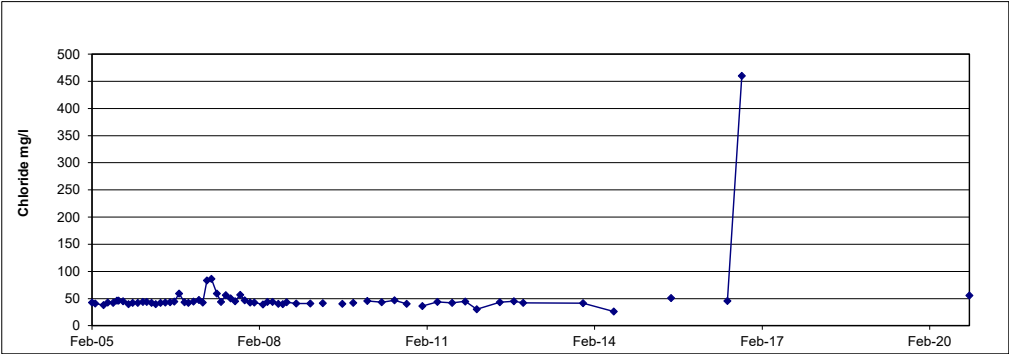
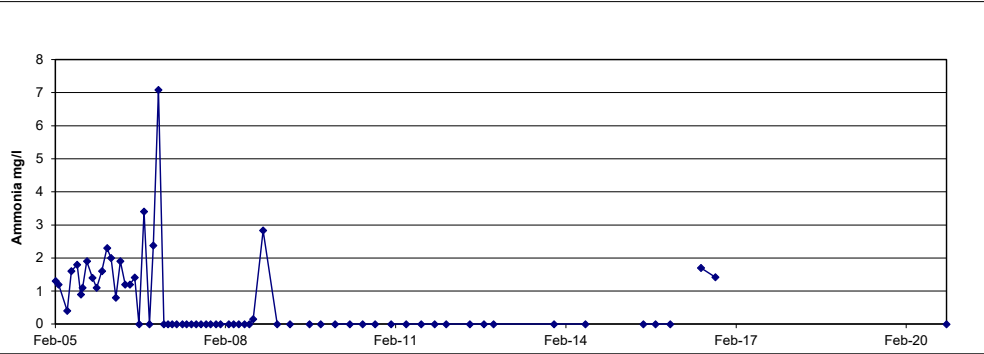
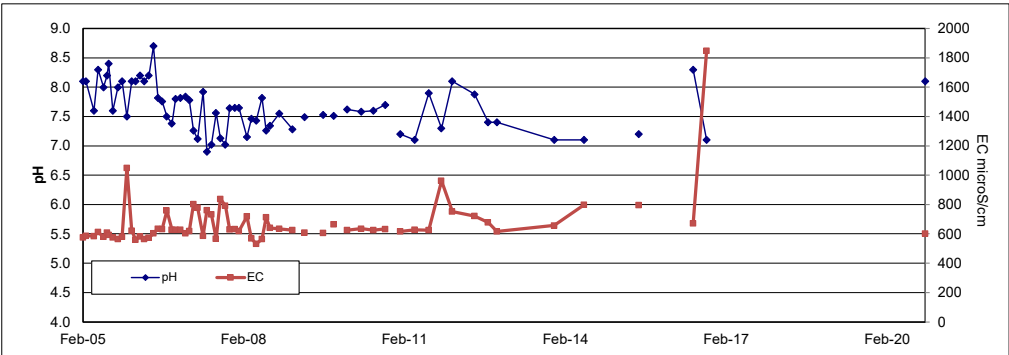
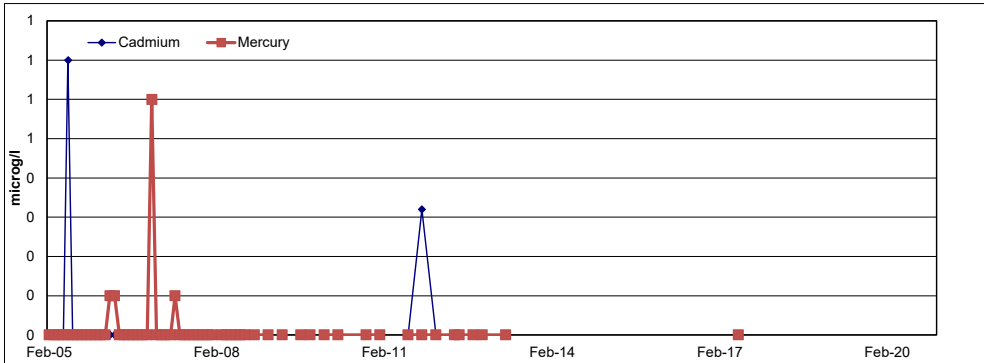
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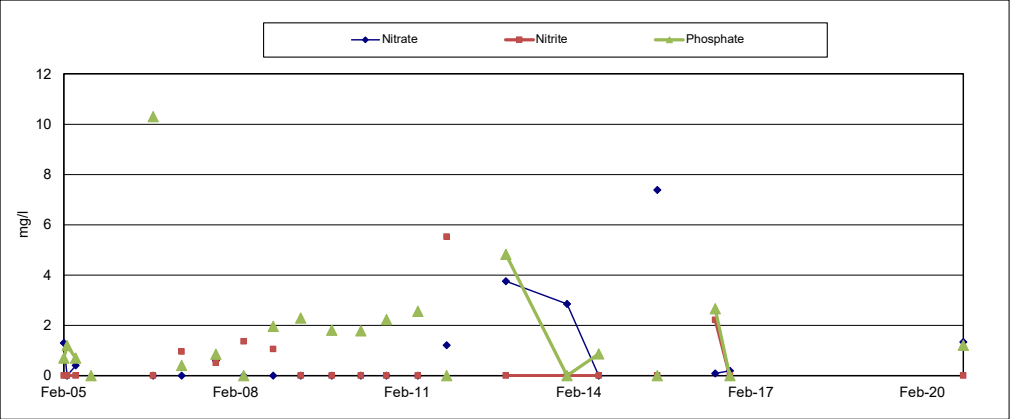
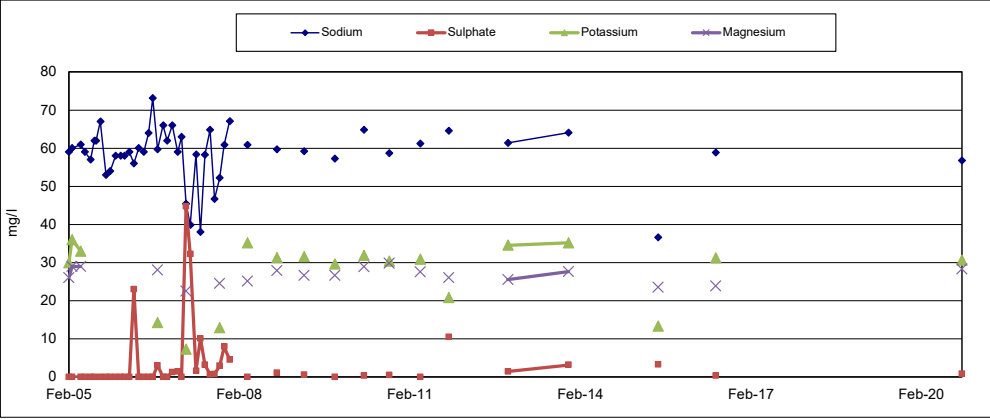
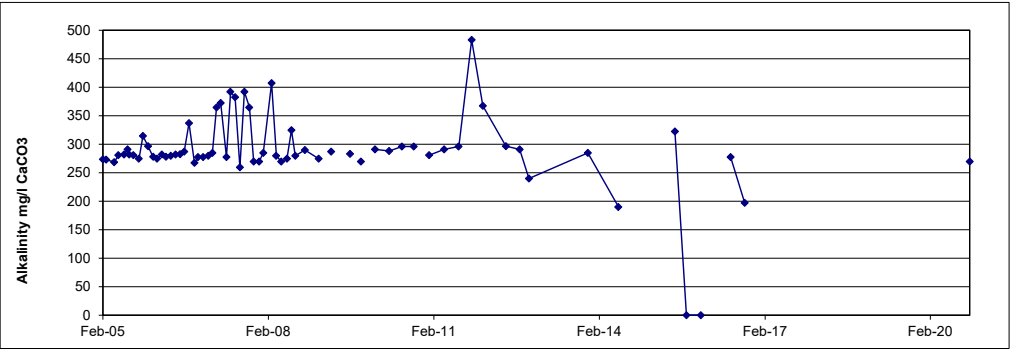
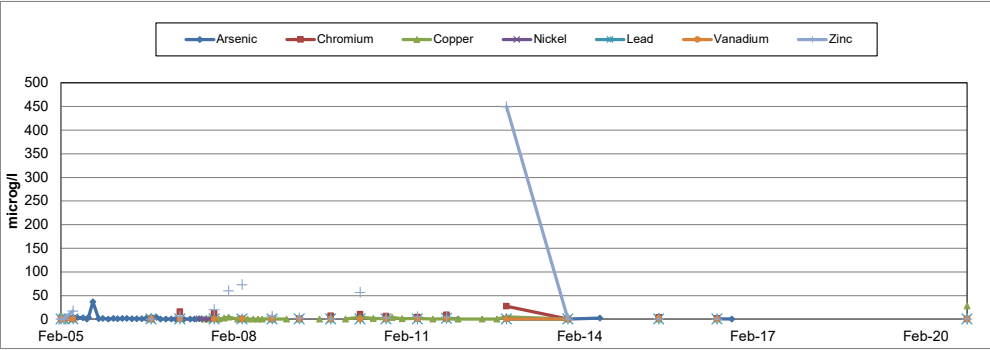


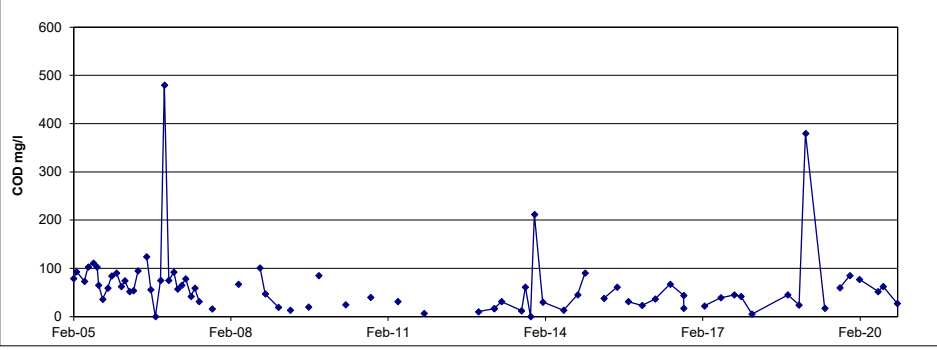
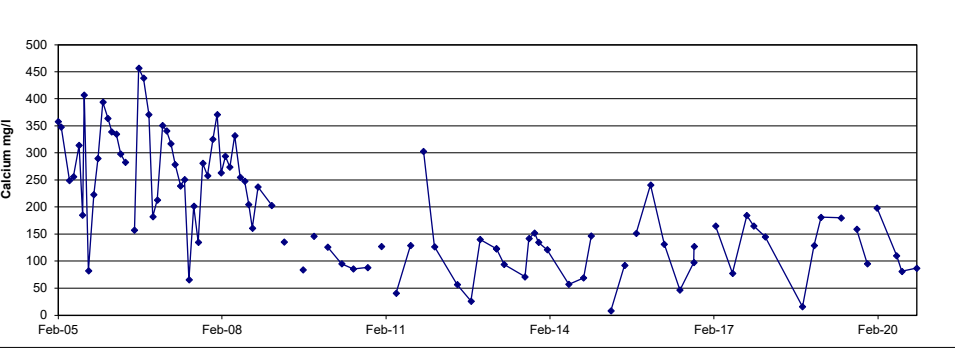
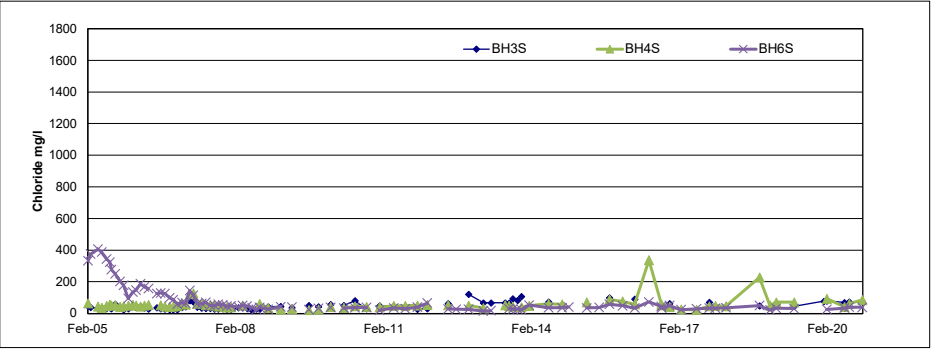
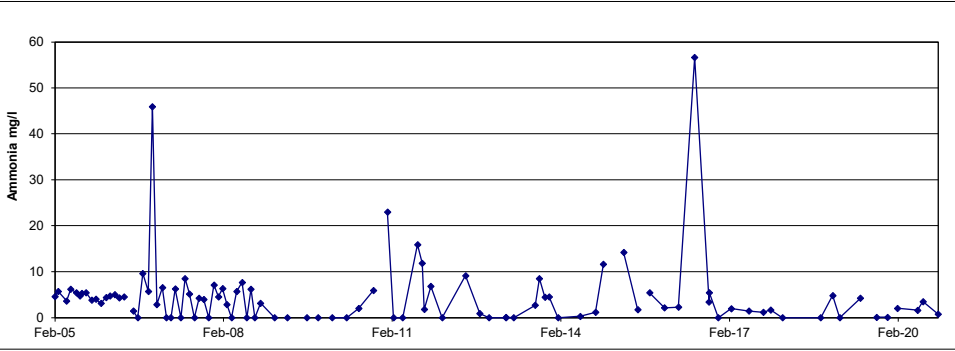
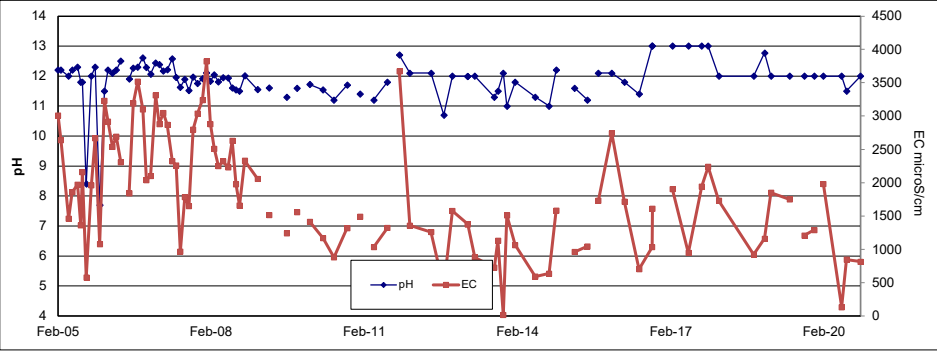
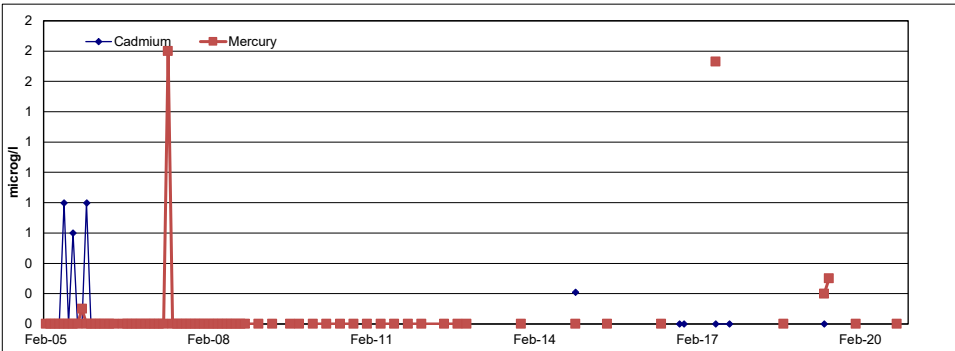


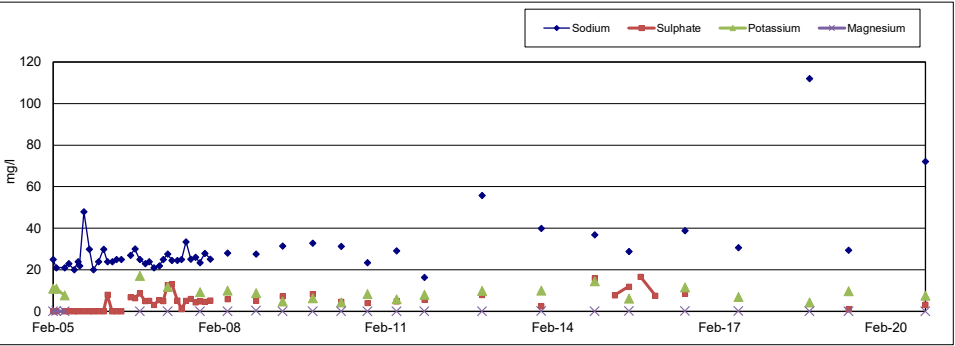
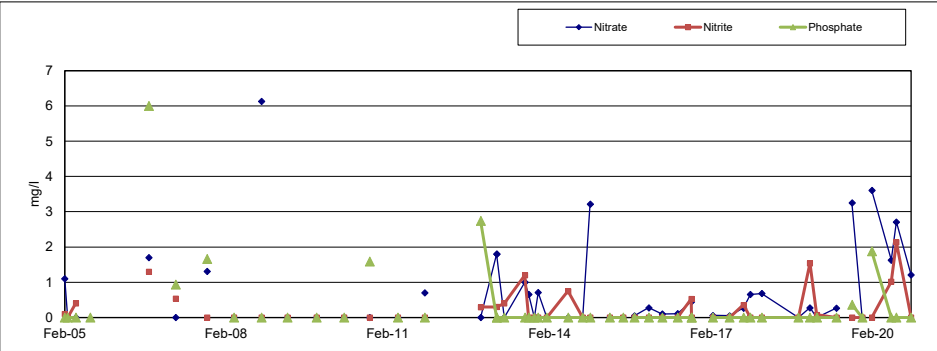
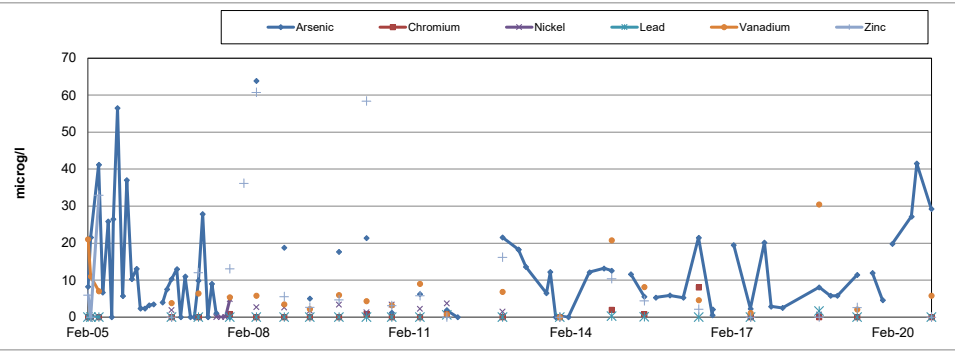
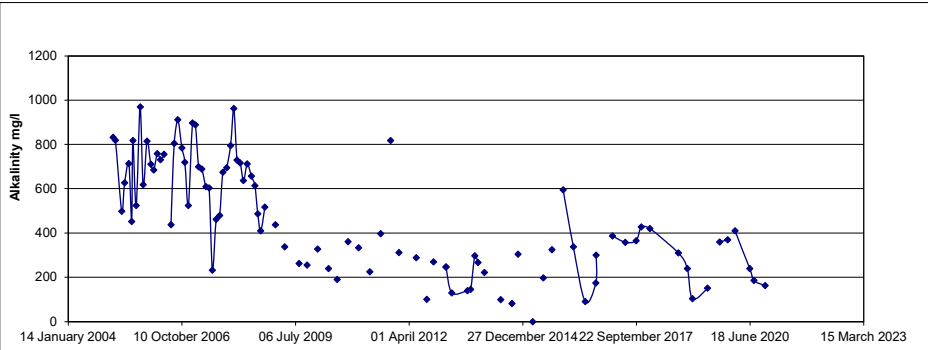
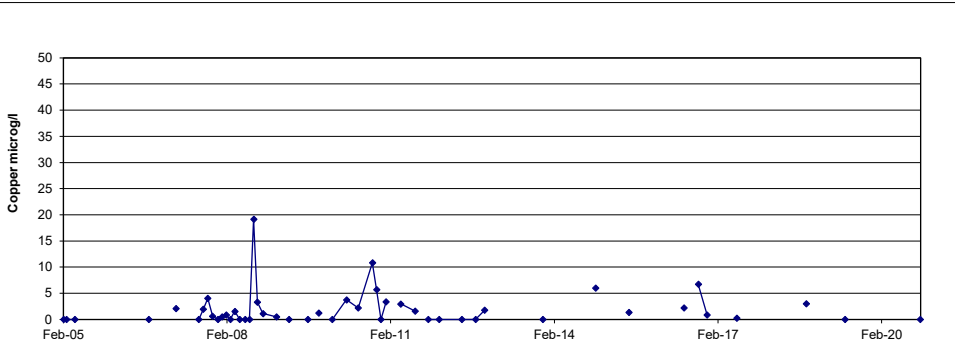


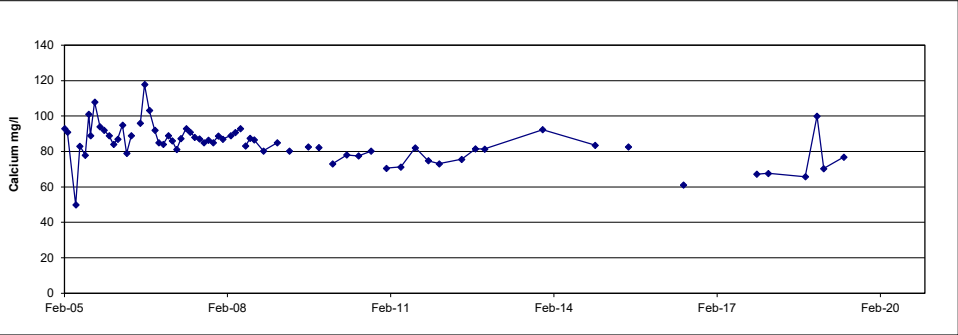
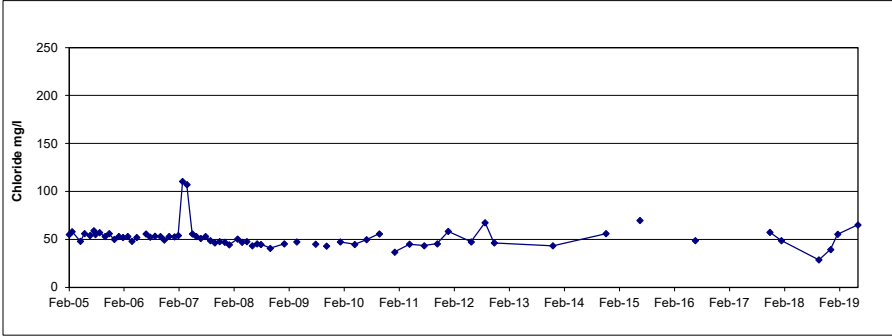
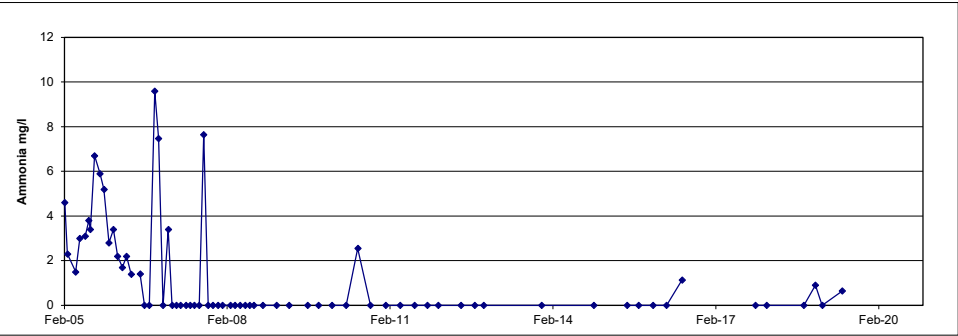
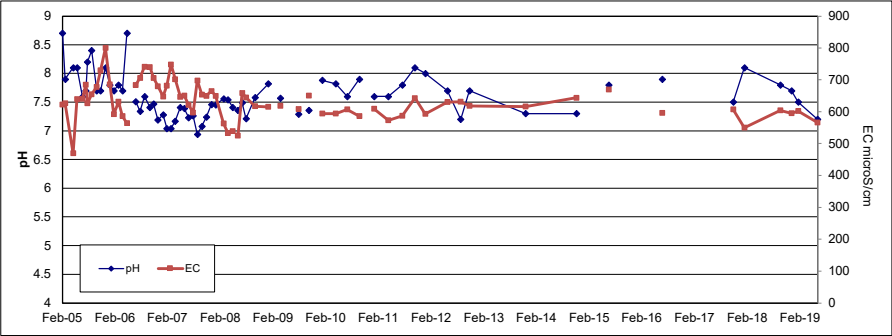
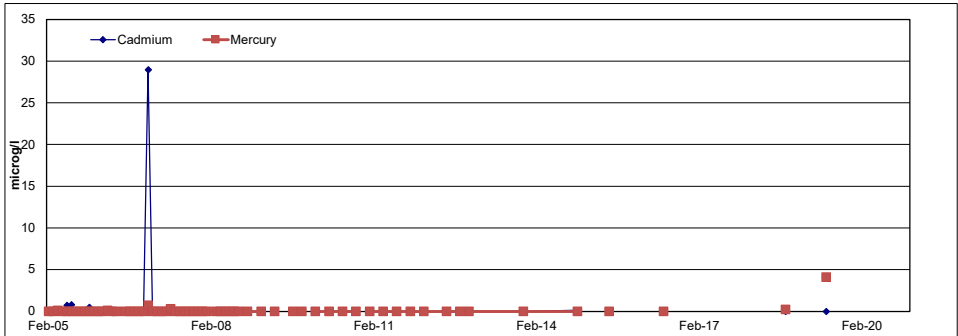


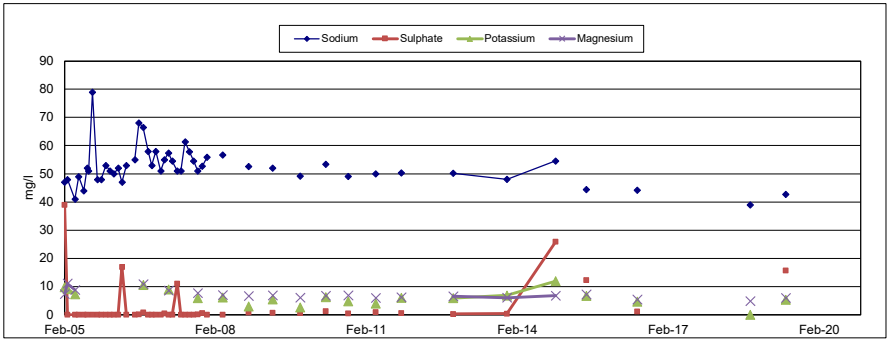
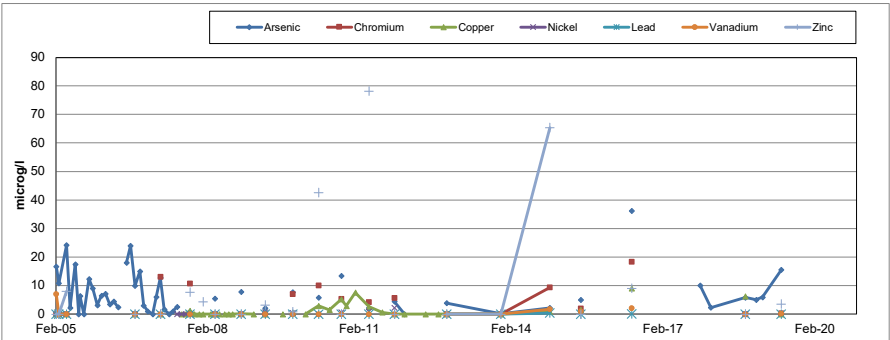
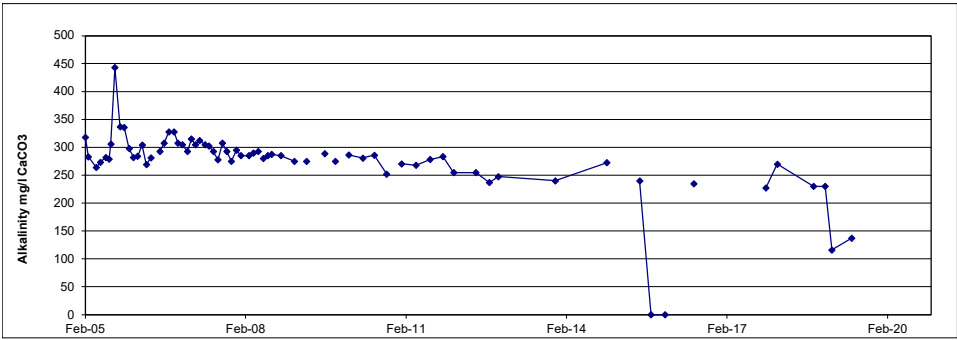
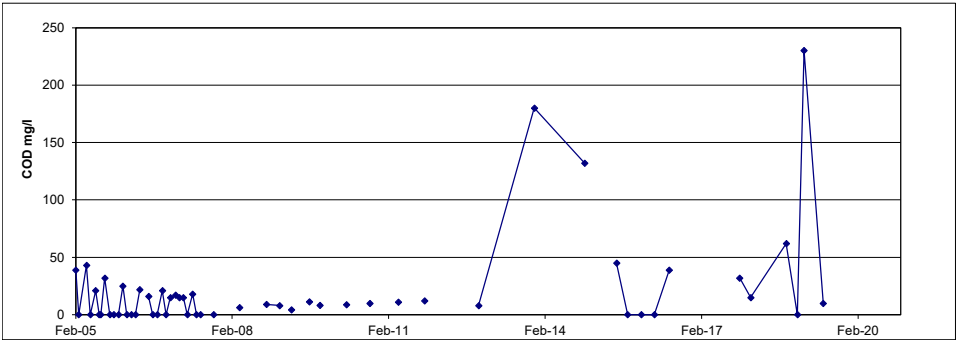


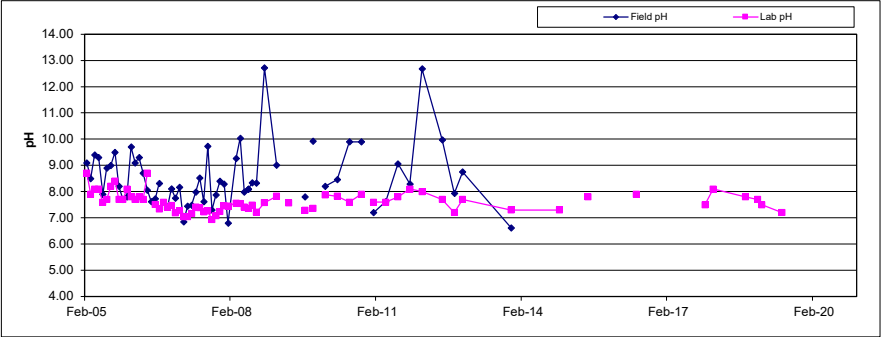
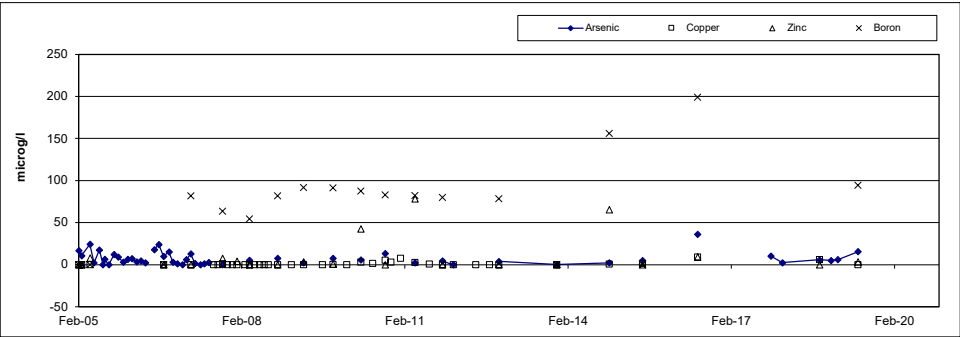
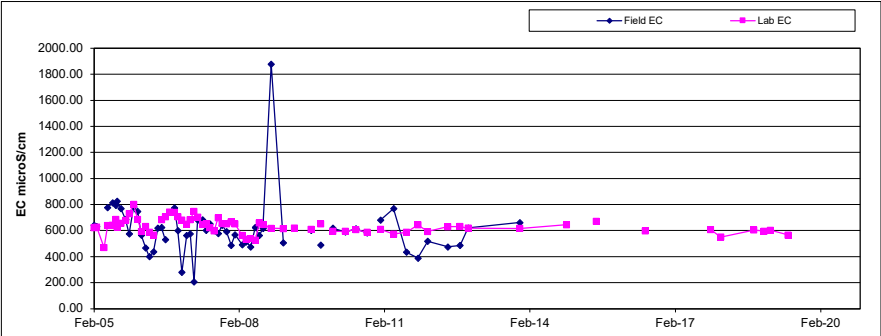
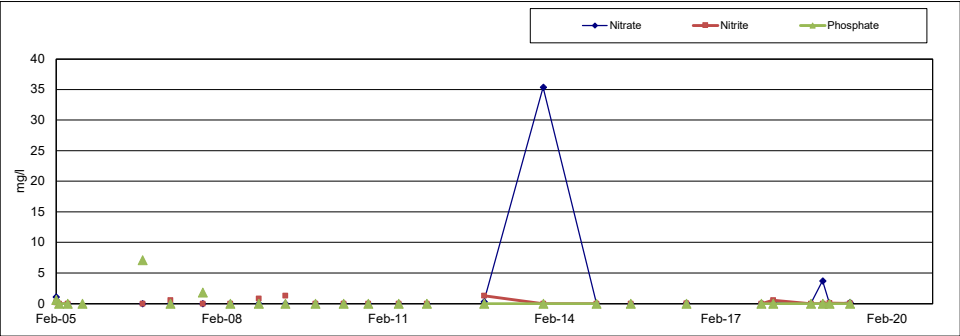


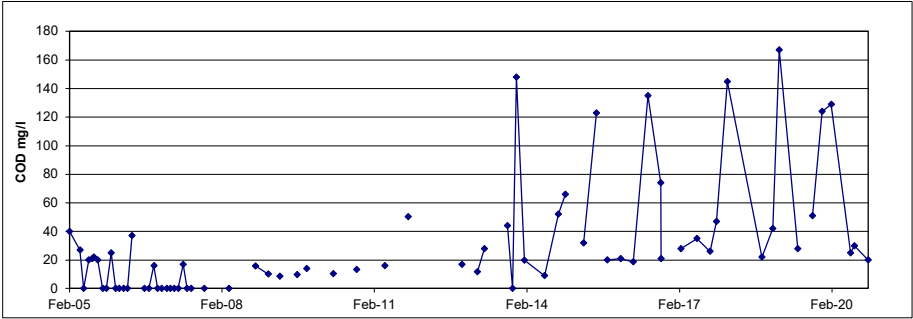
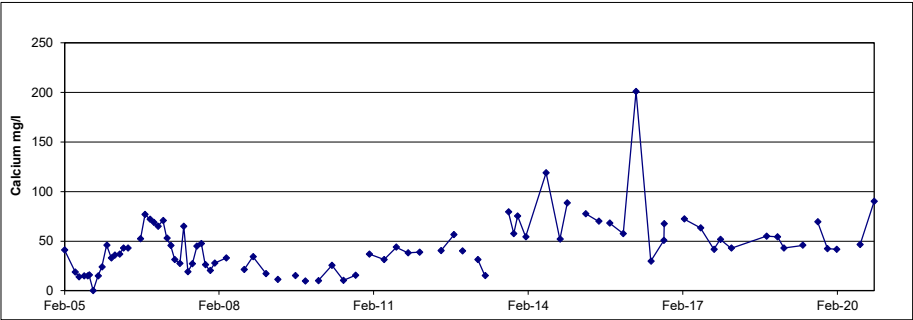
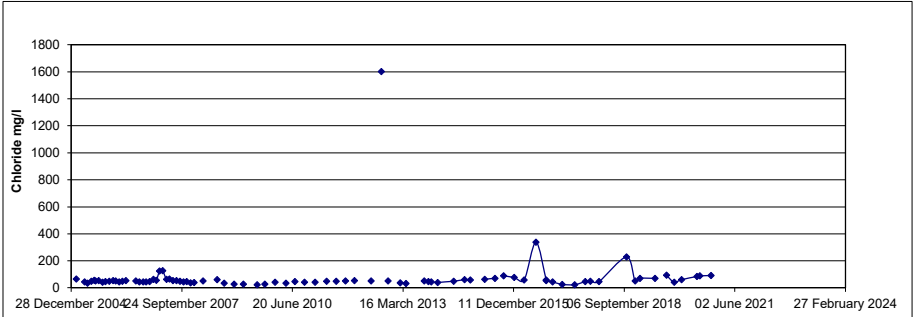
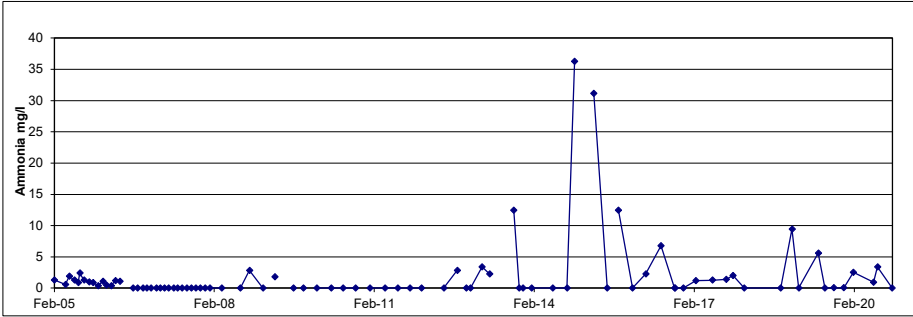
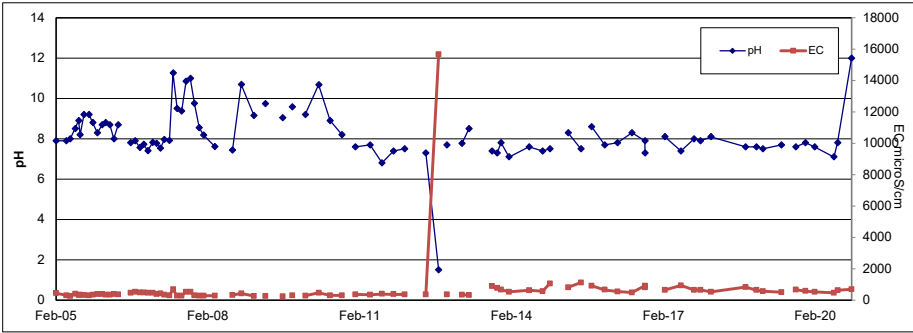
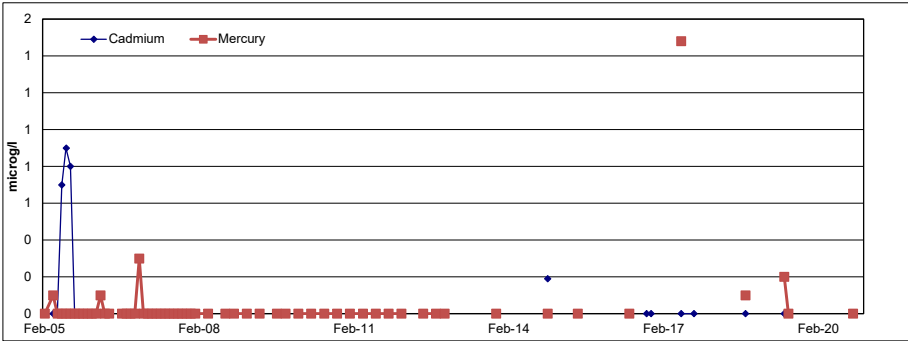


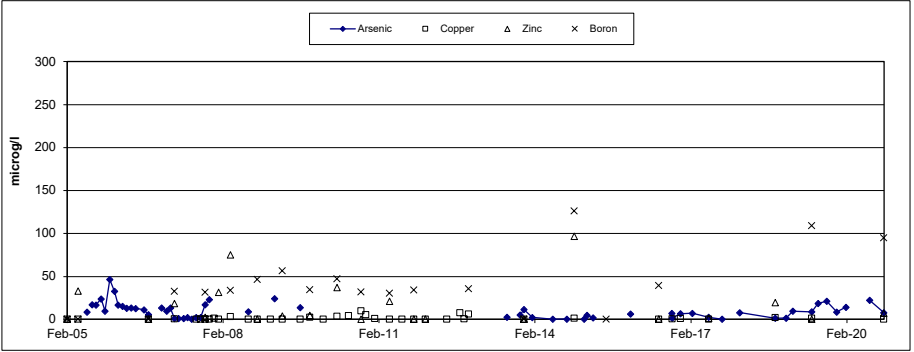
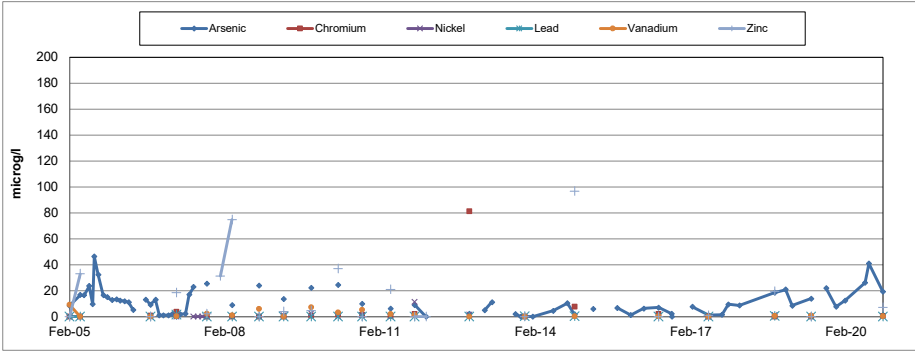
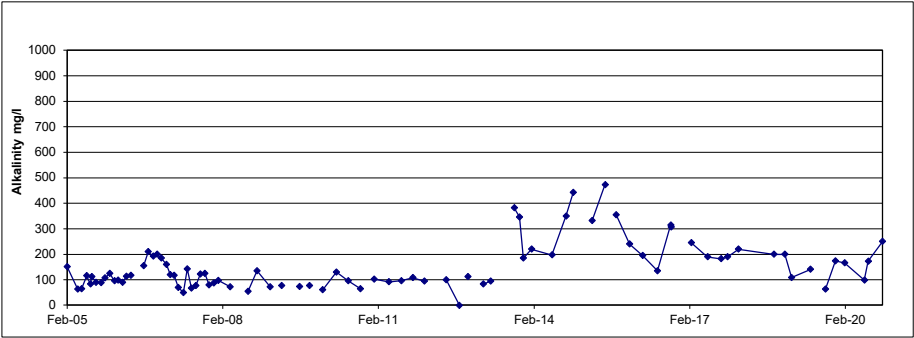
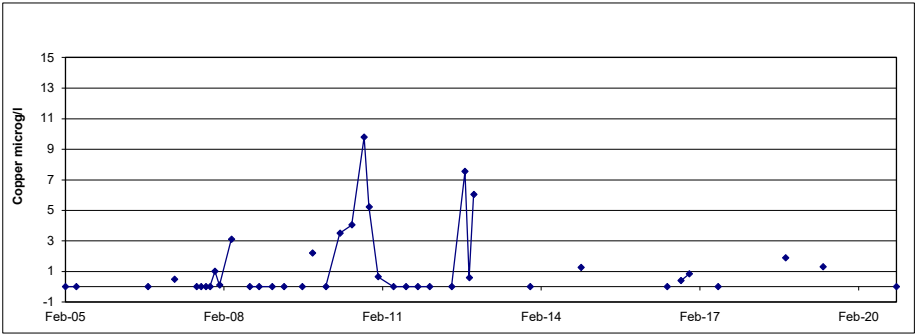


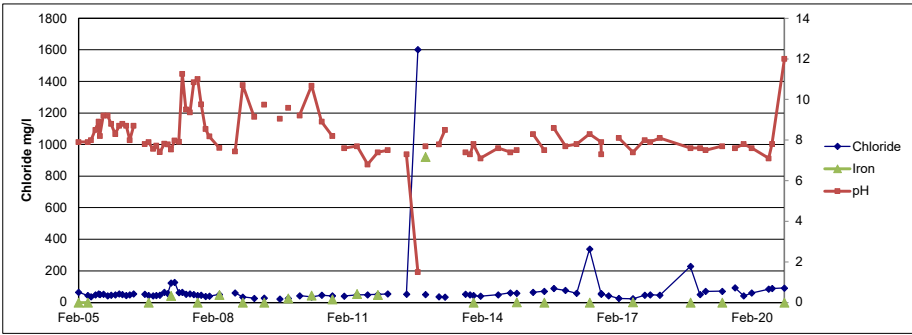
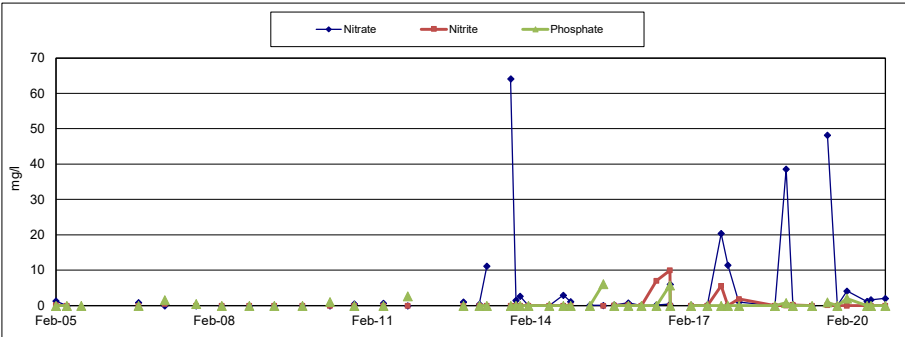
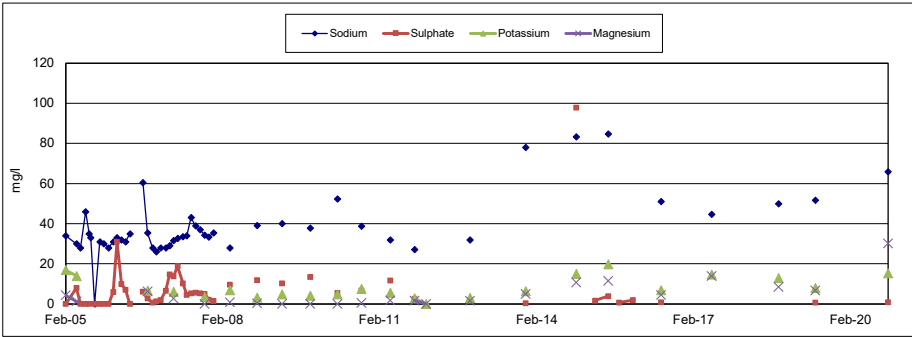


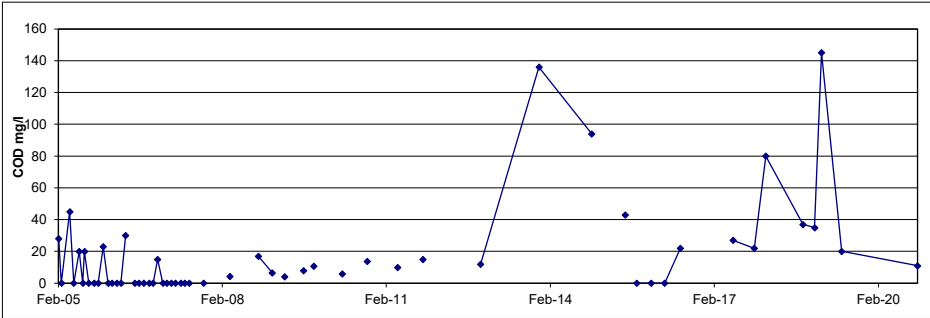
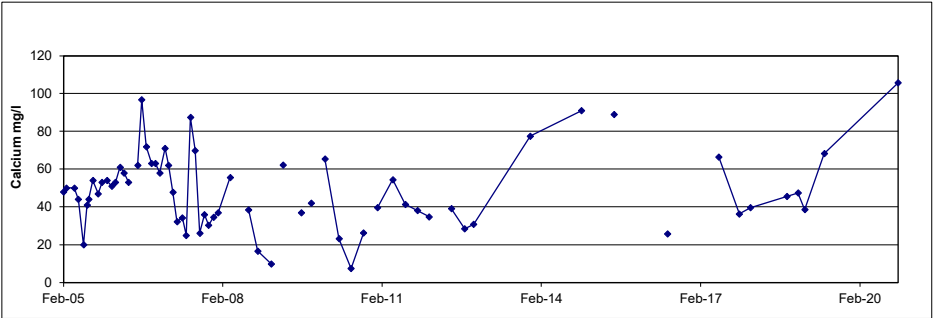
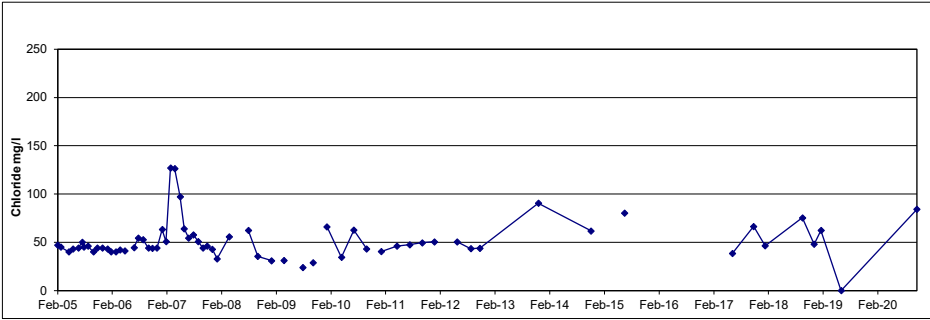
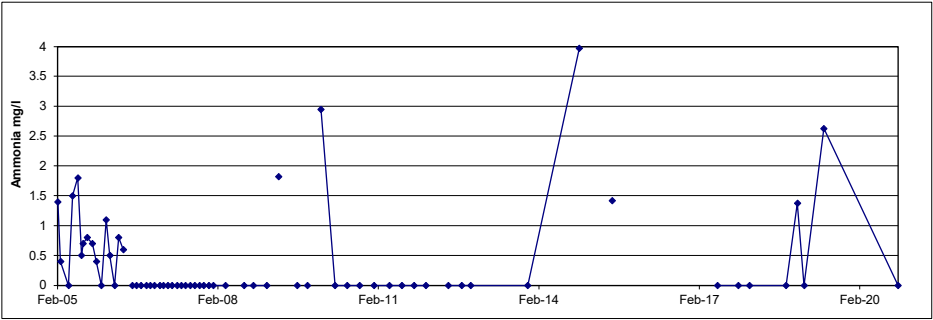
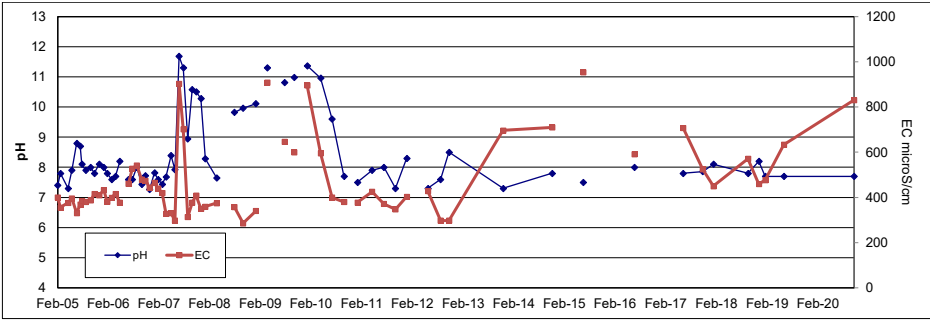
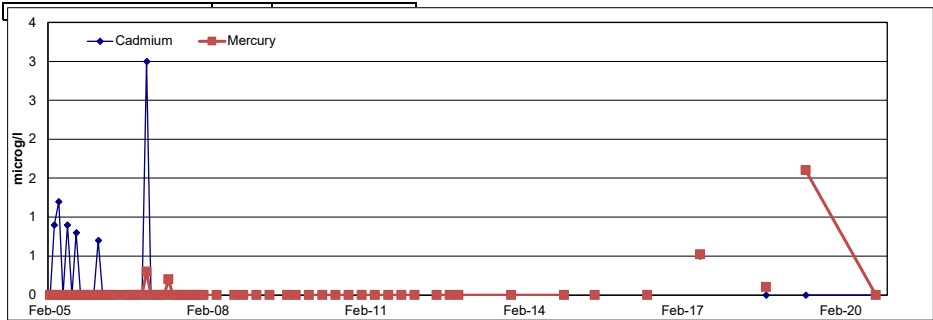


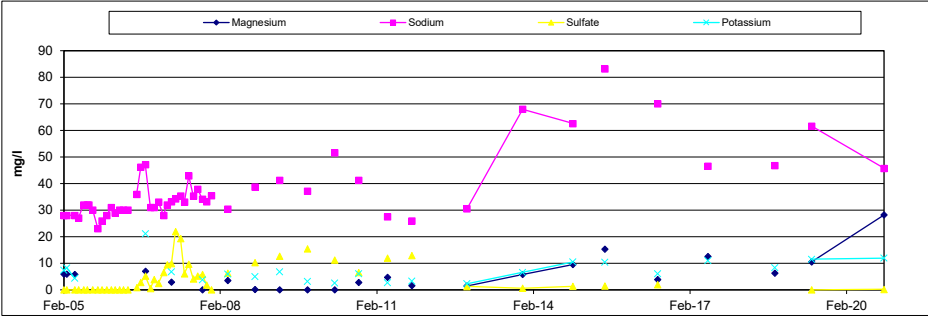
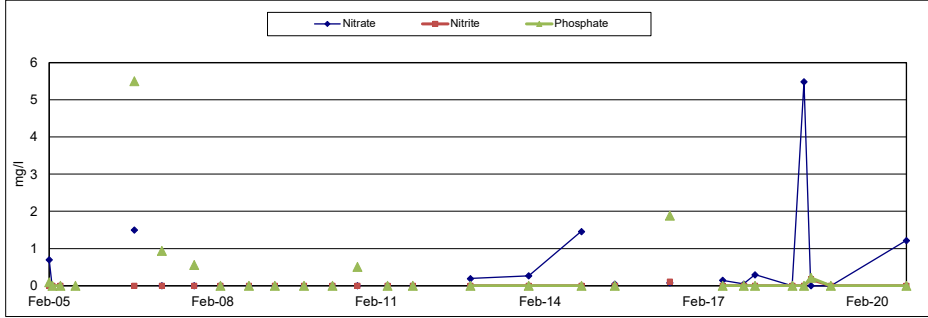
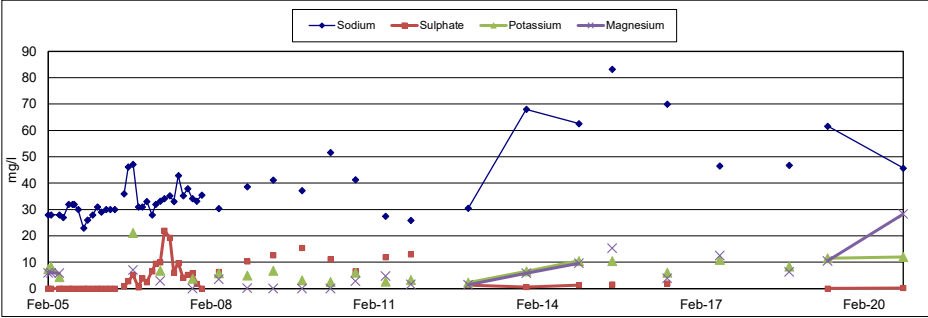
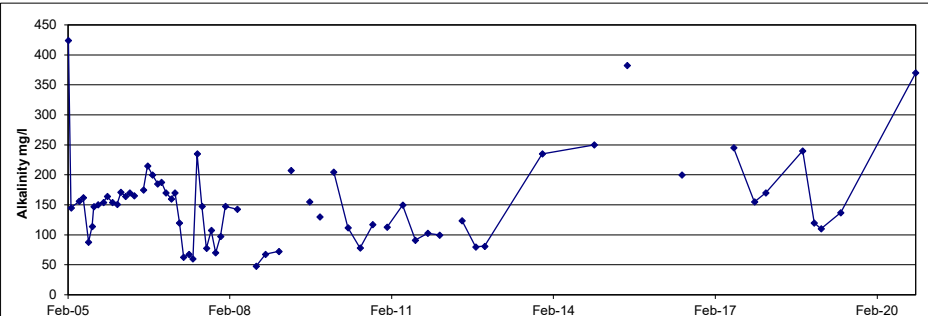
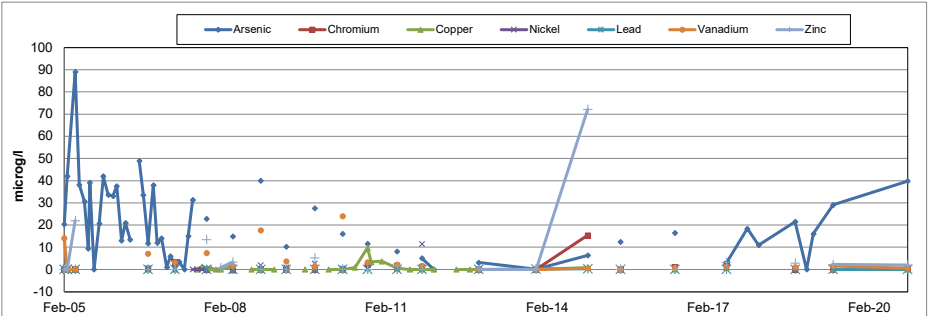


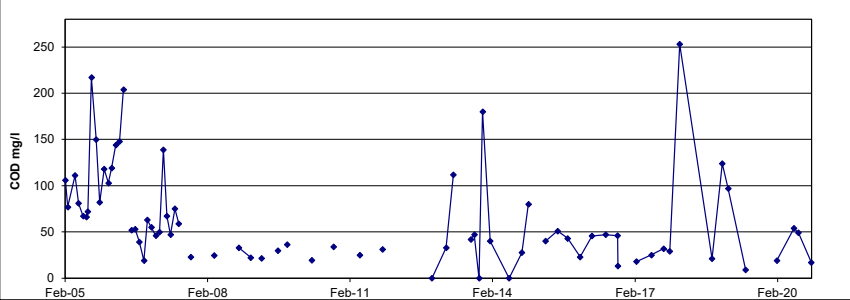
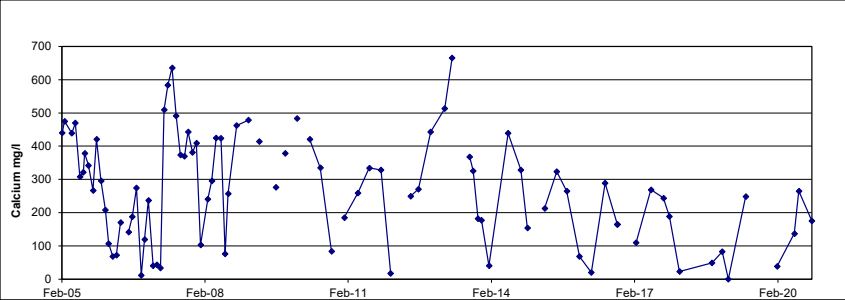
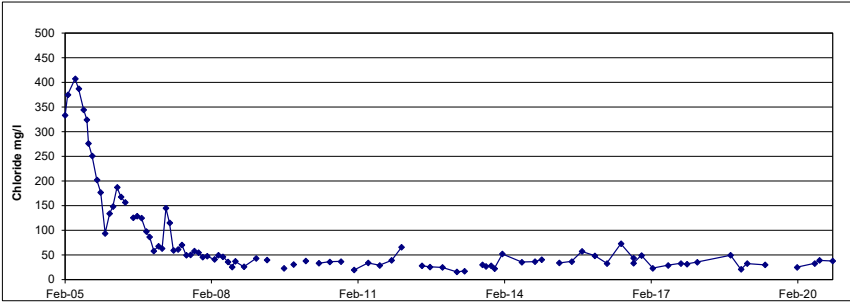
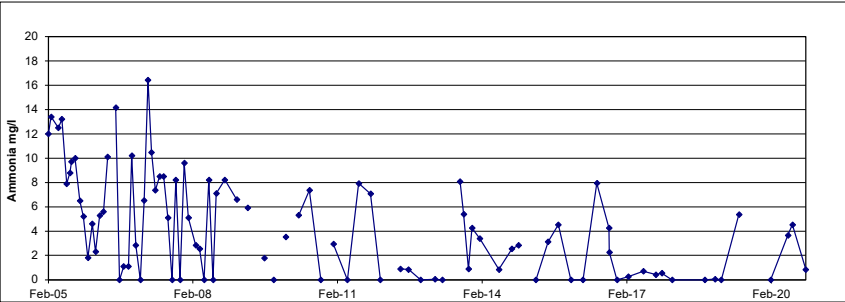
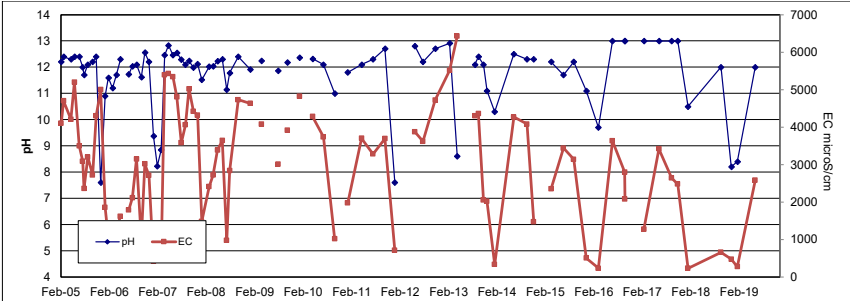
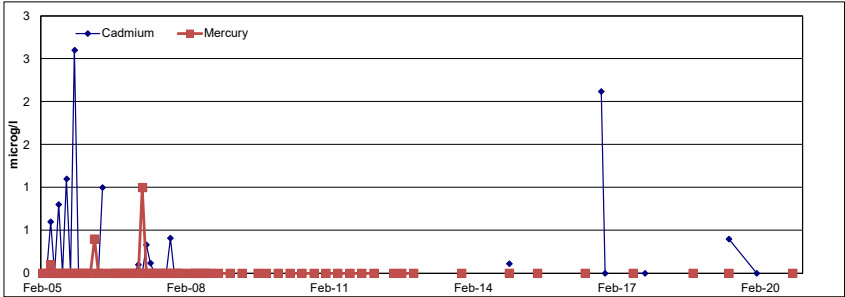


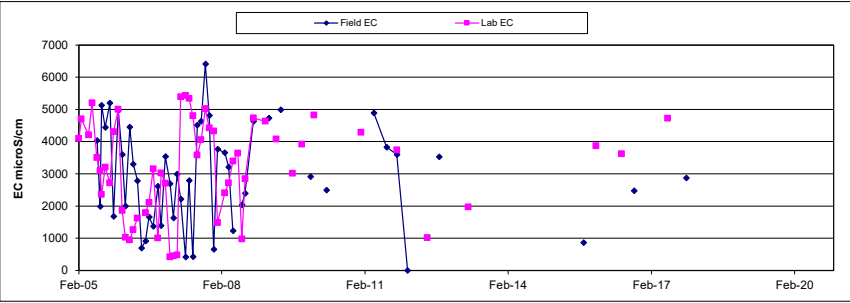
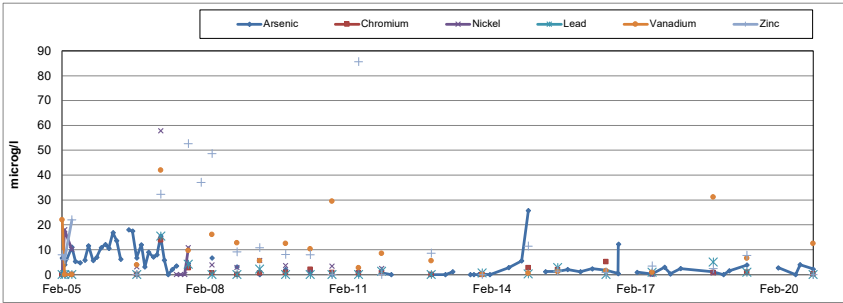
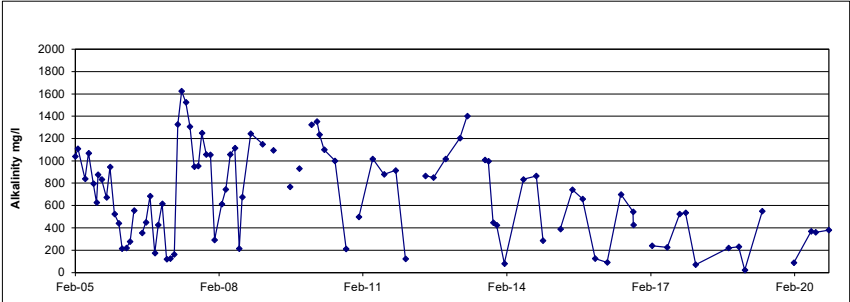
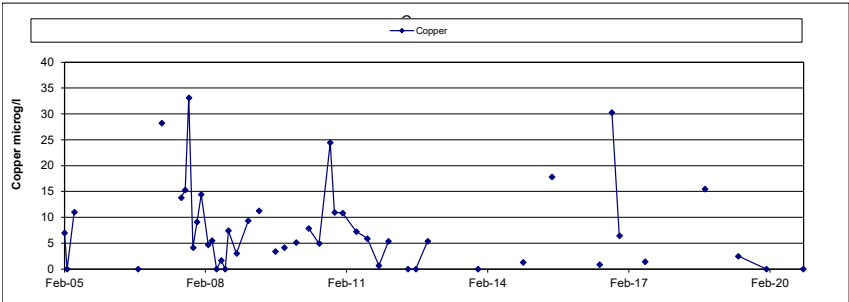


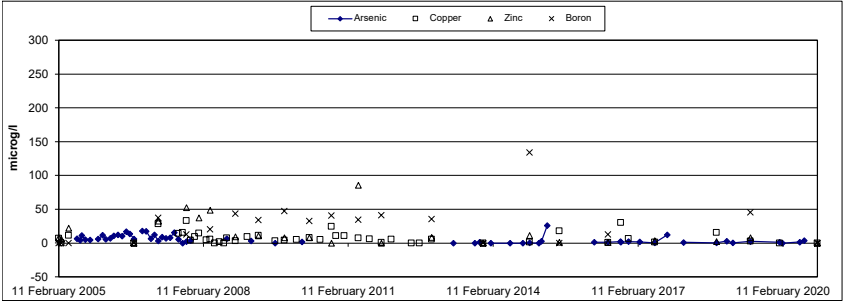
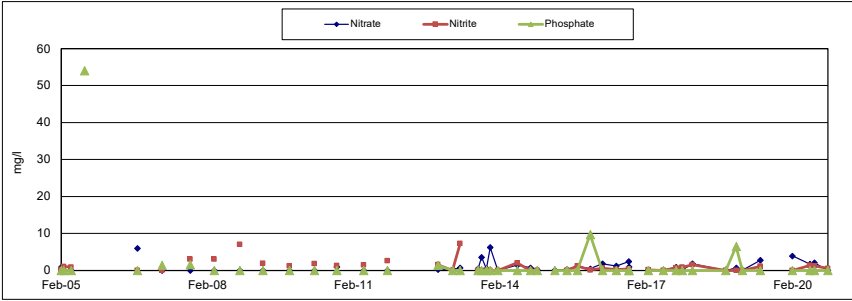
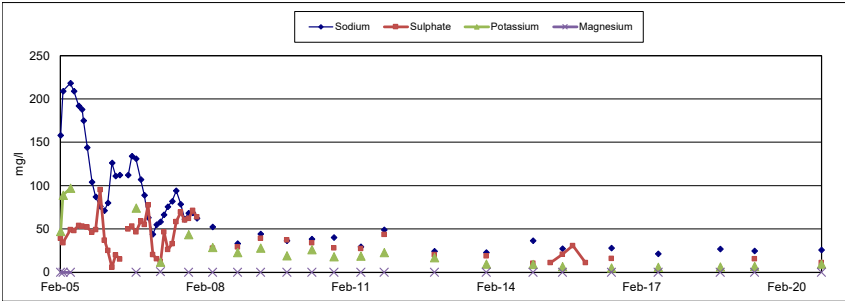


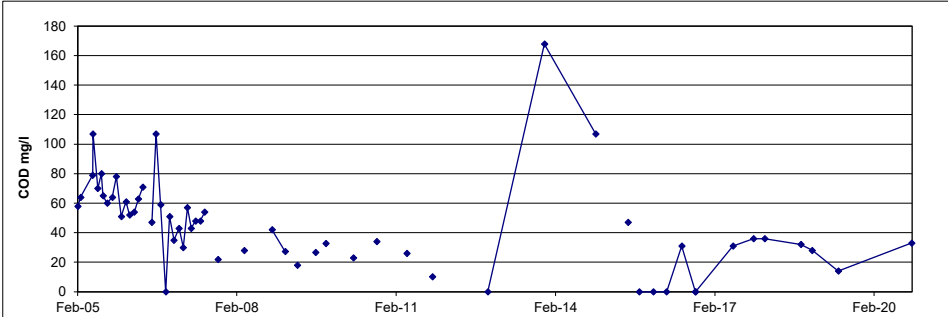
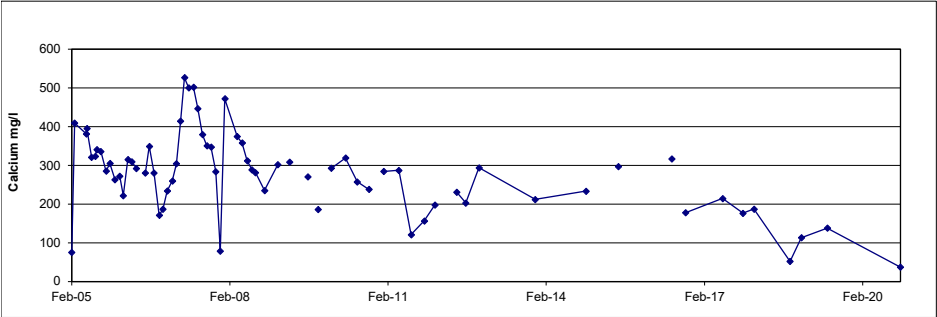
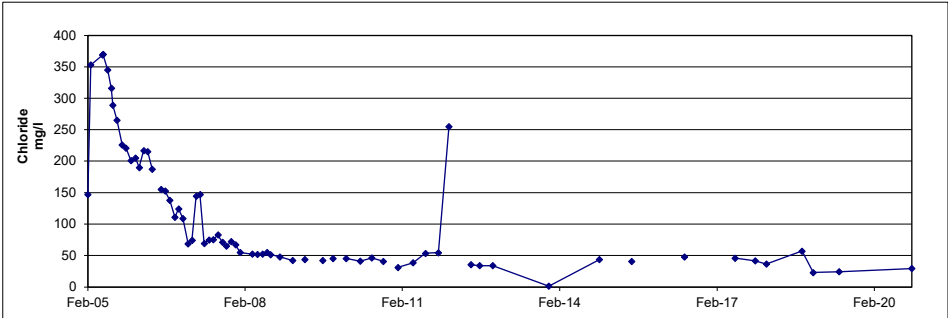
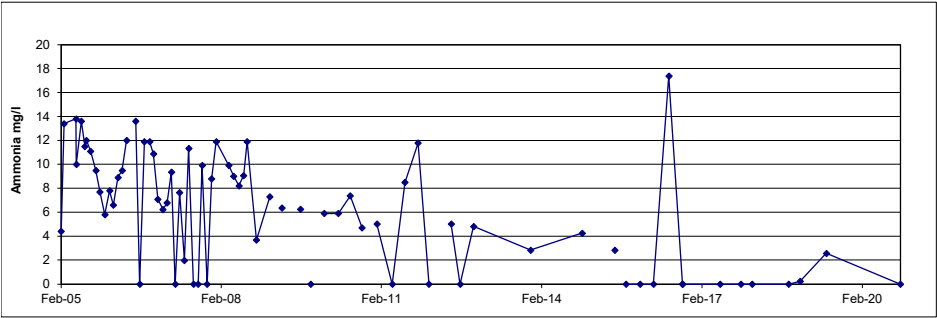
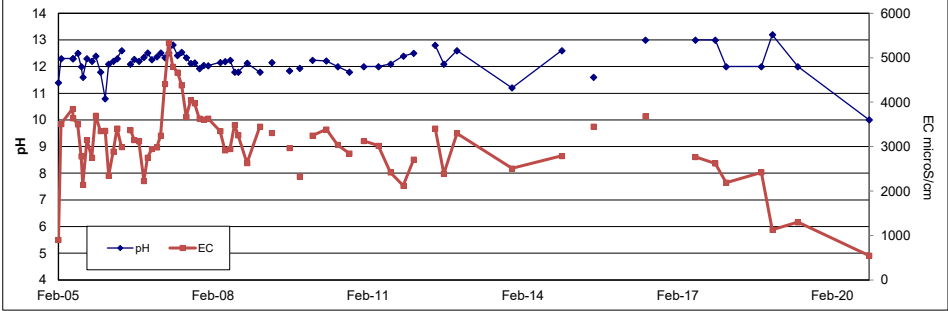
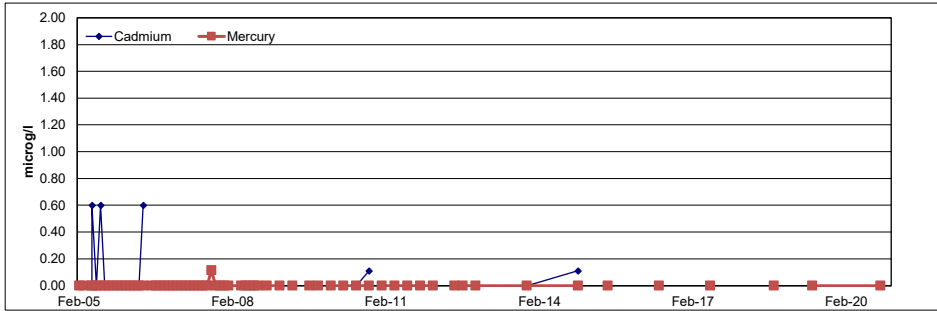


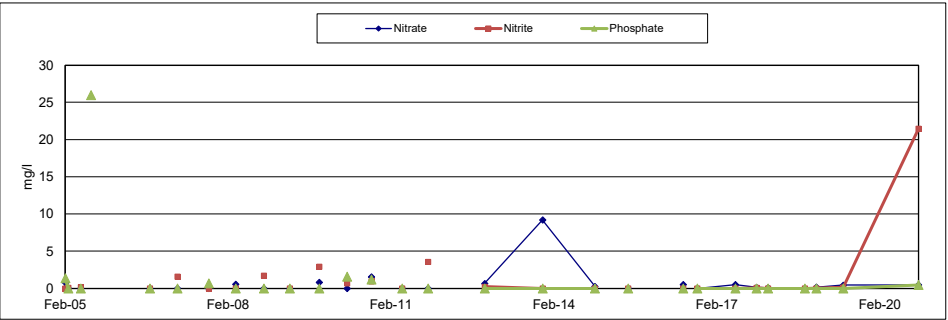
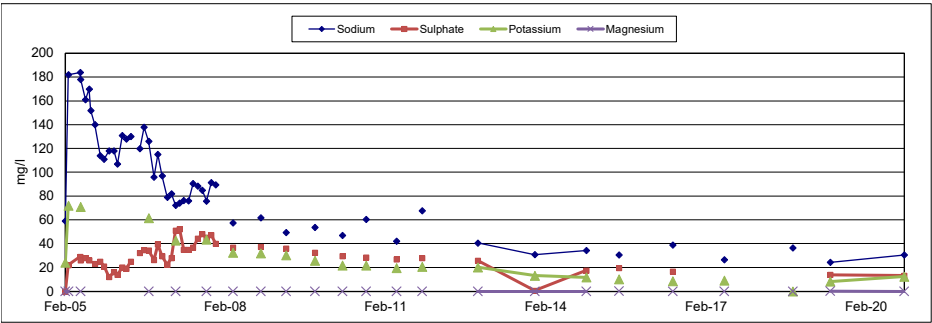
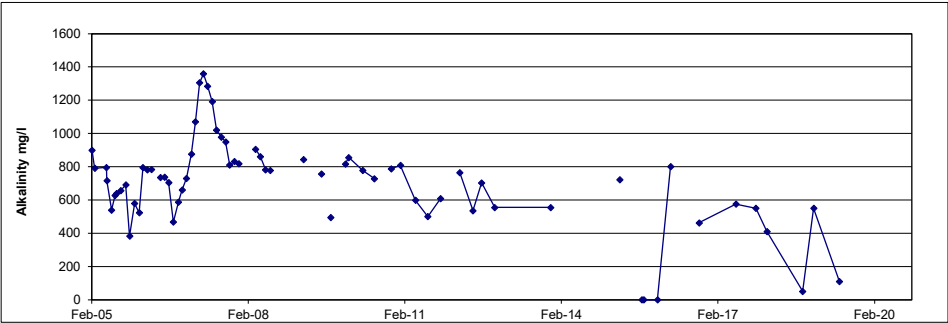
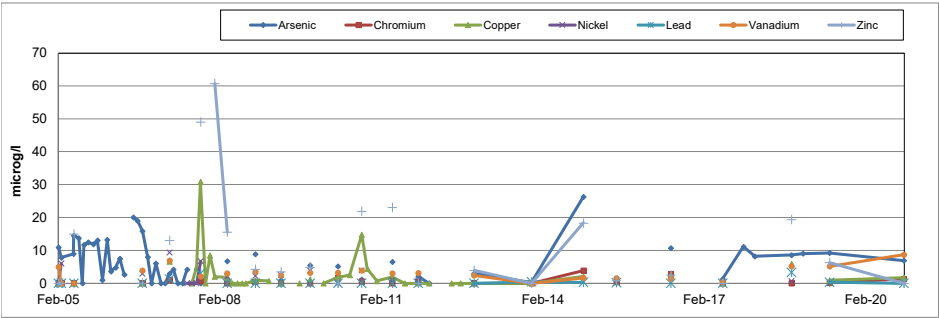


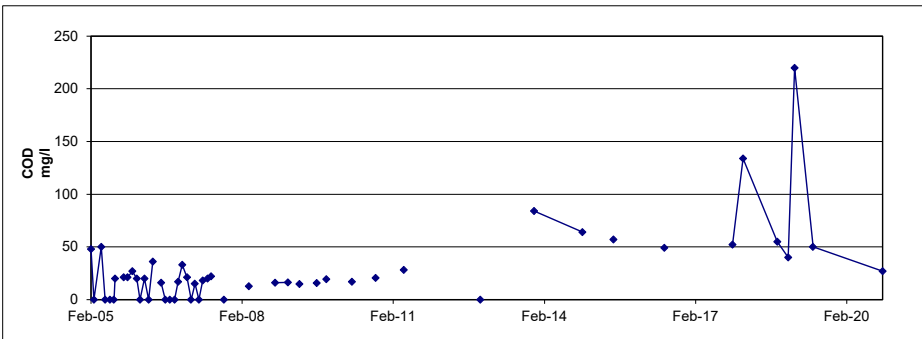
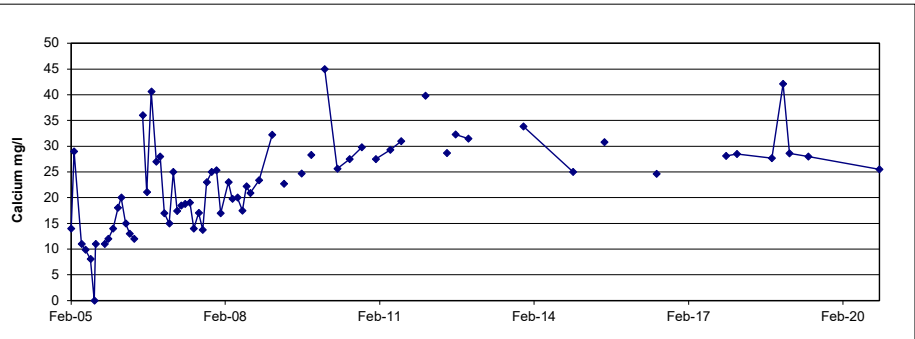
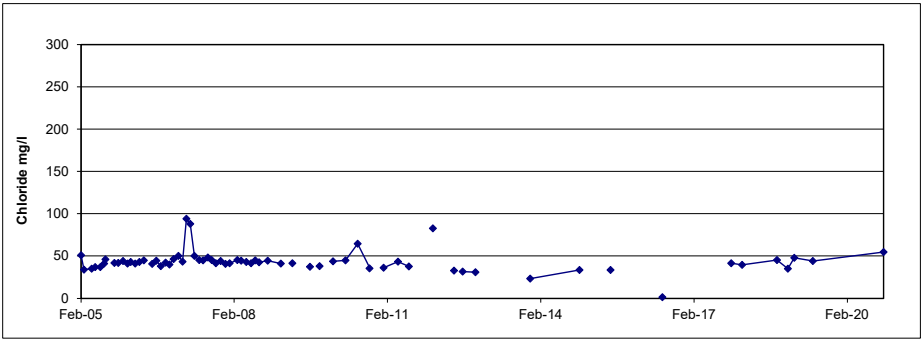
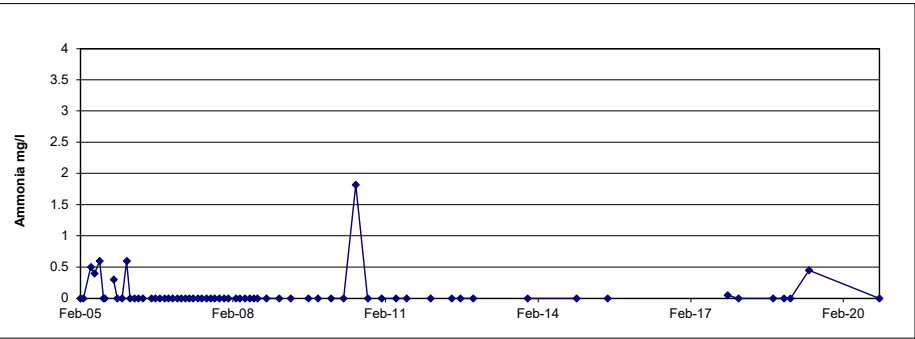
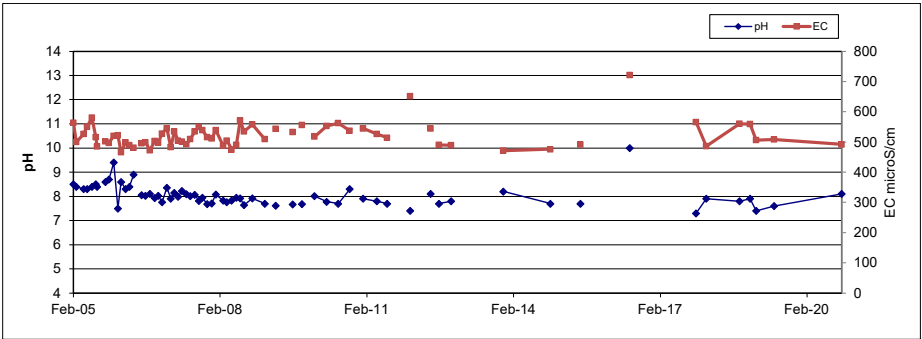
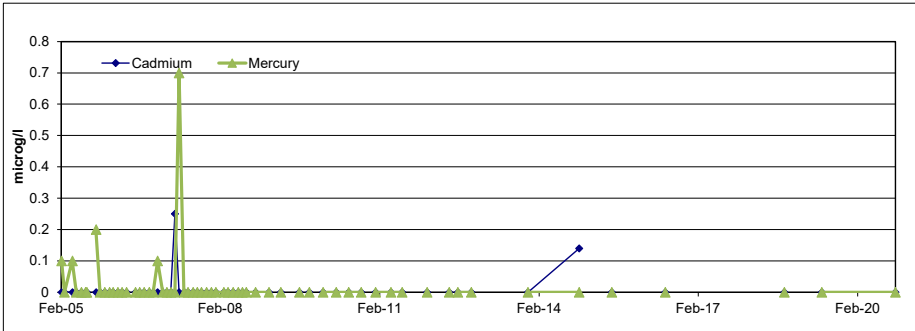


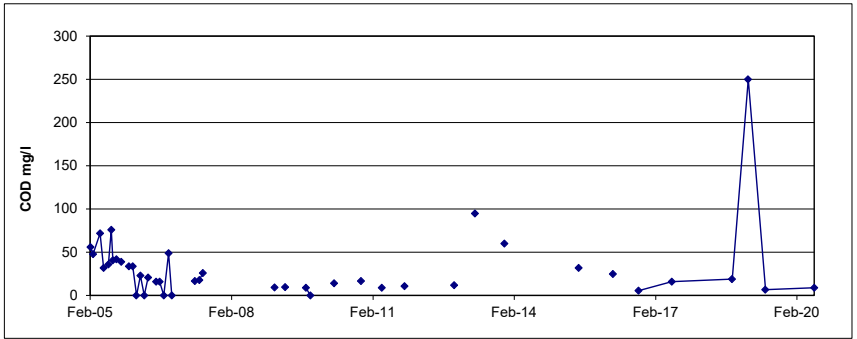
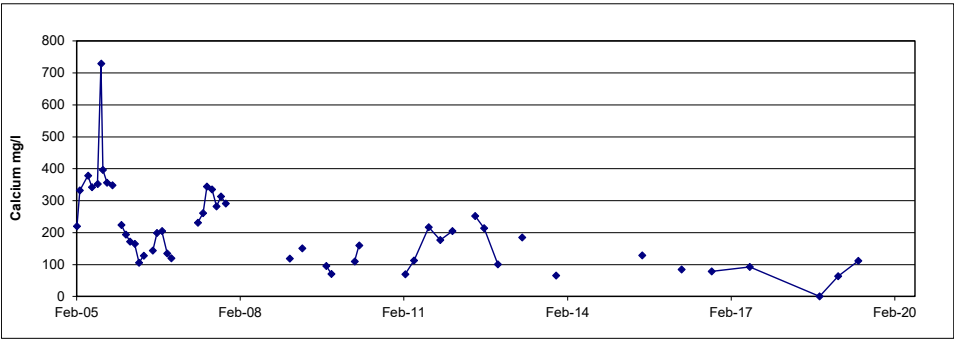
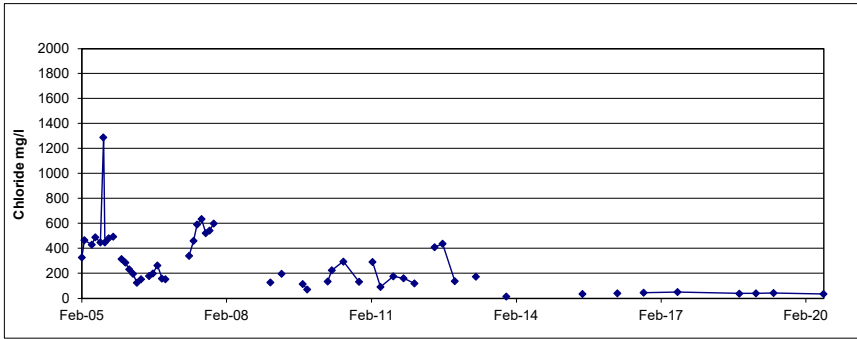
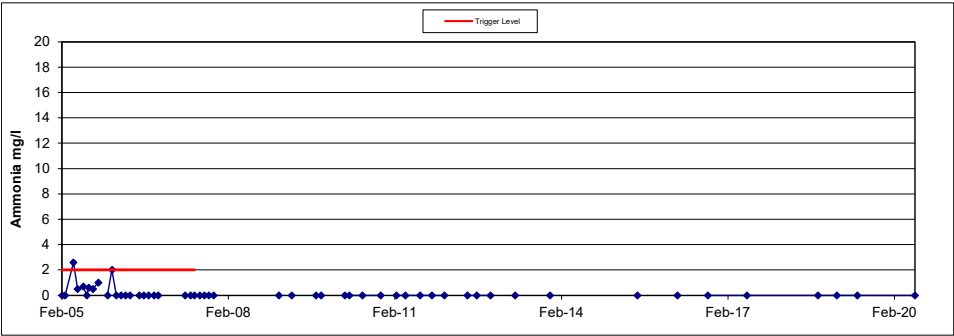
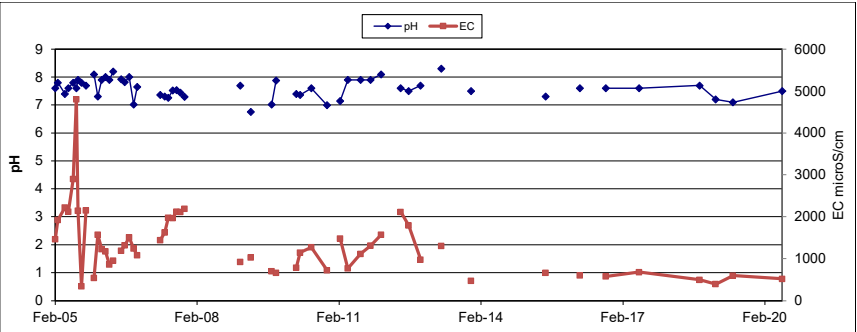
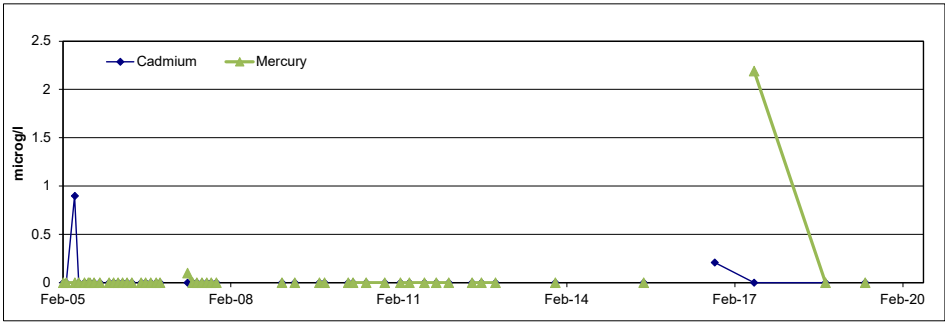


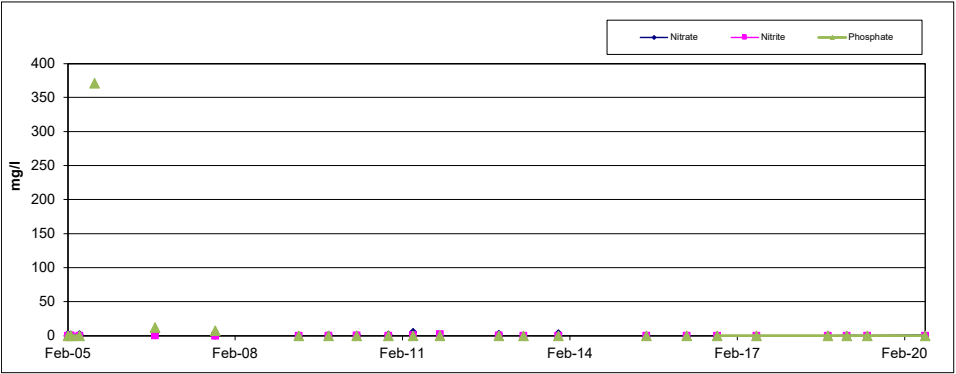
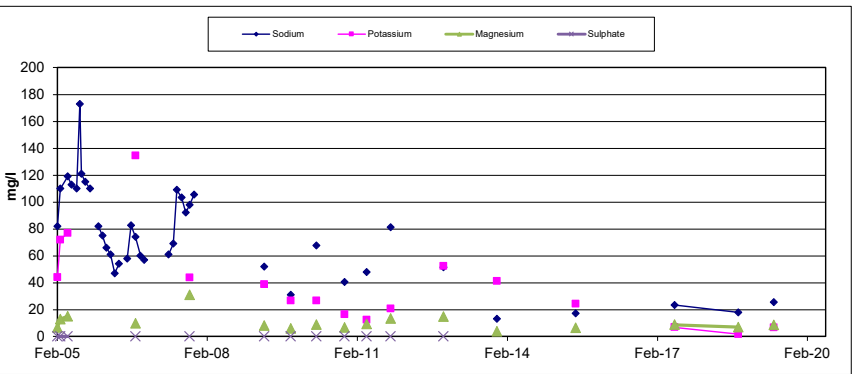
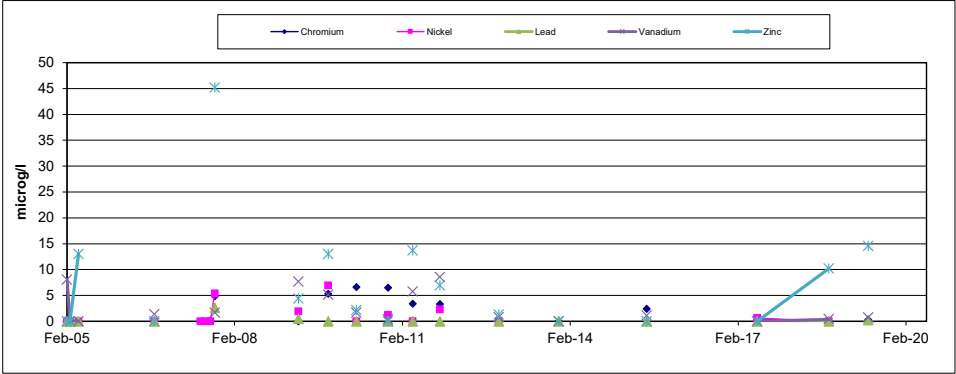
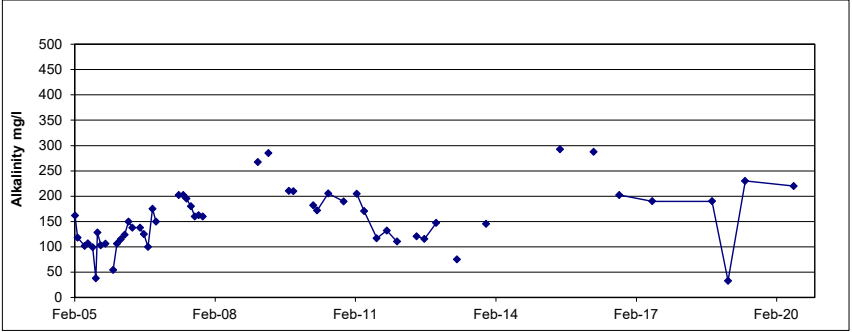
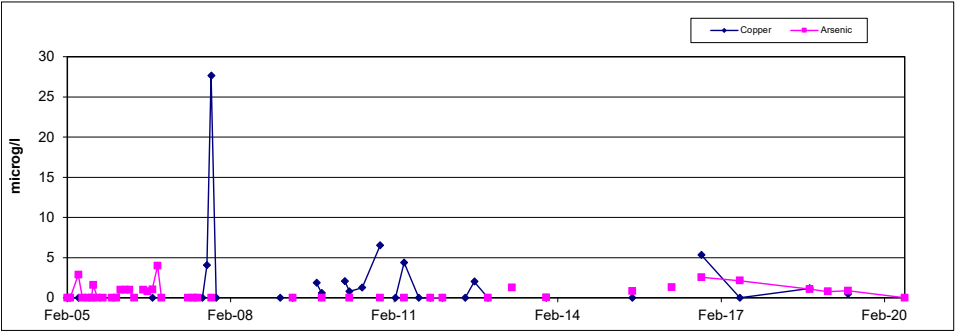


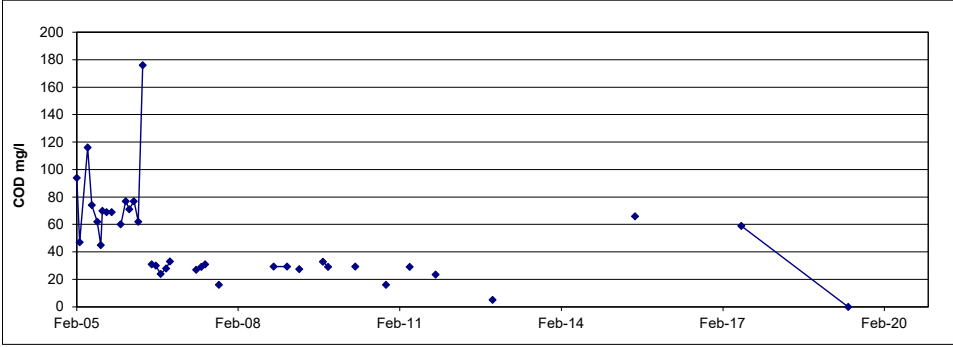
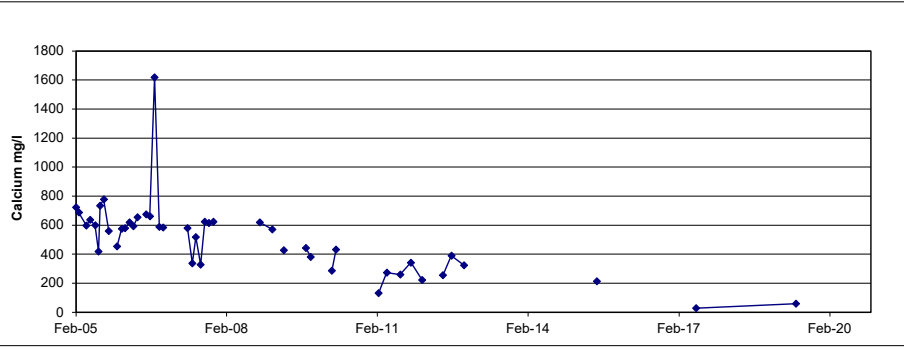
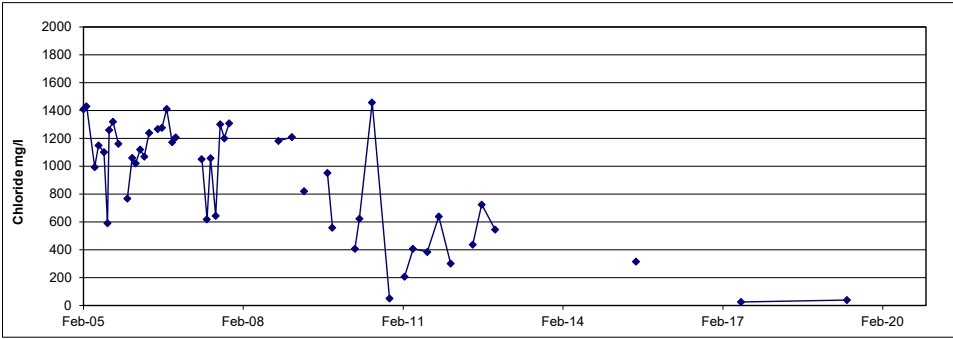
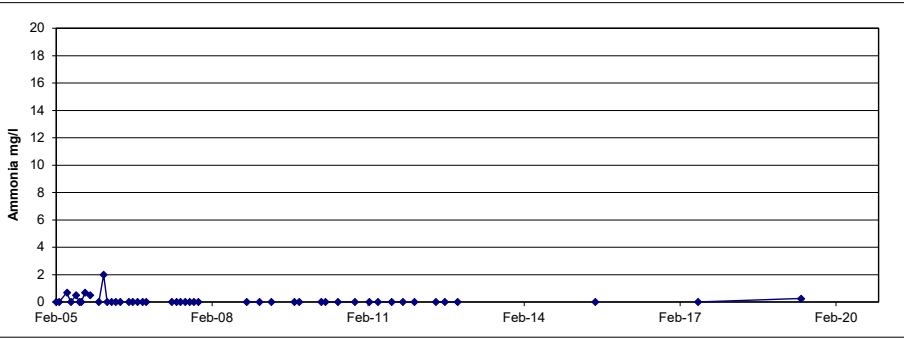
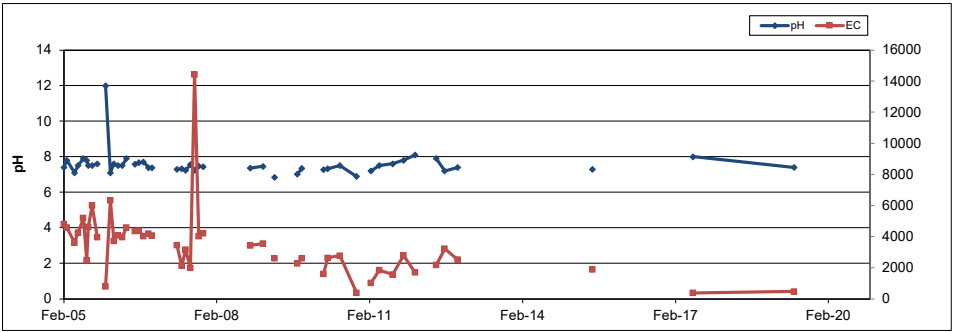
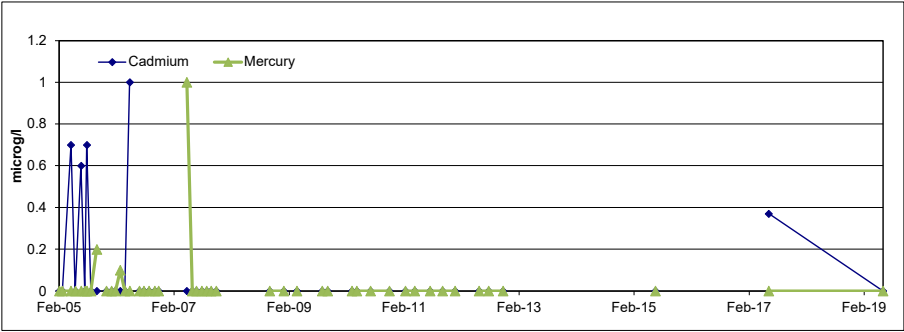


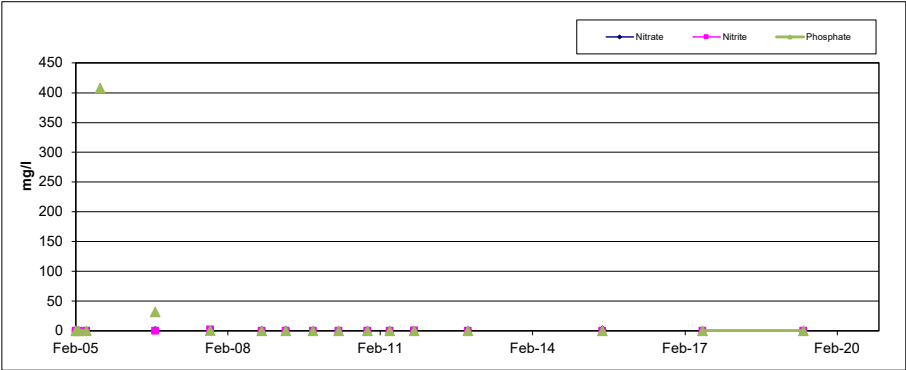
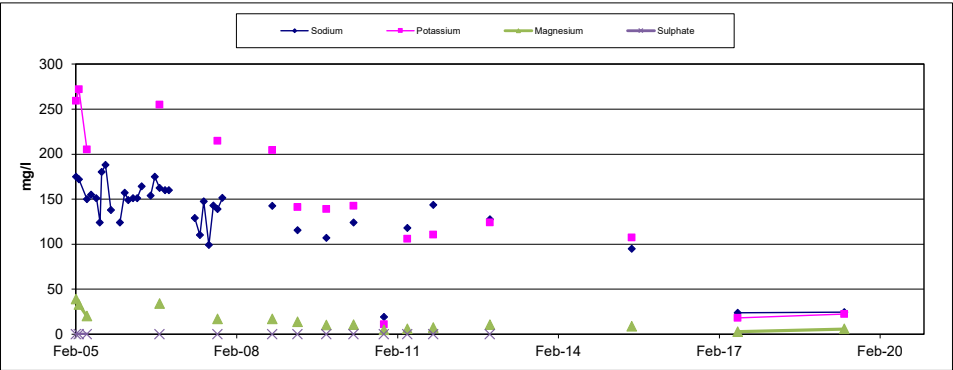
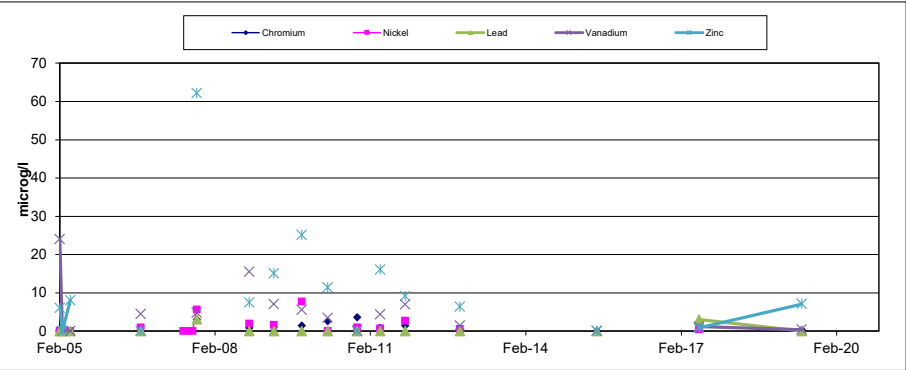
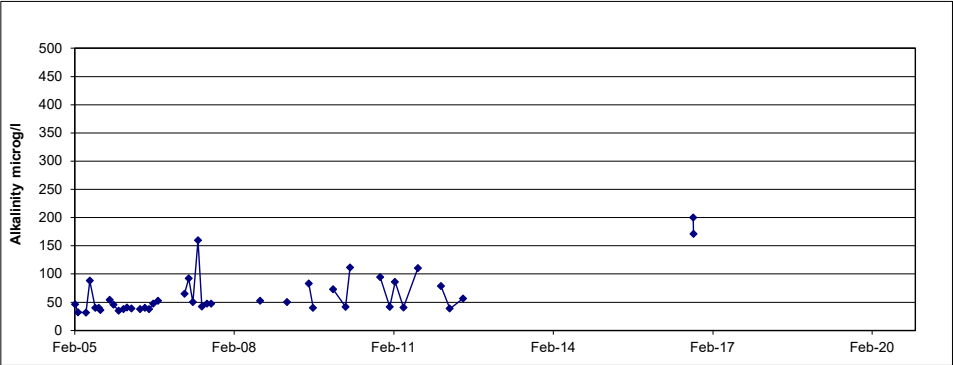
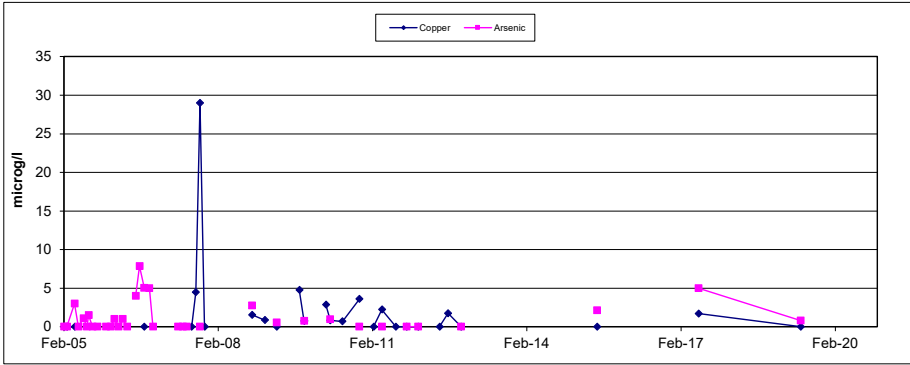


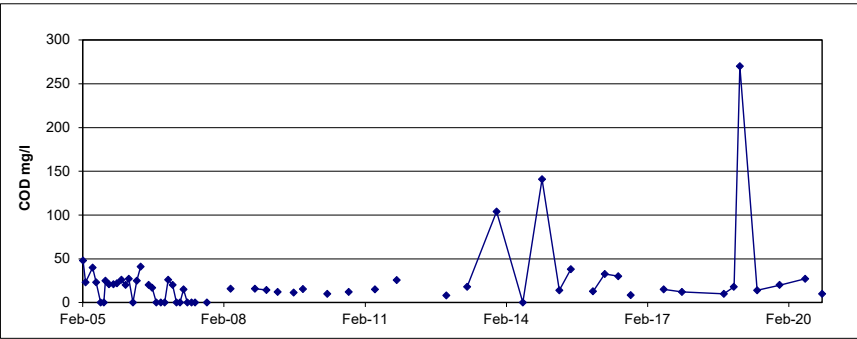
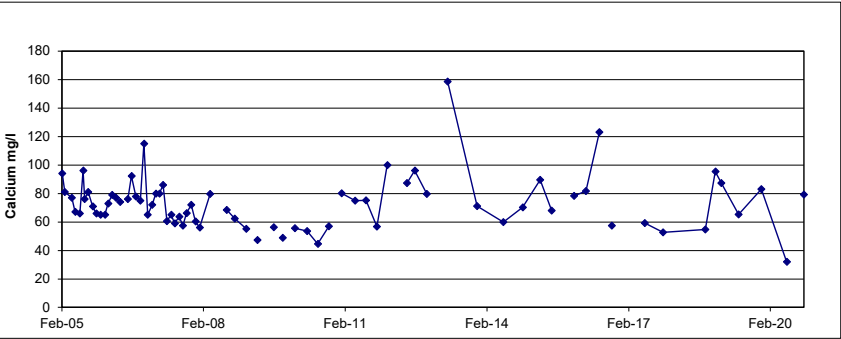
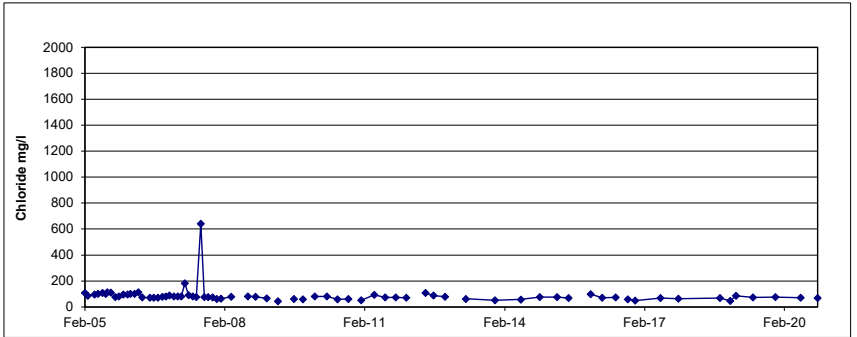
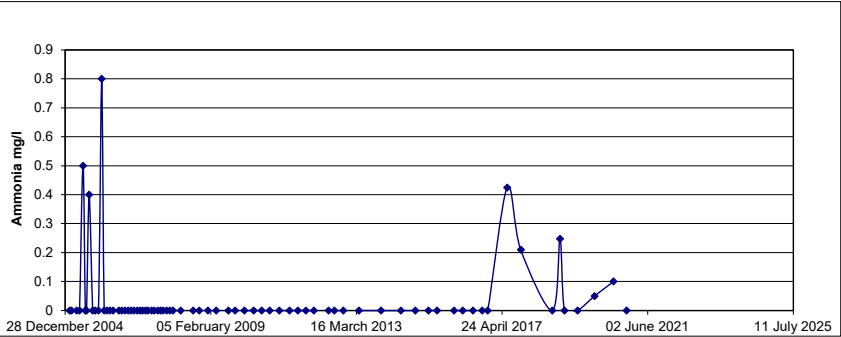
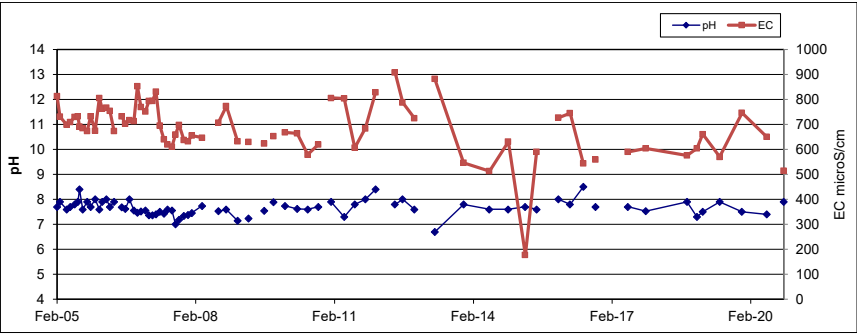
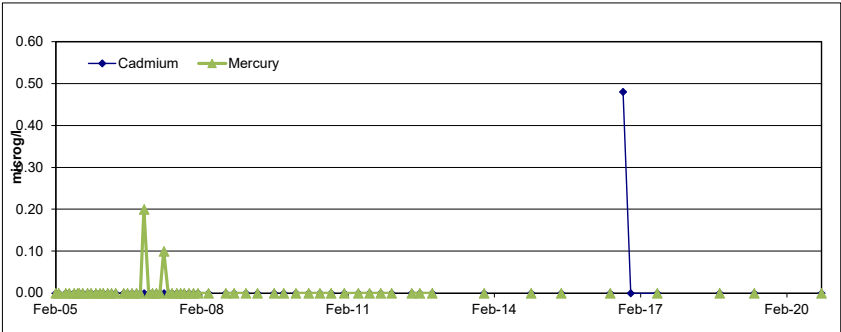


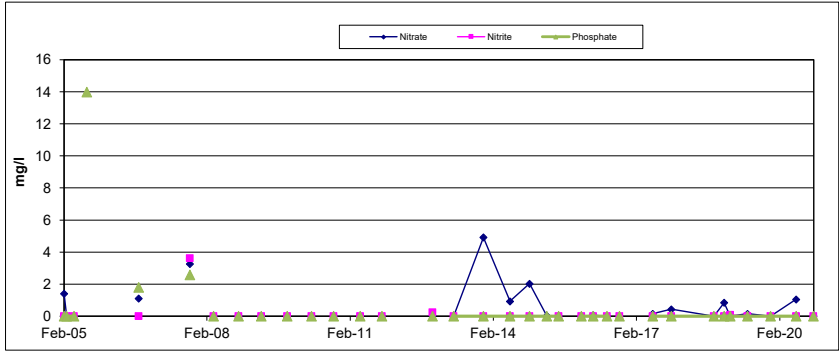
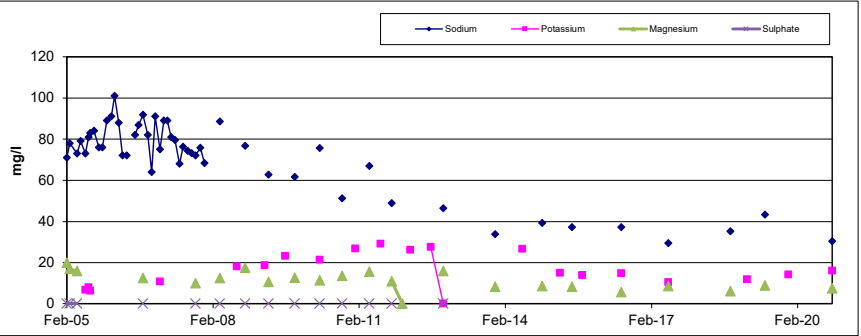
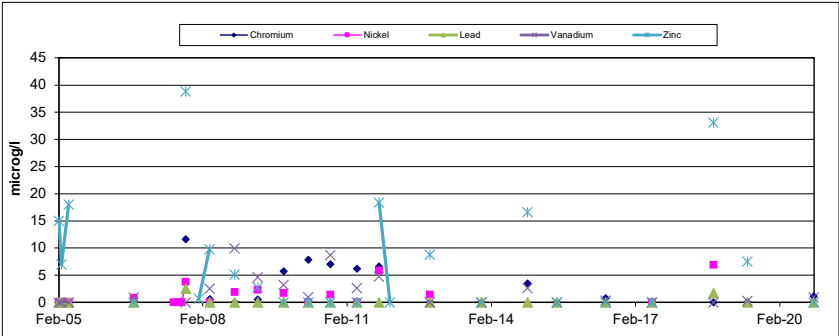
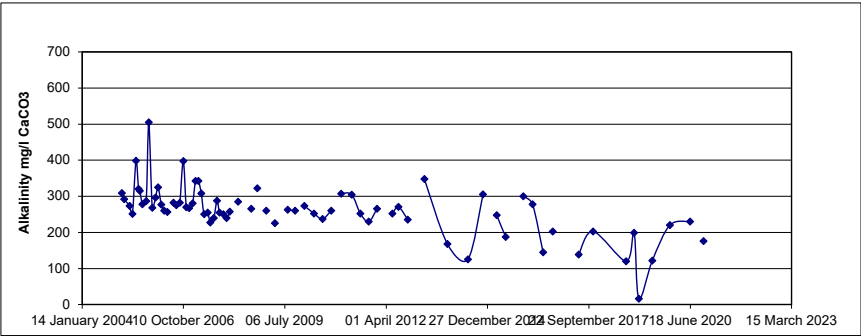
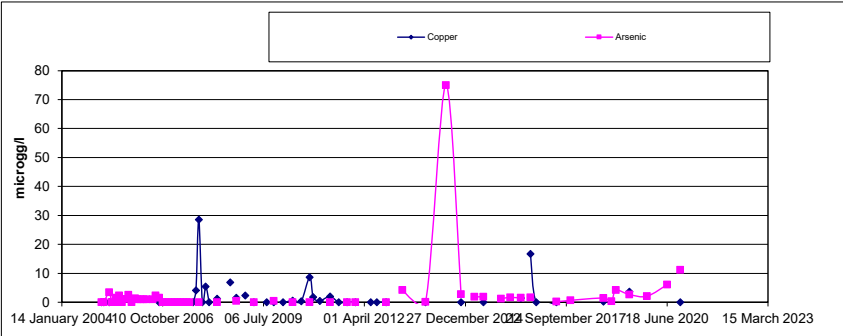


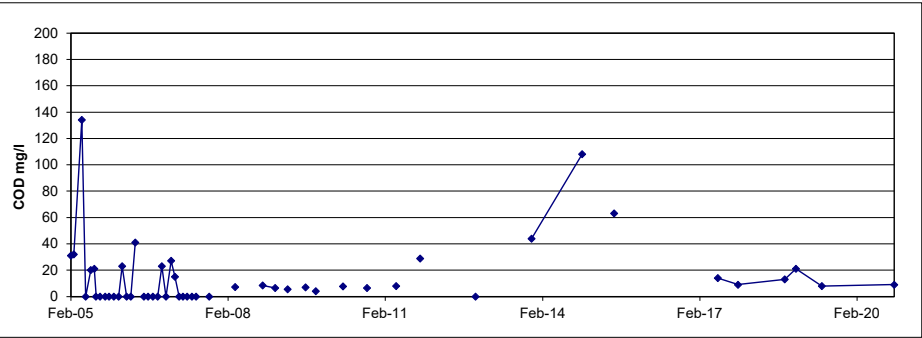
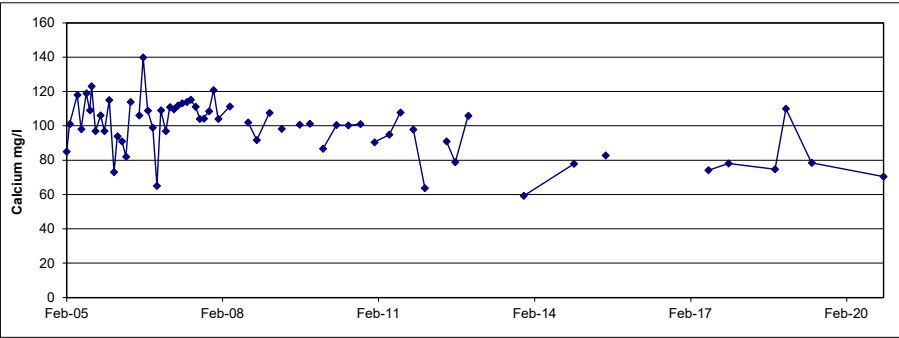
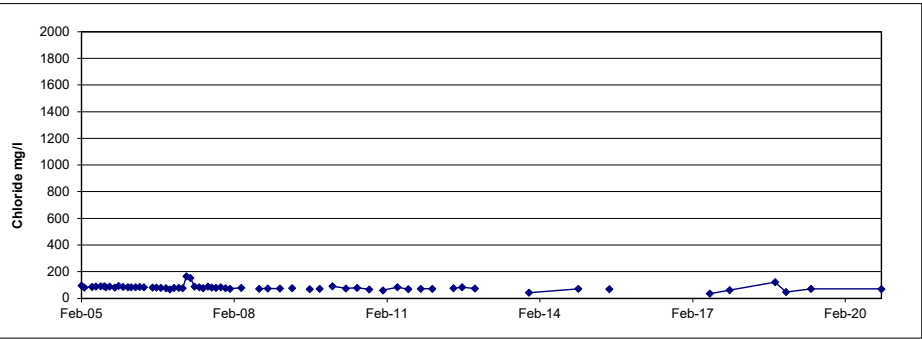
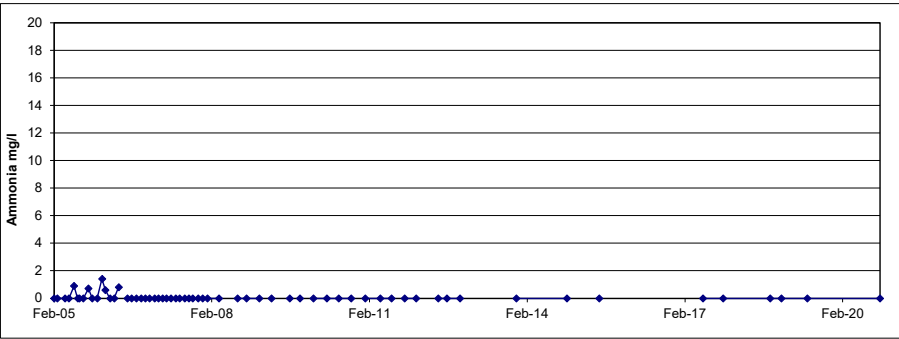
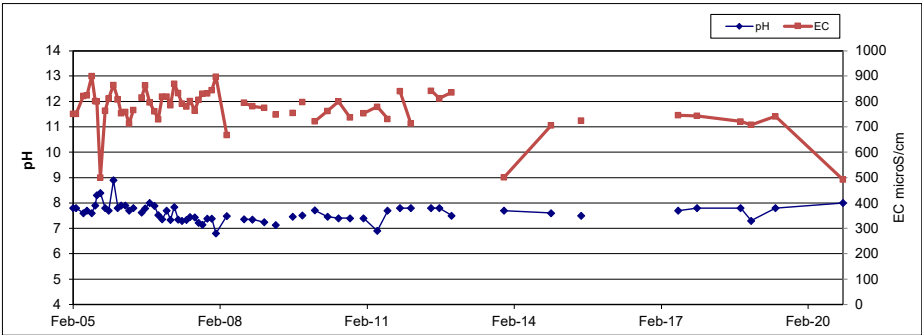
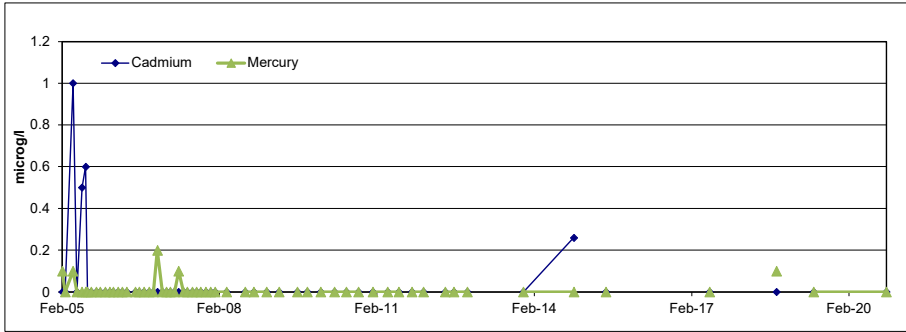


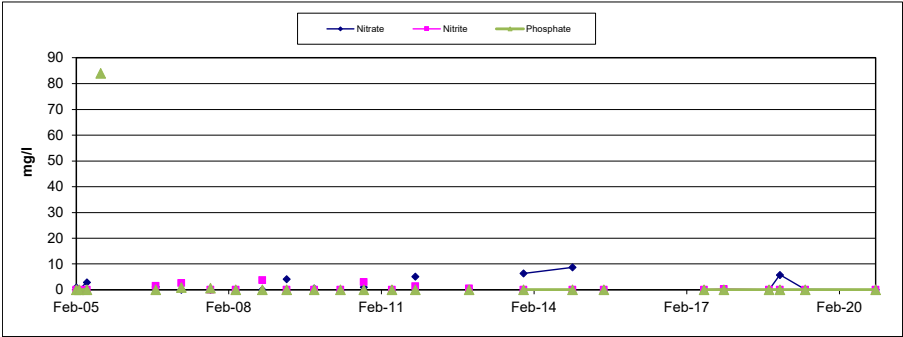
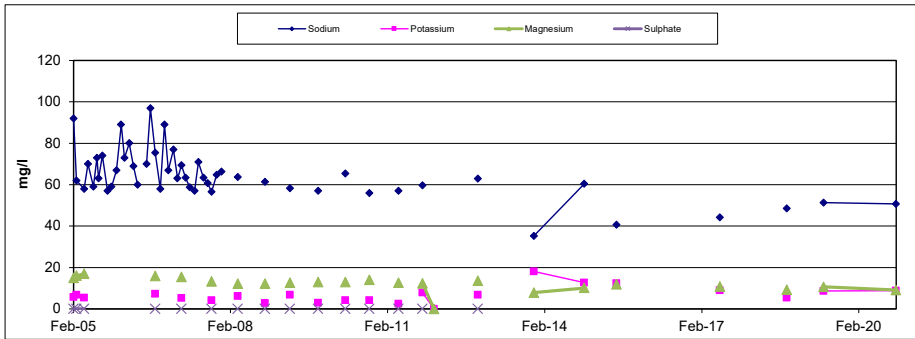
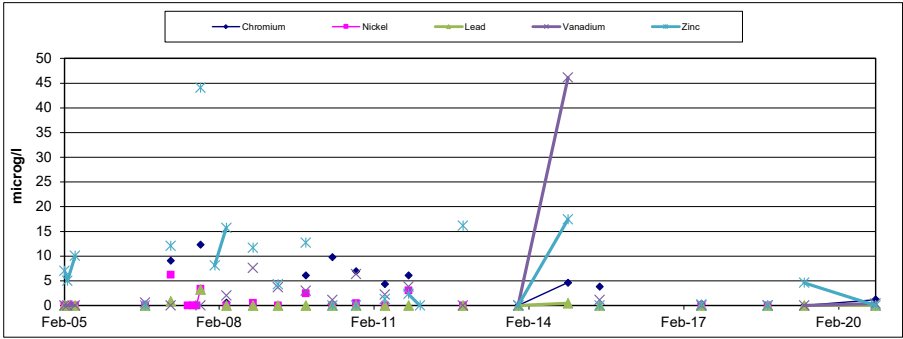
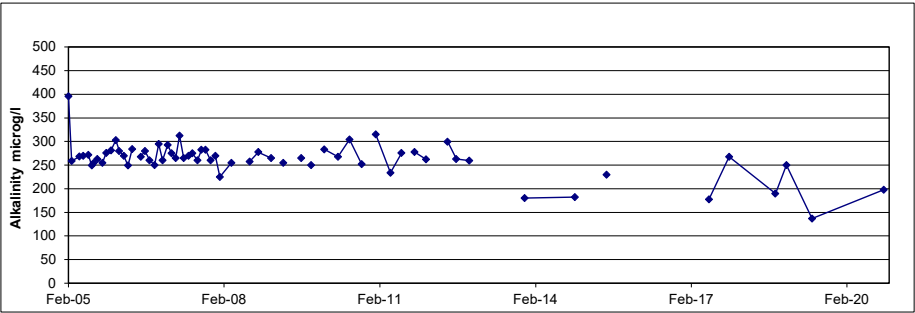
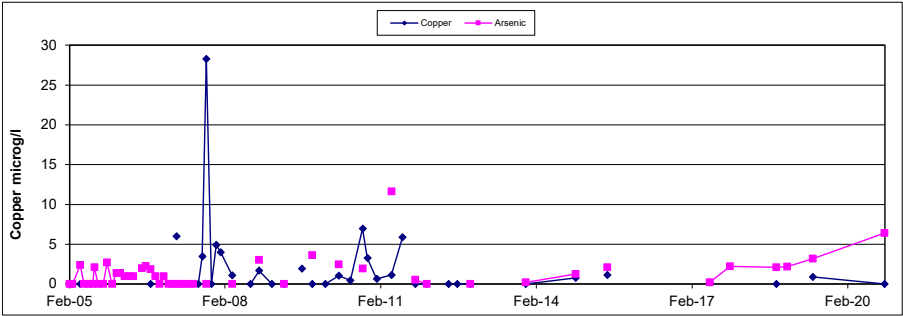


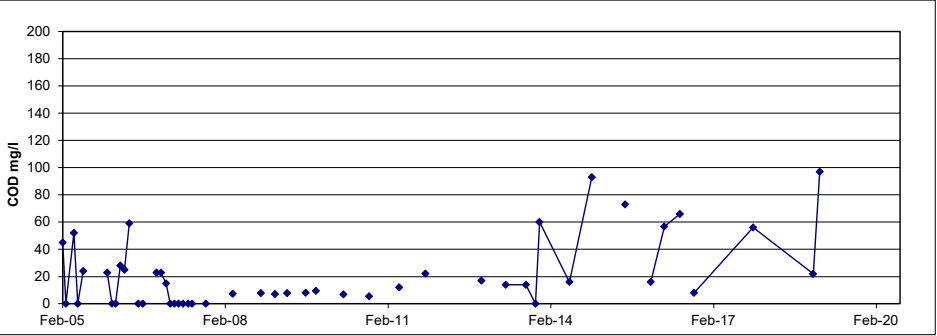
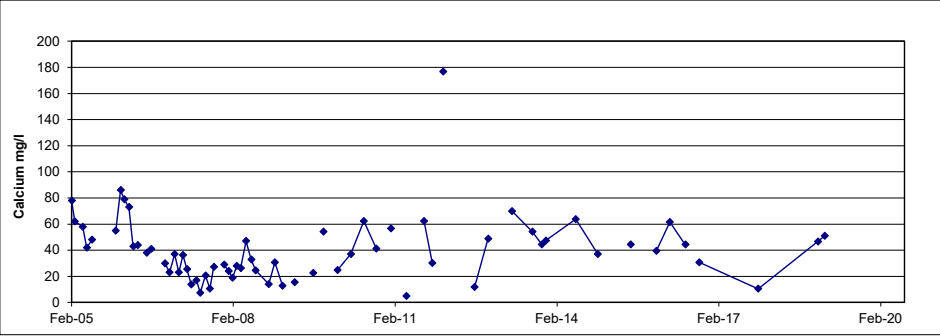
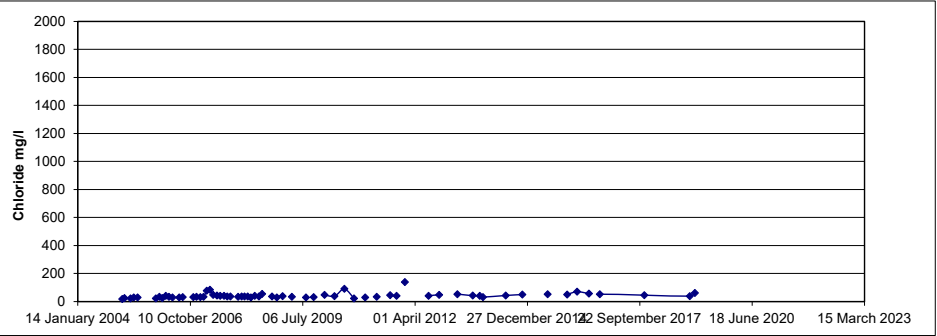
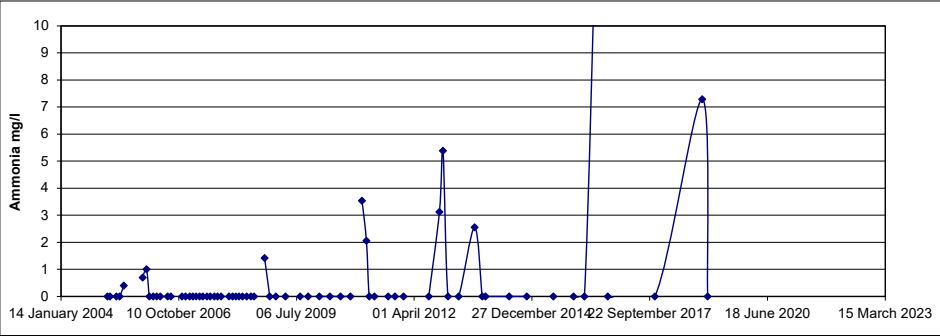
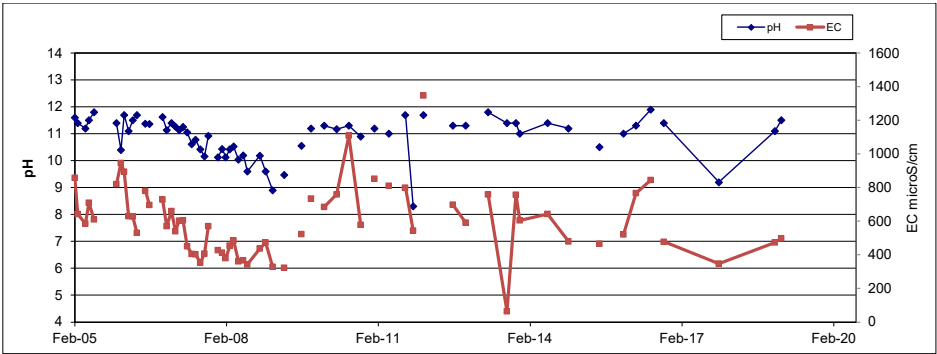
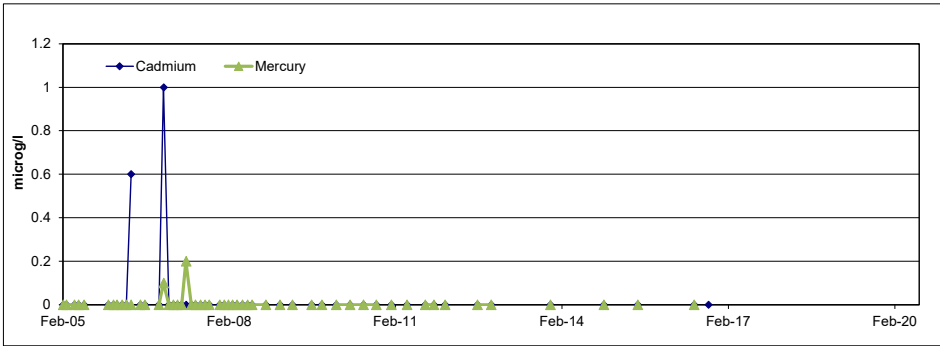


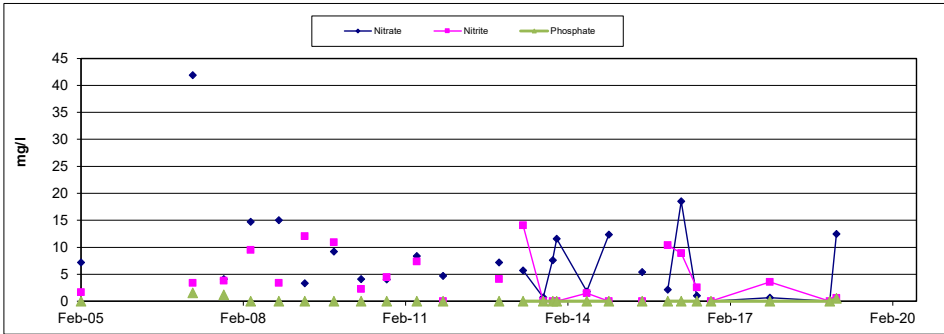
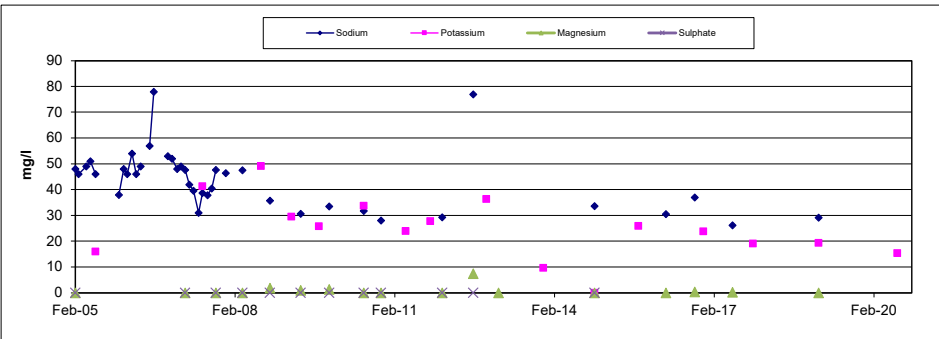
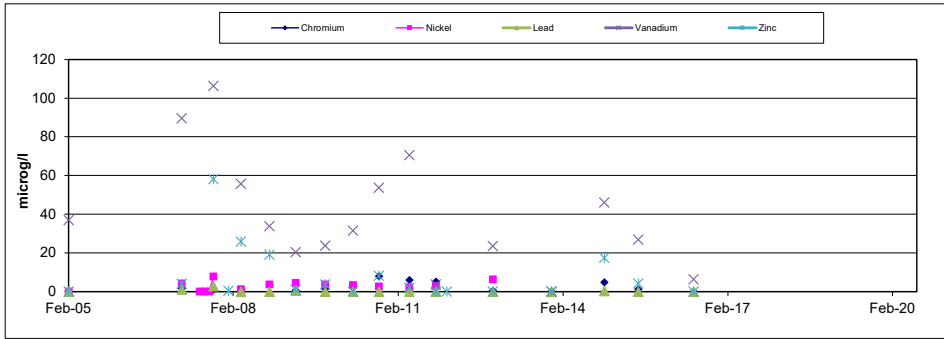
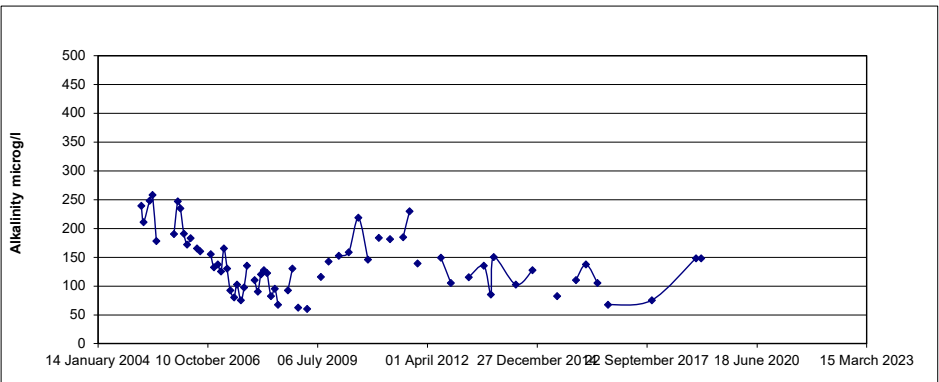
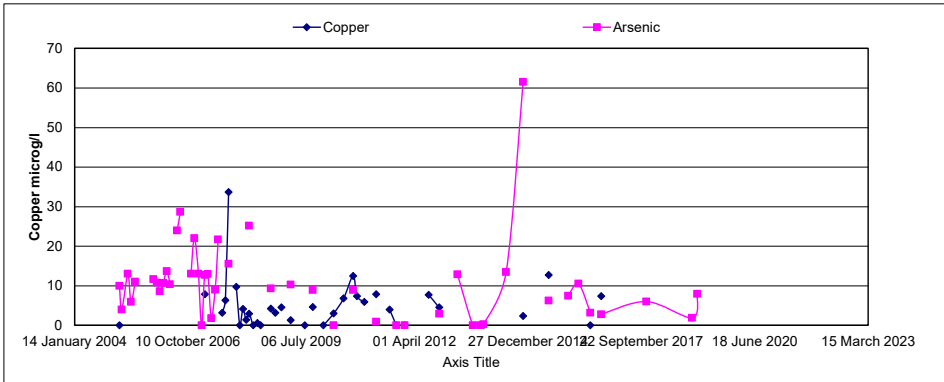


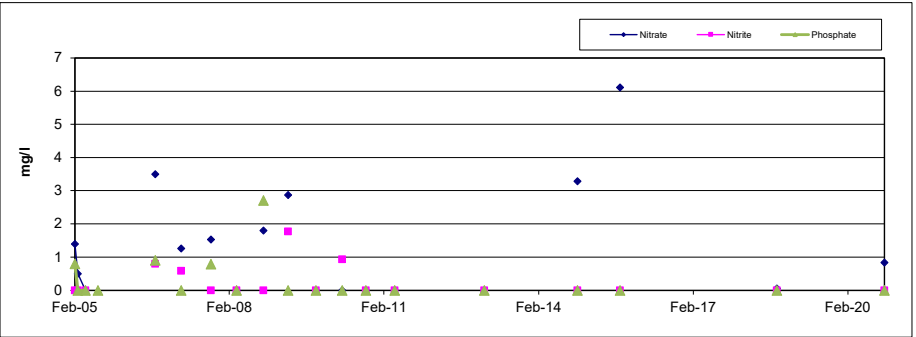
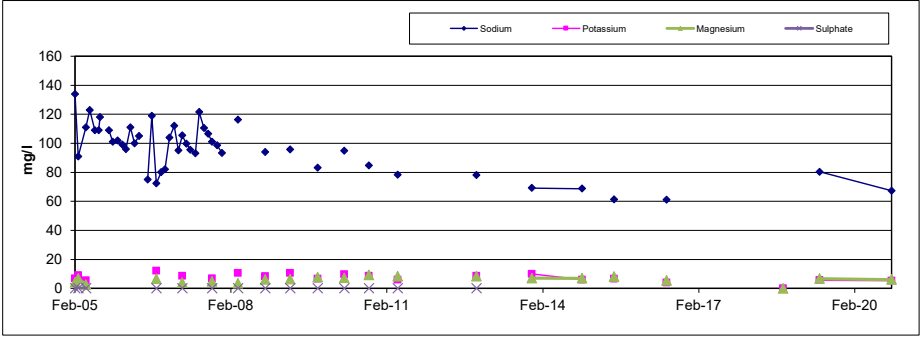
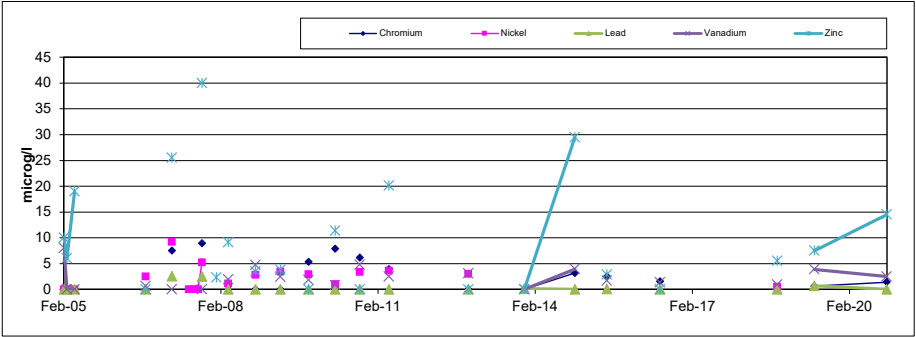
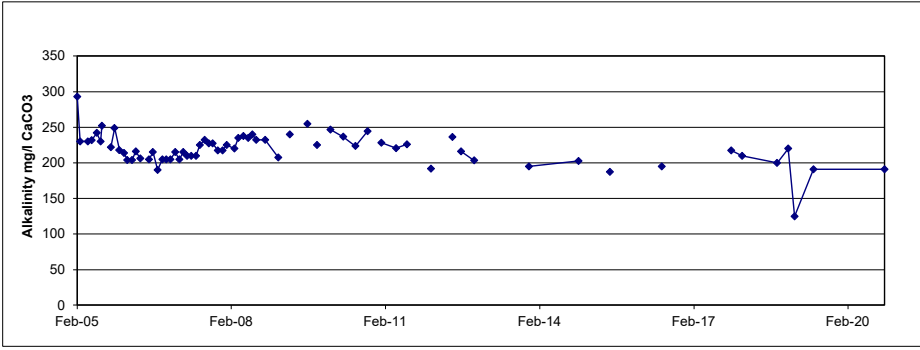
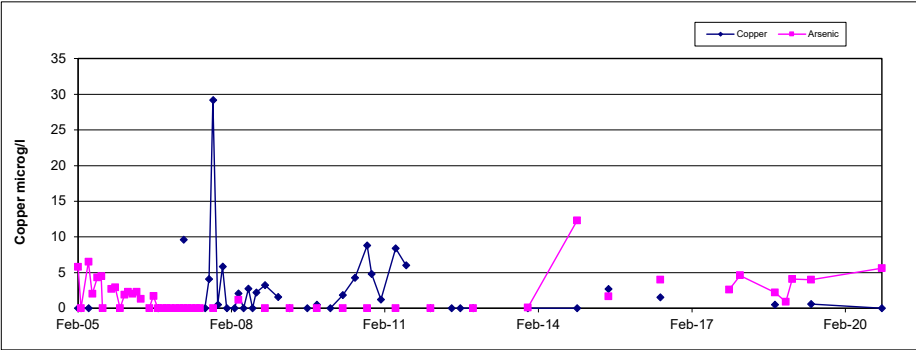




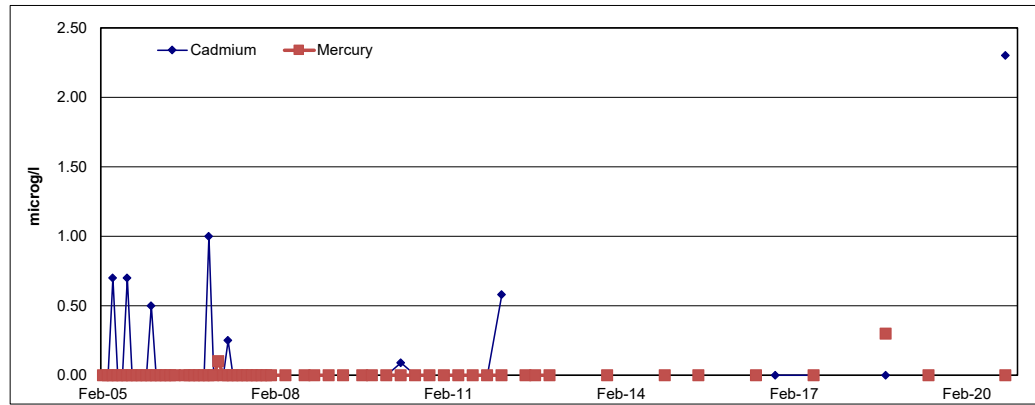




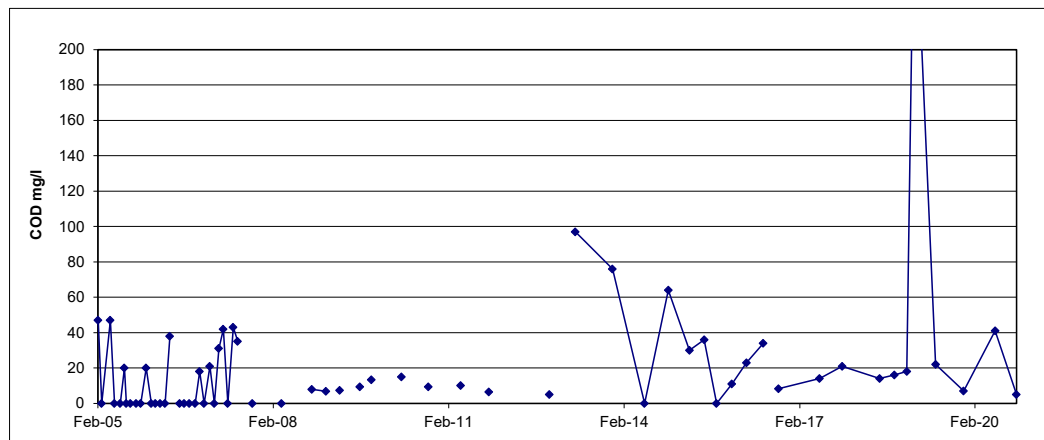
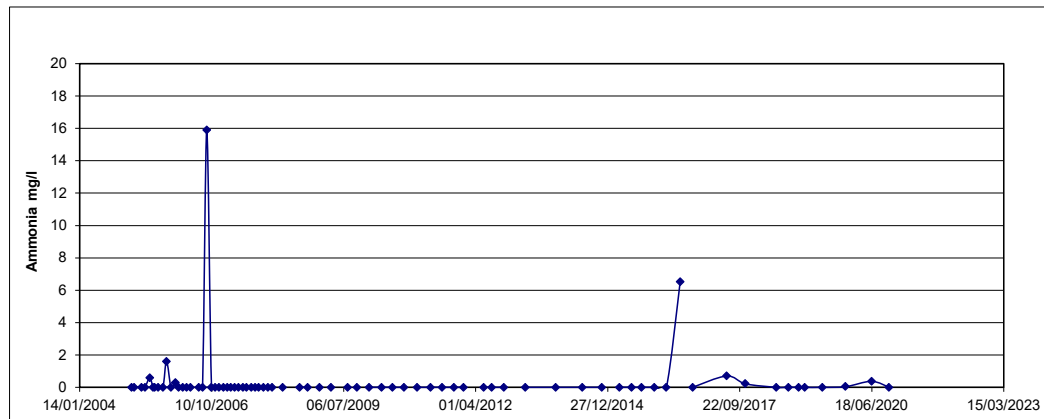




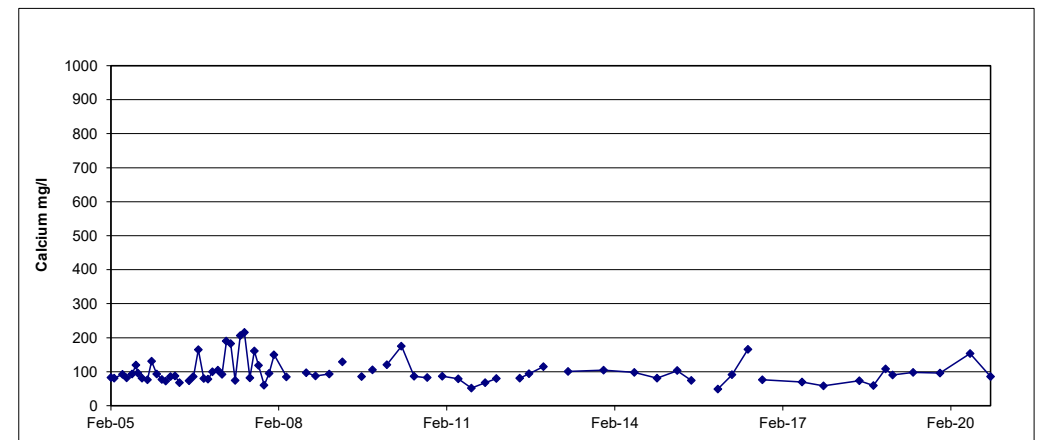
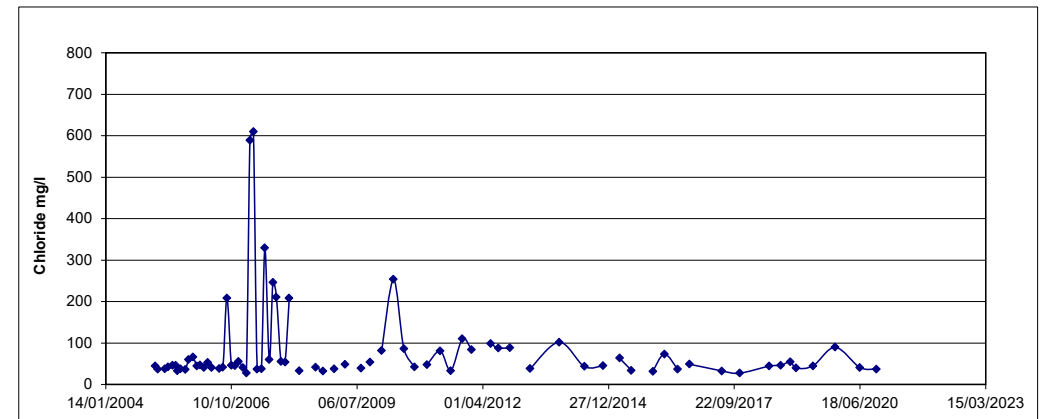
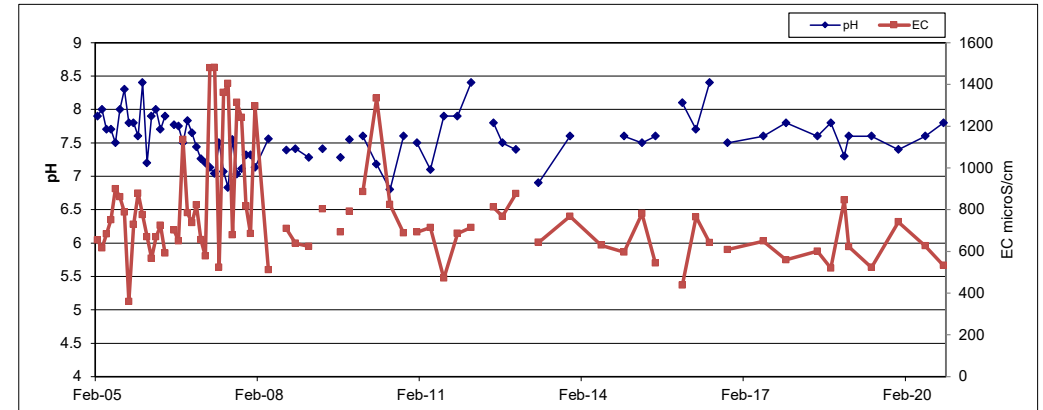
Morfa Landfill

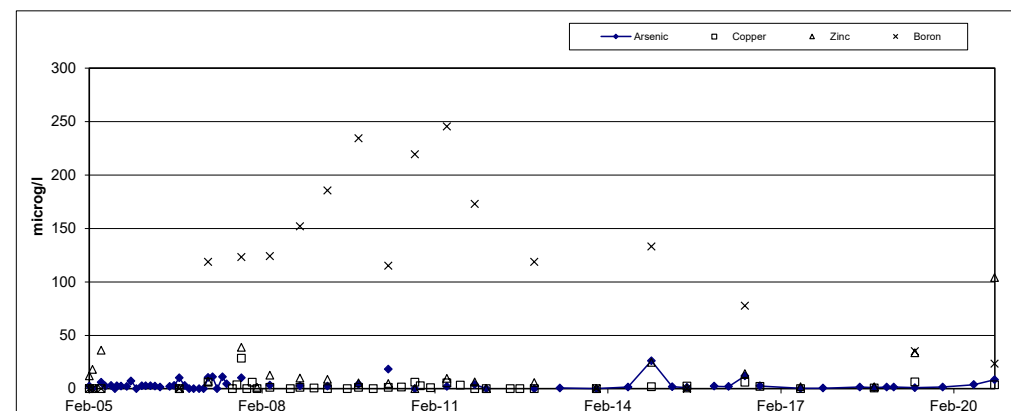
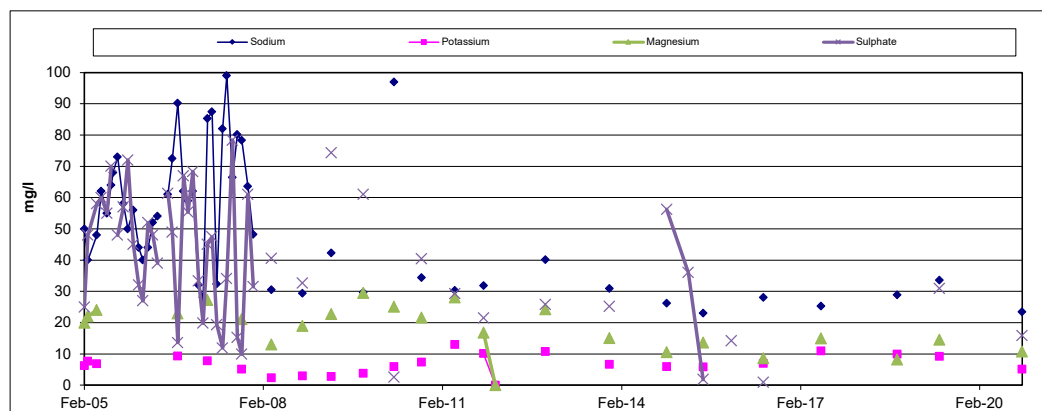
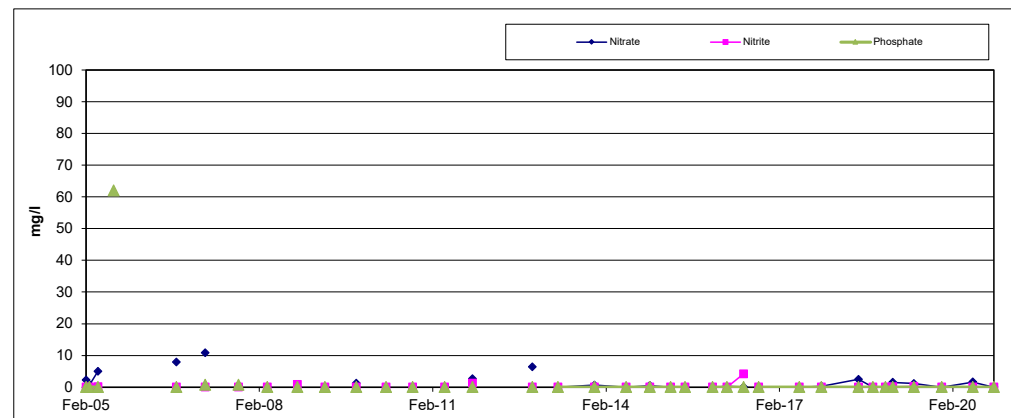
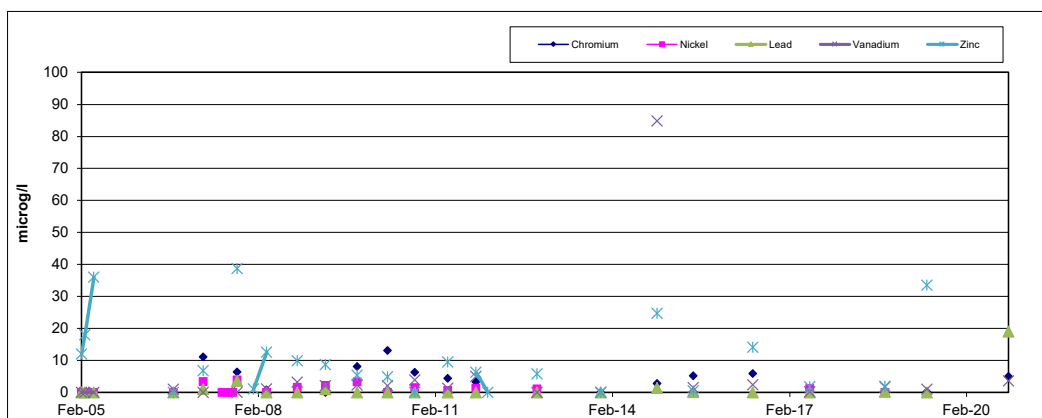
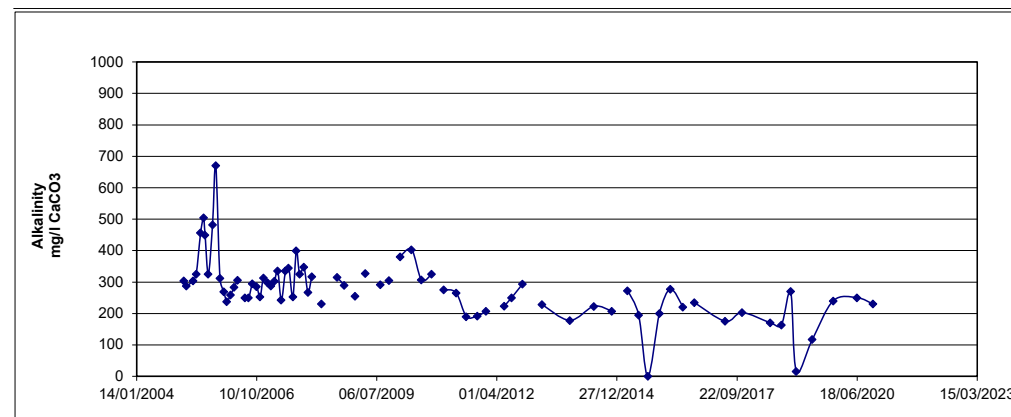
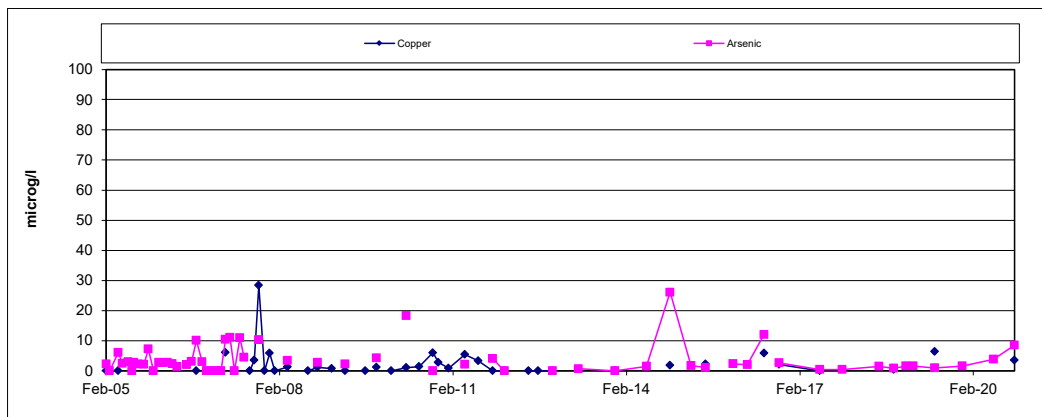


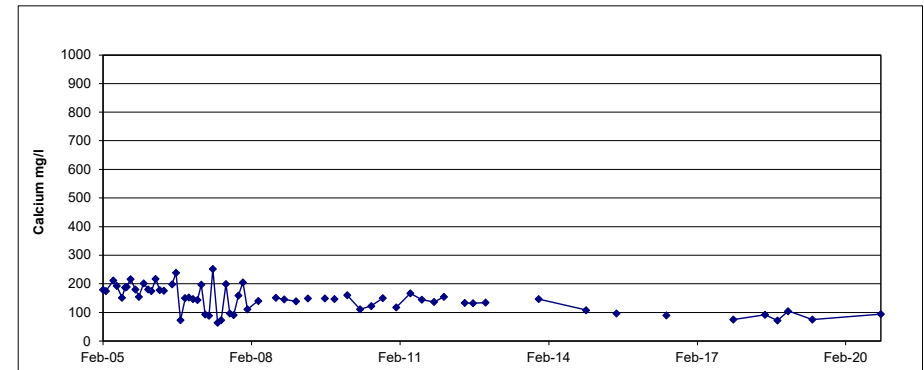
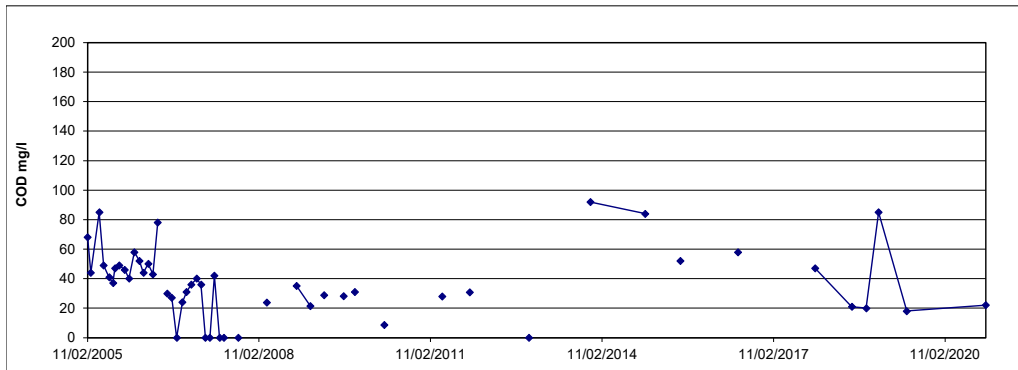
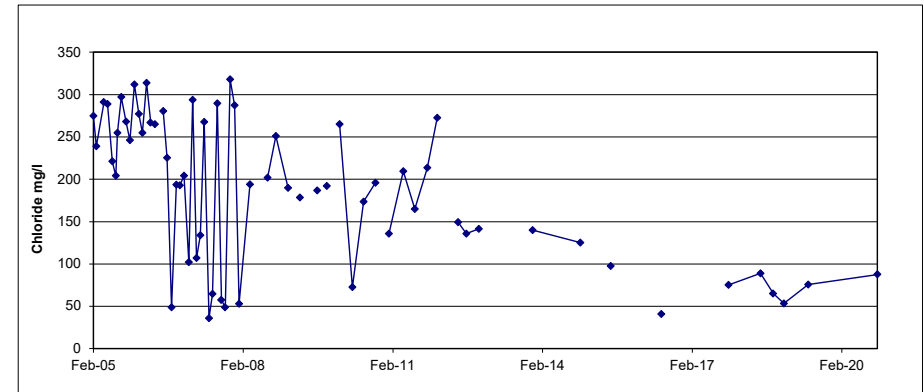
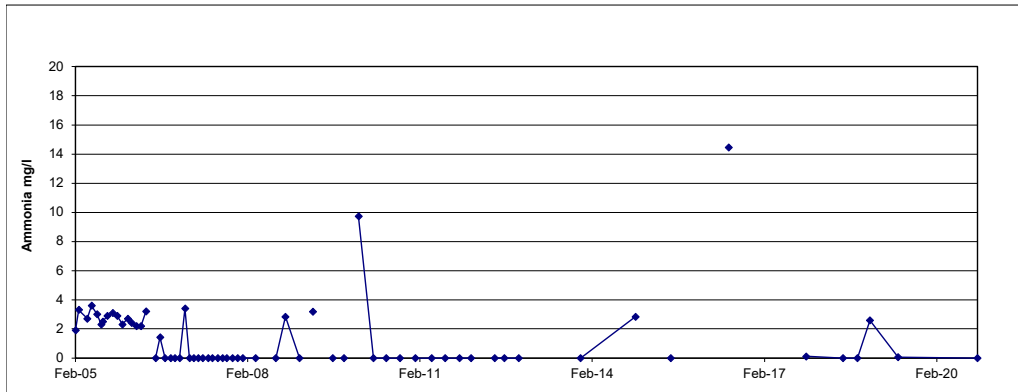
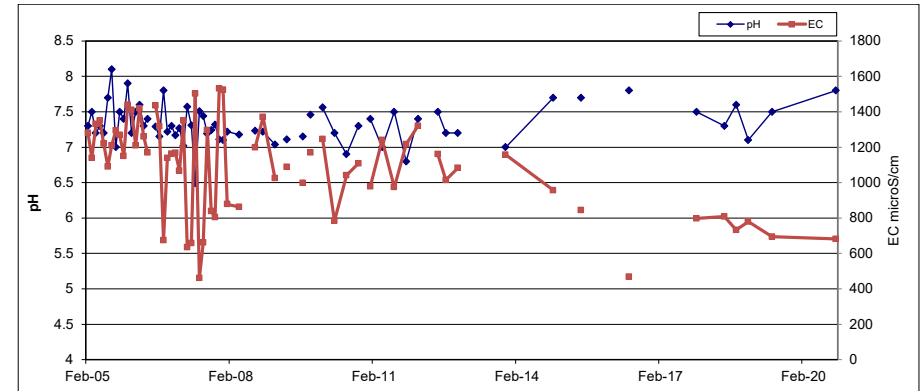
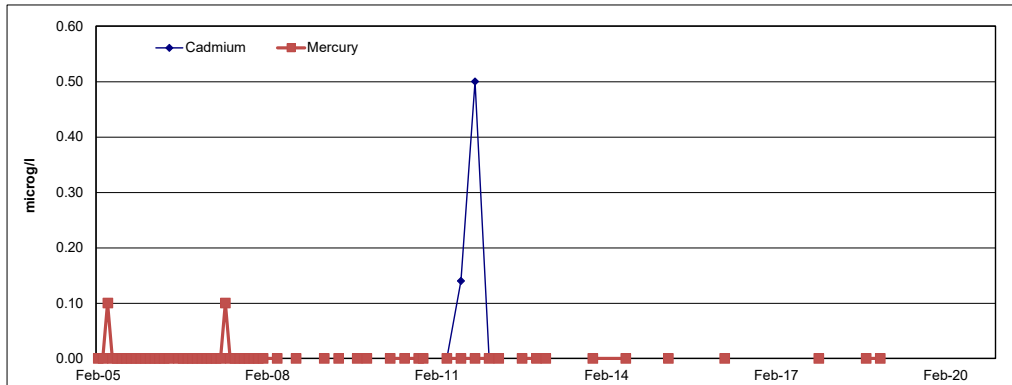
Monitoring data for BH13S

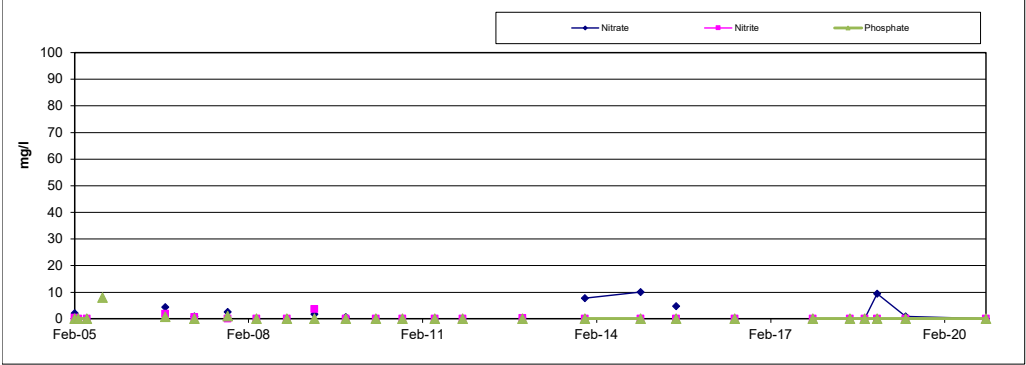
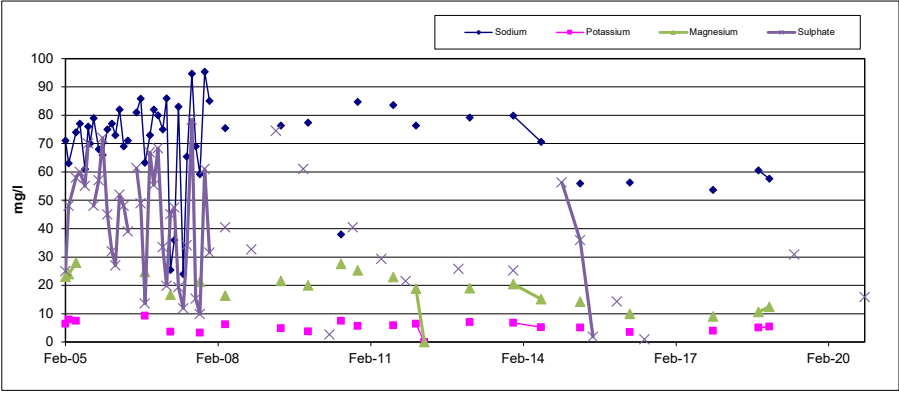
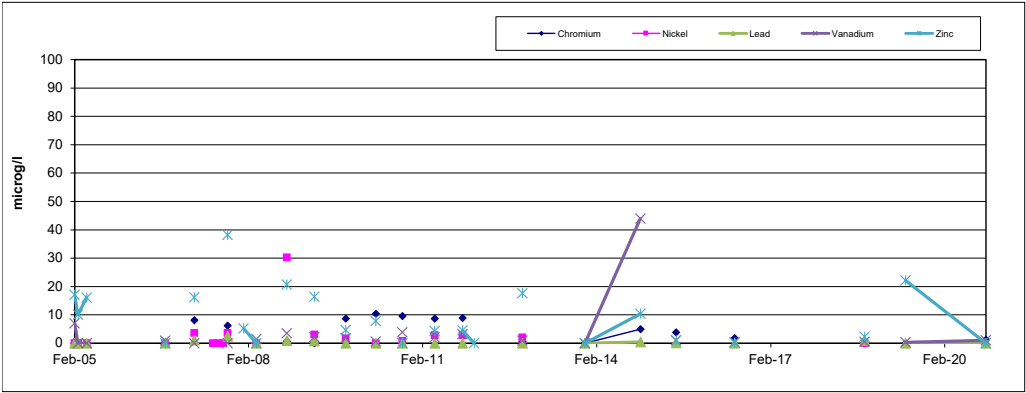
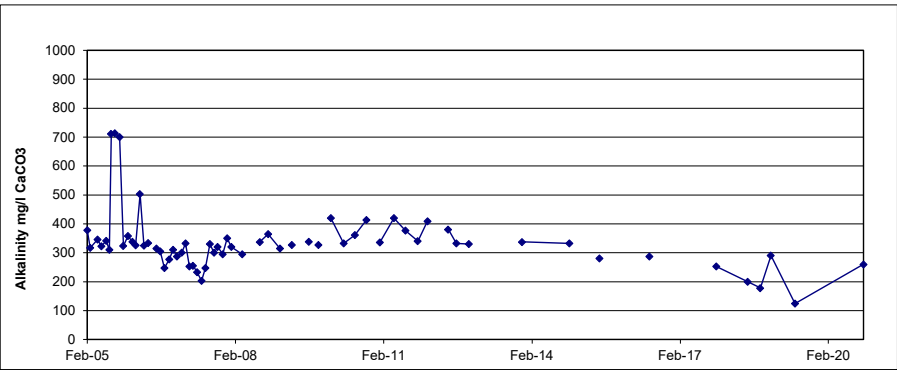
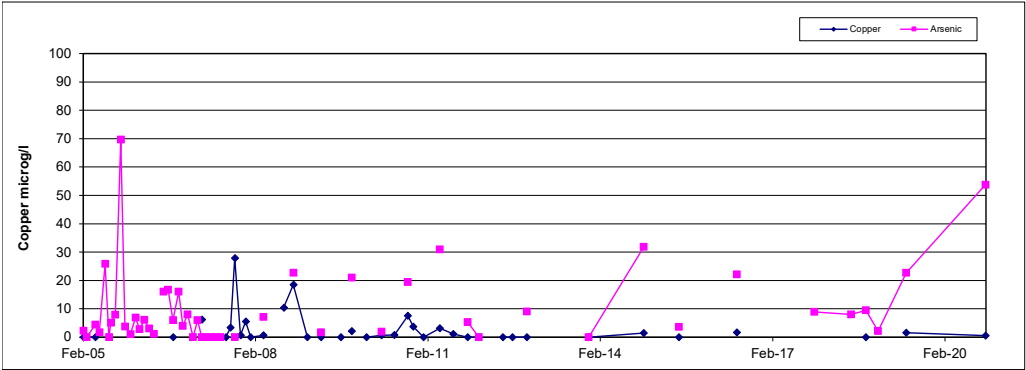


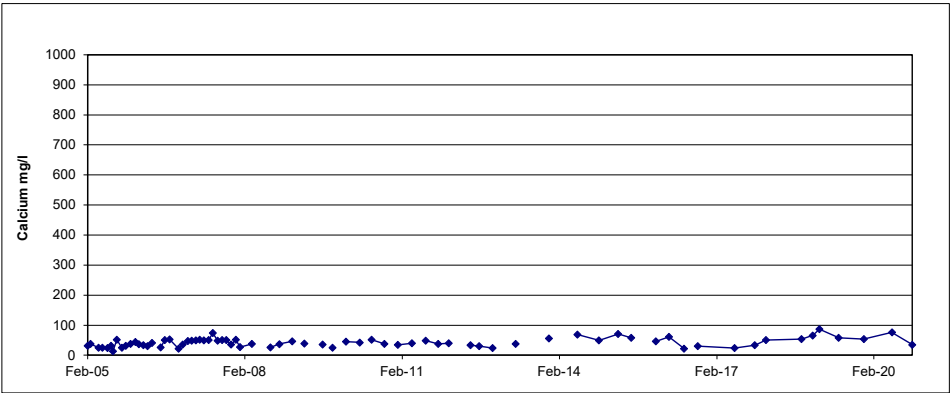
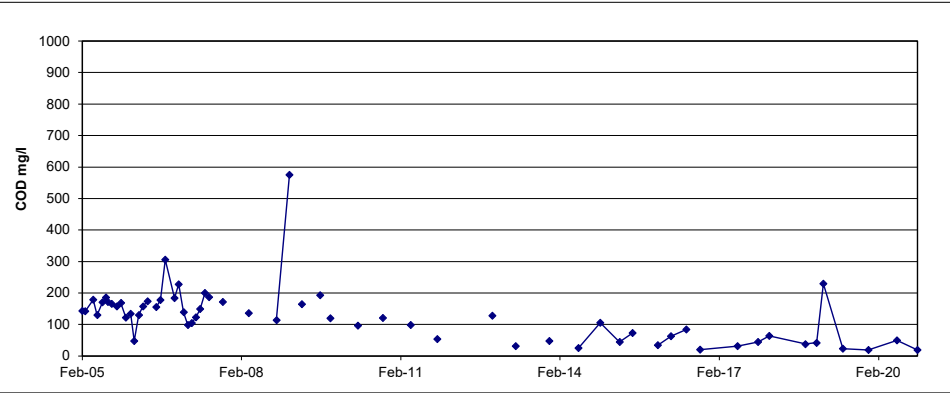
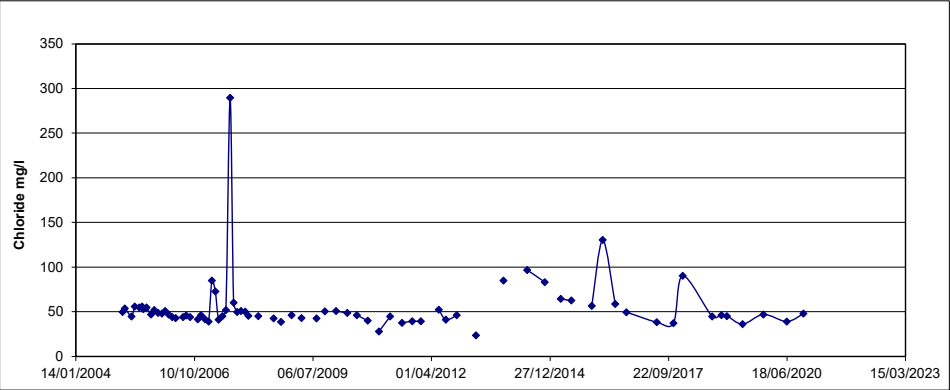
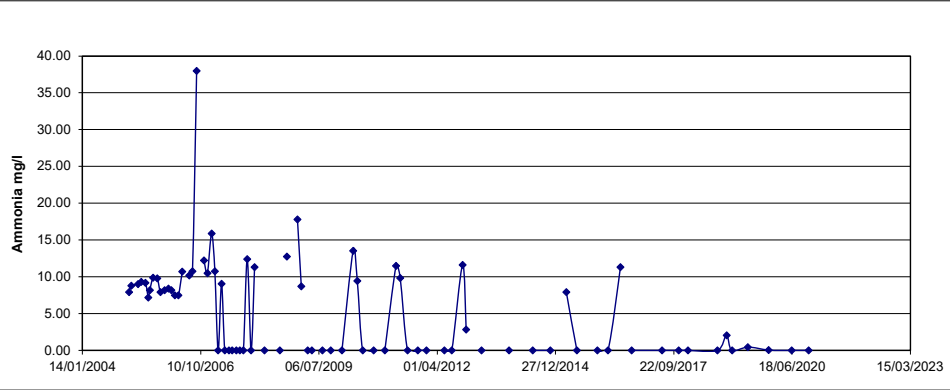
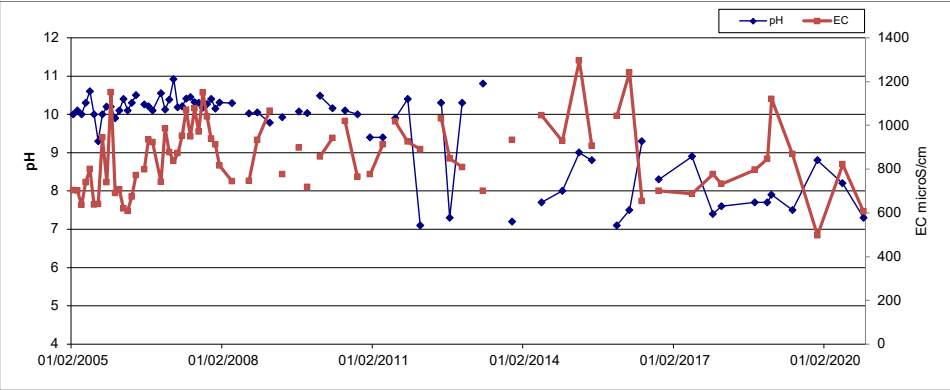
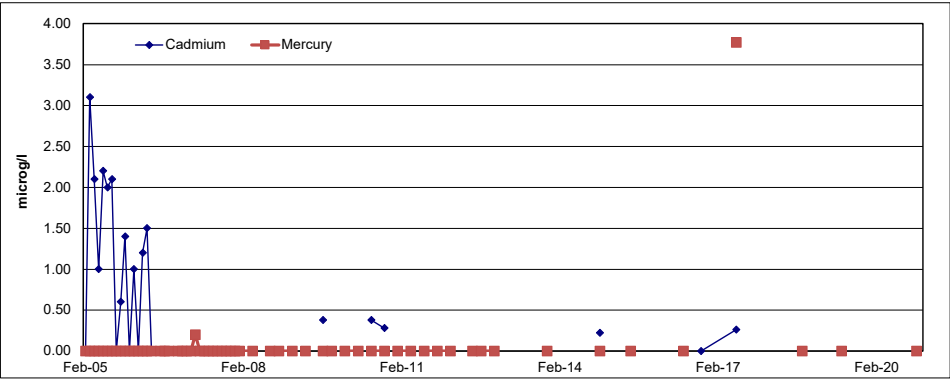
Tata Steel (UK) Ltd

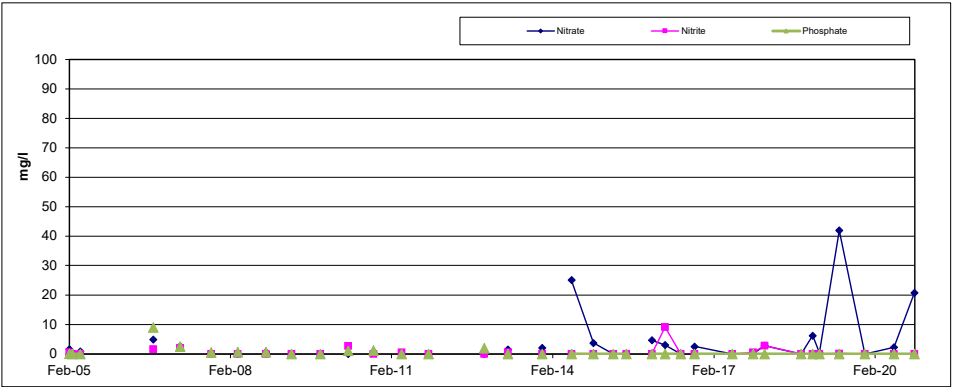
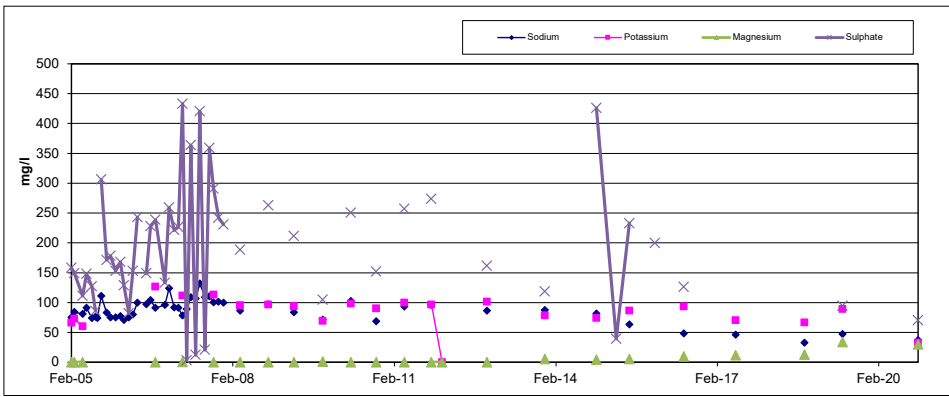
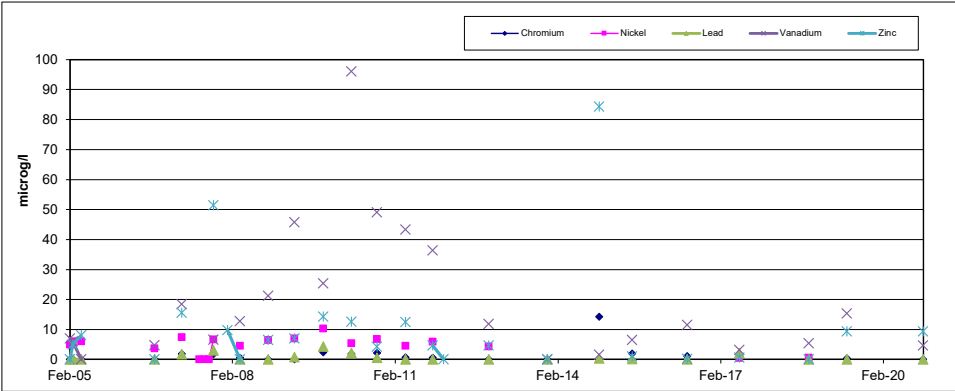
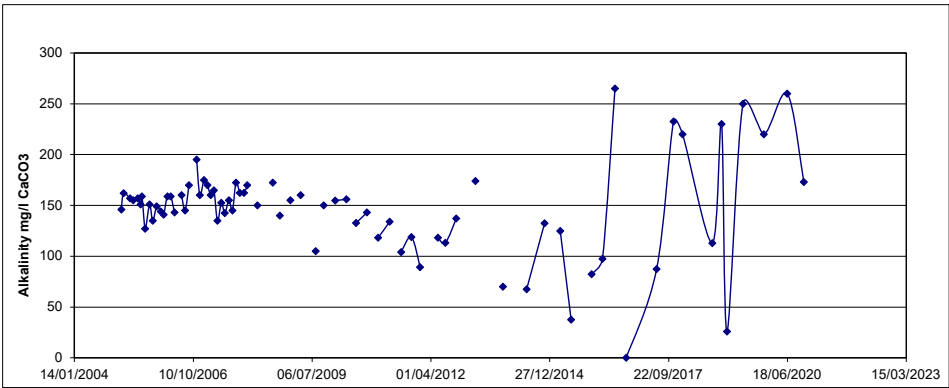
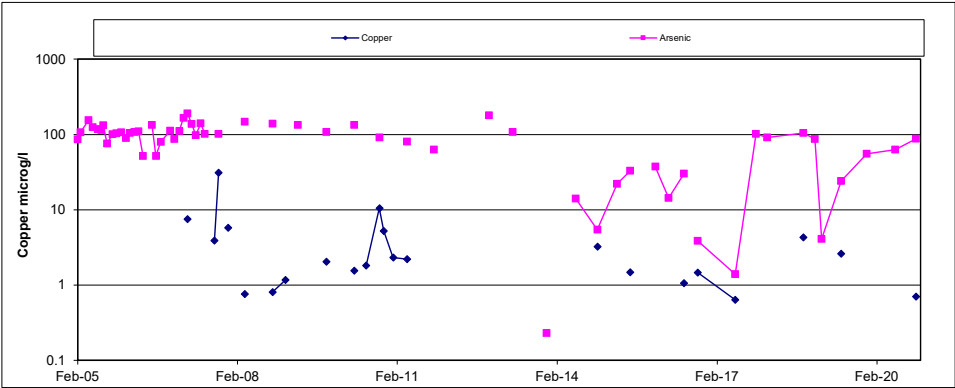


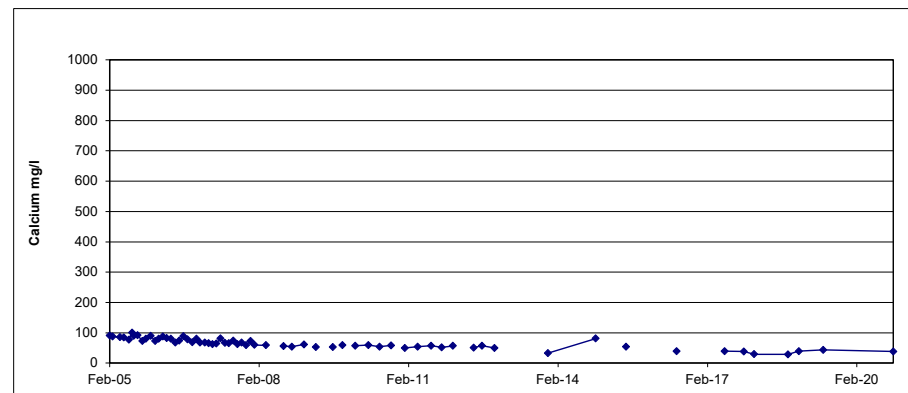
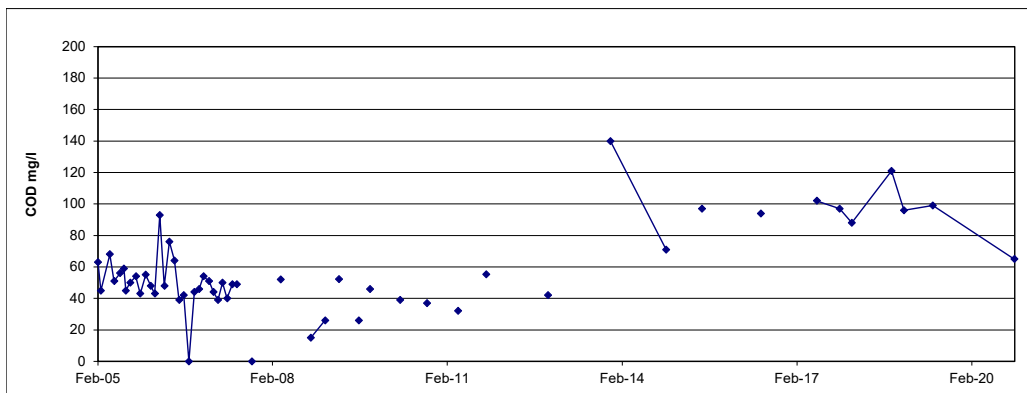
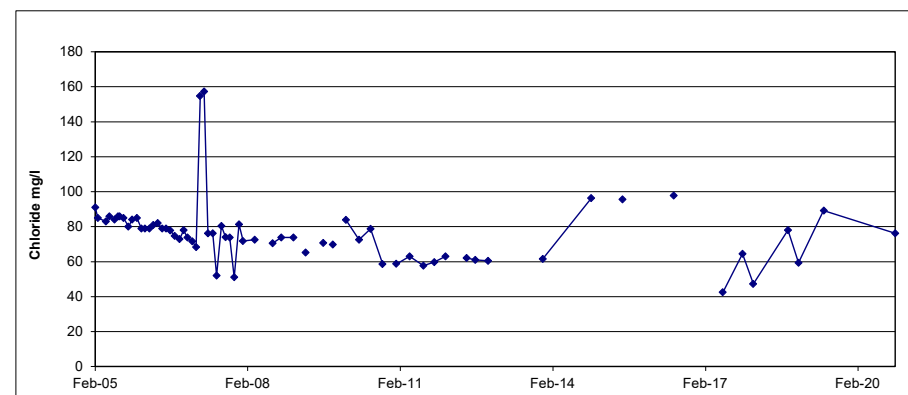
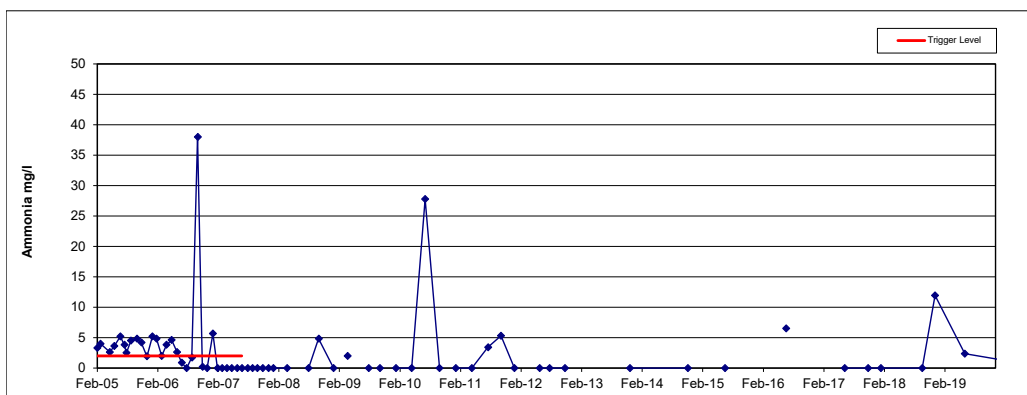
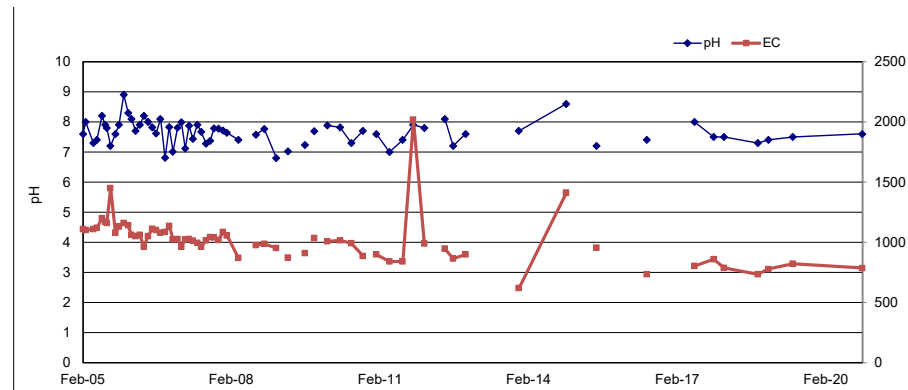
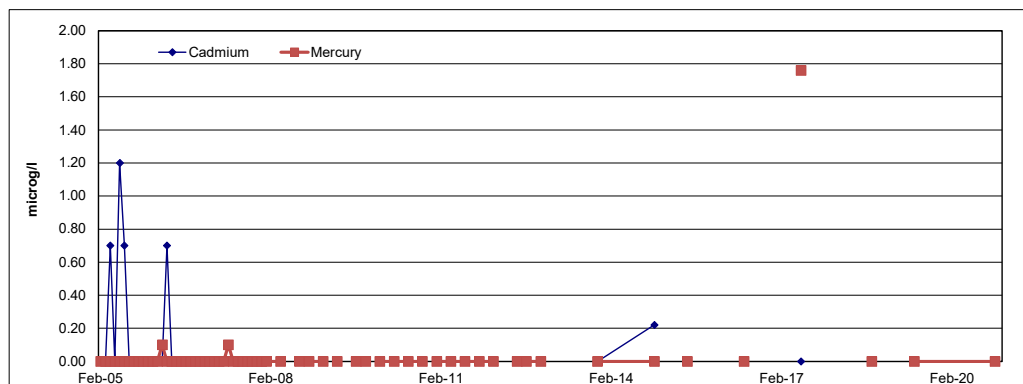


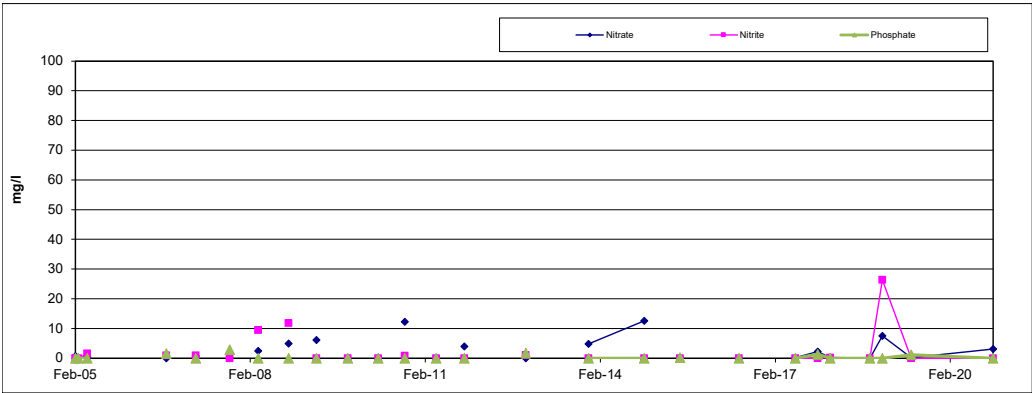
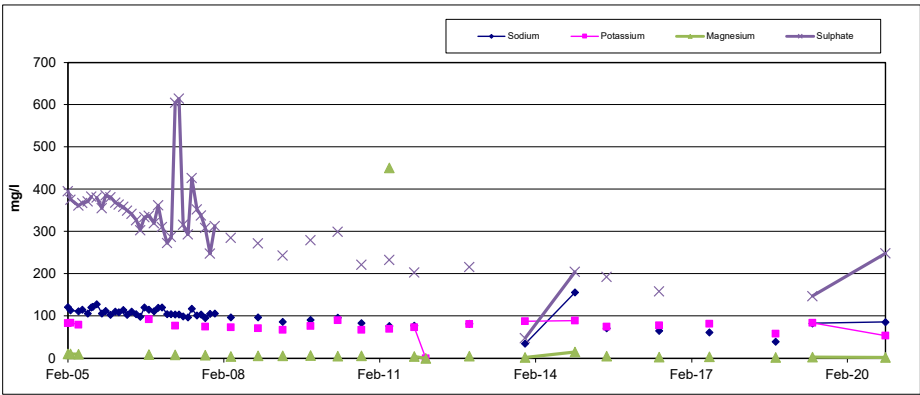
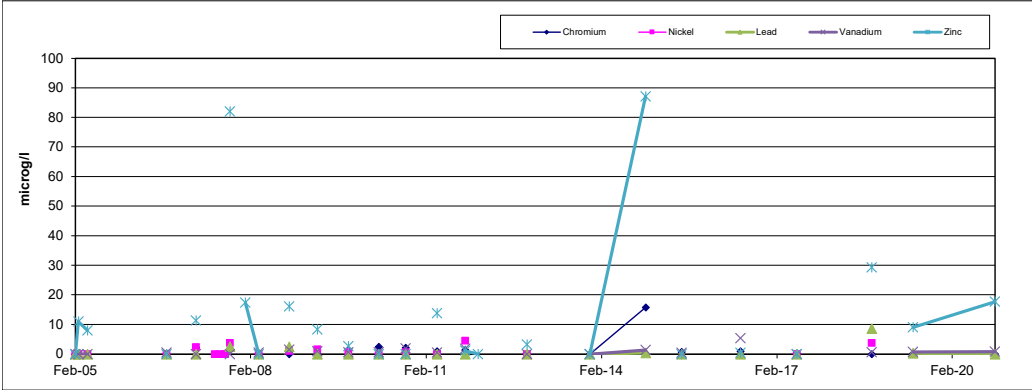
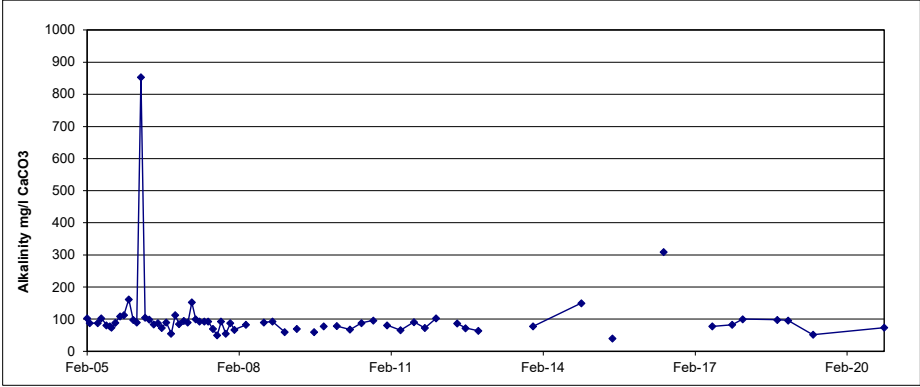
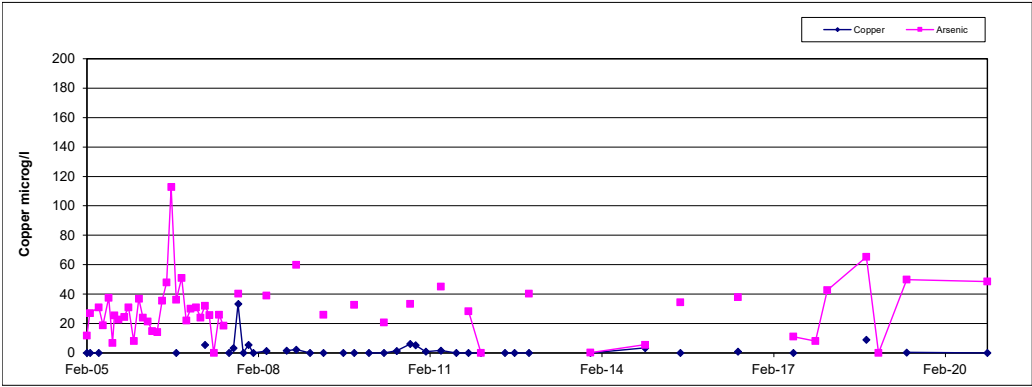


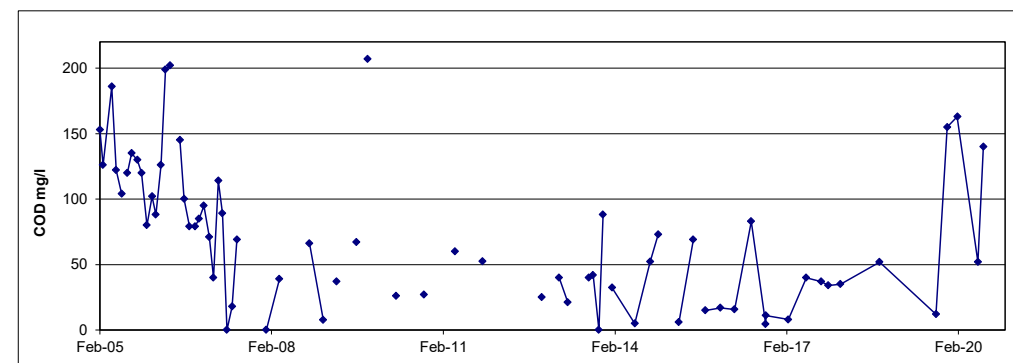
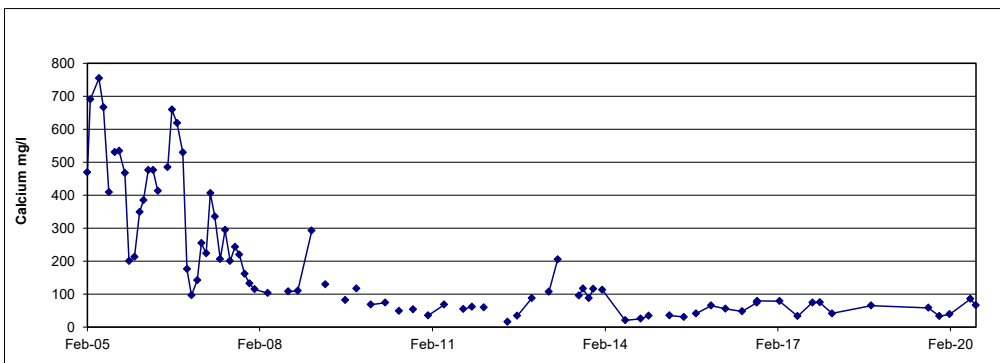
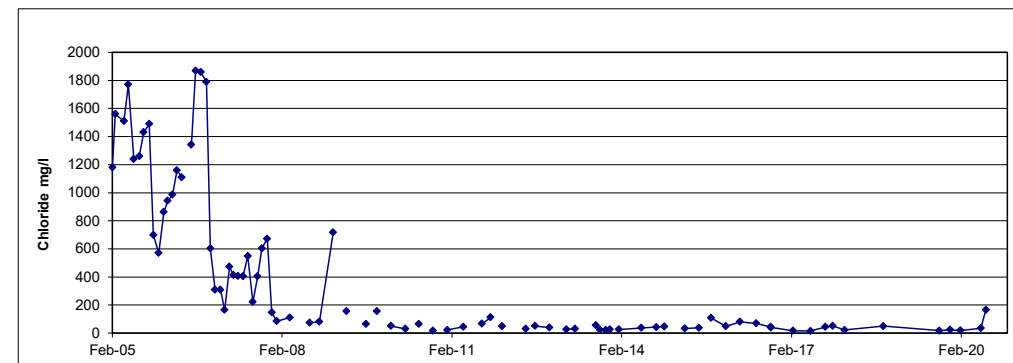
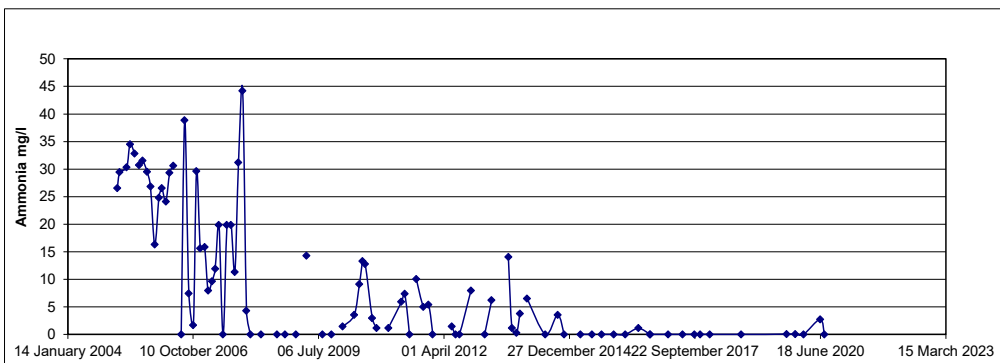
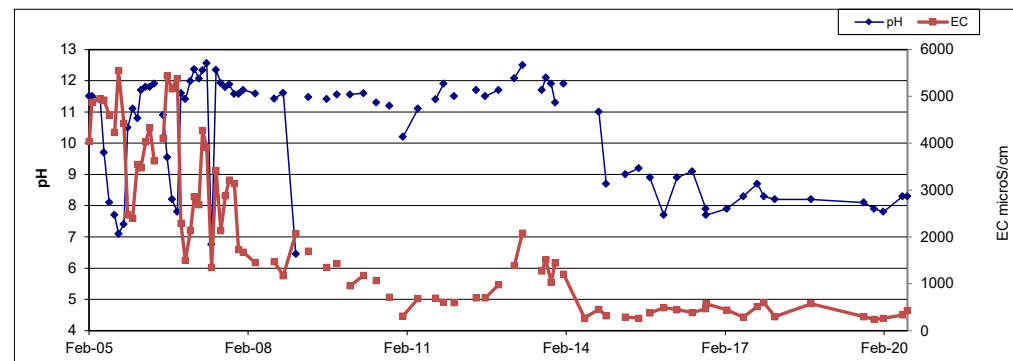
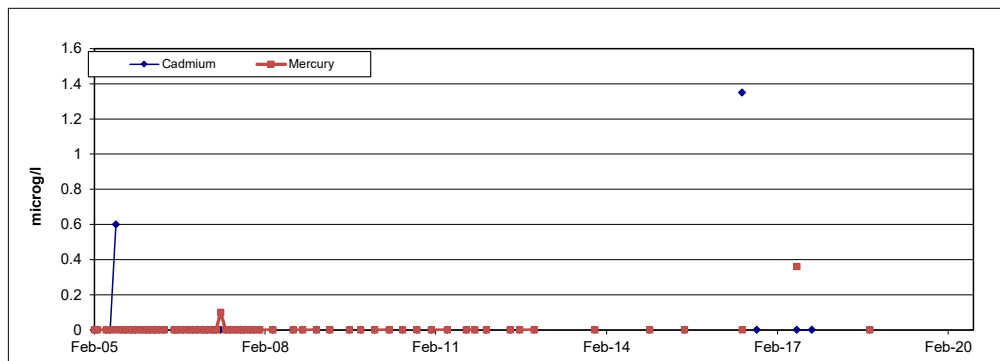


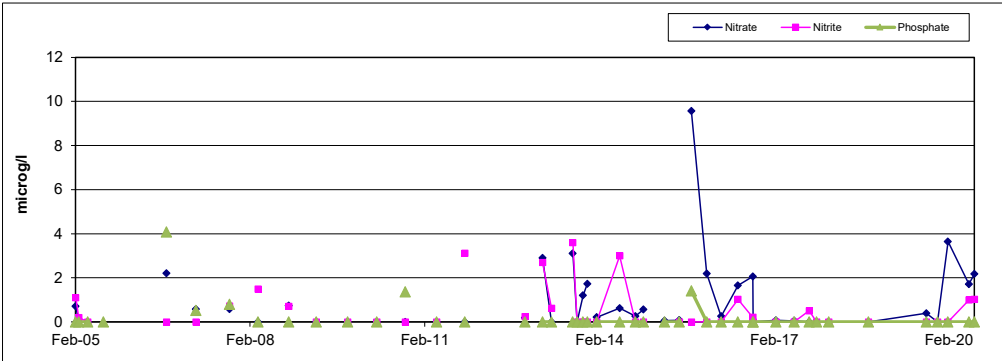
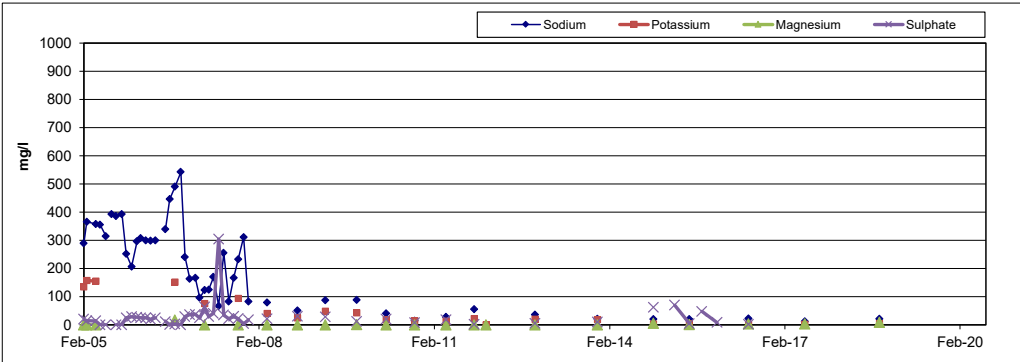
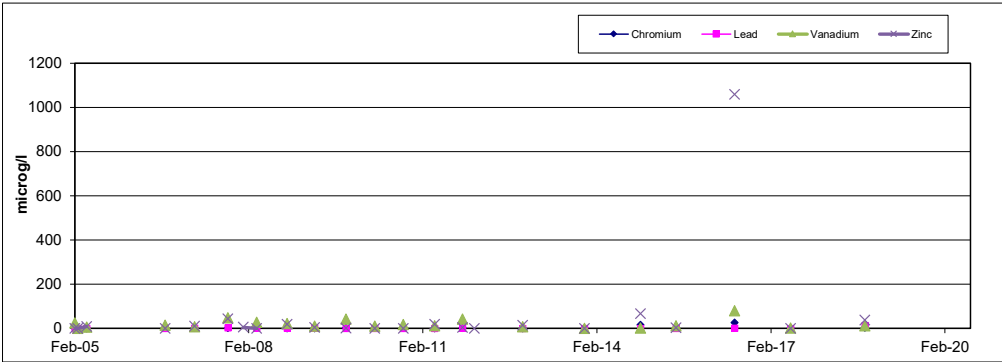
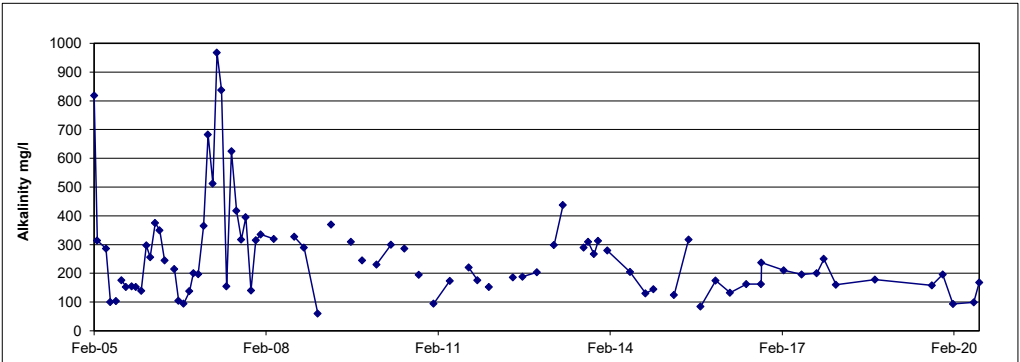
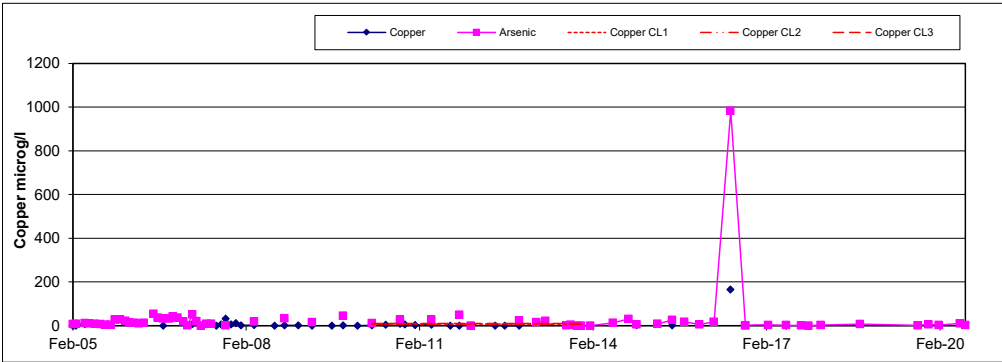


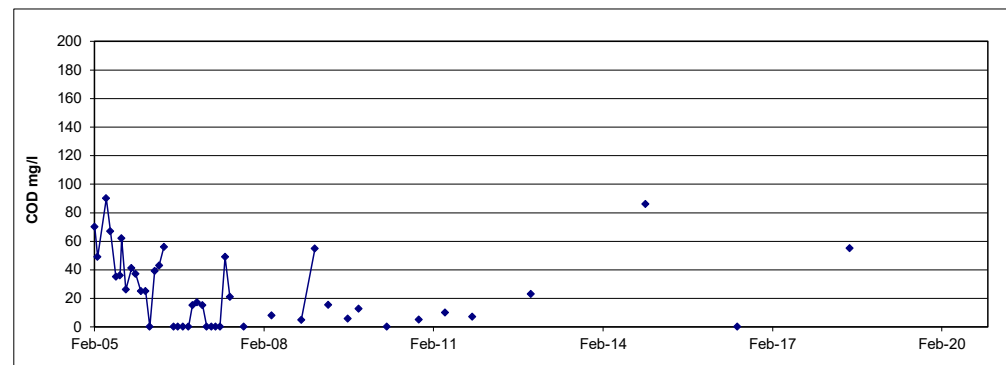
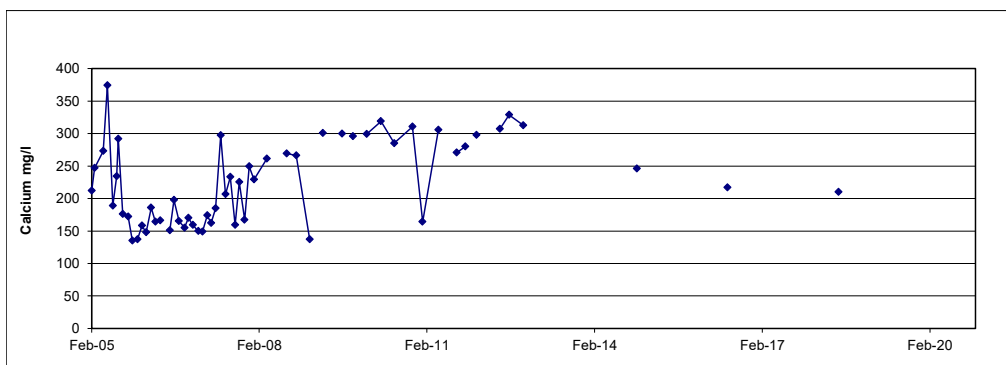
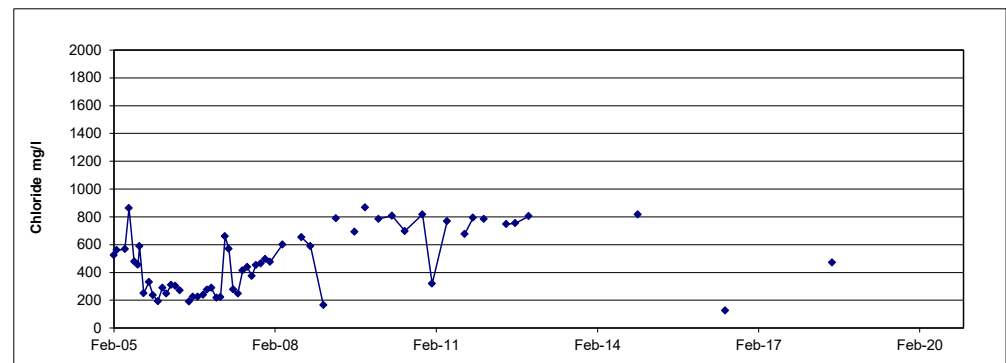
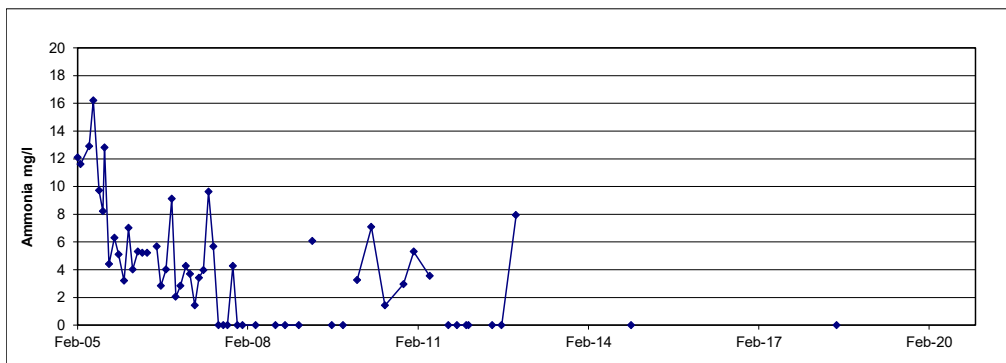
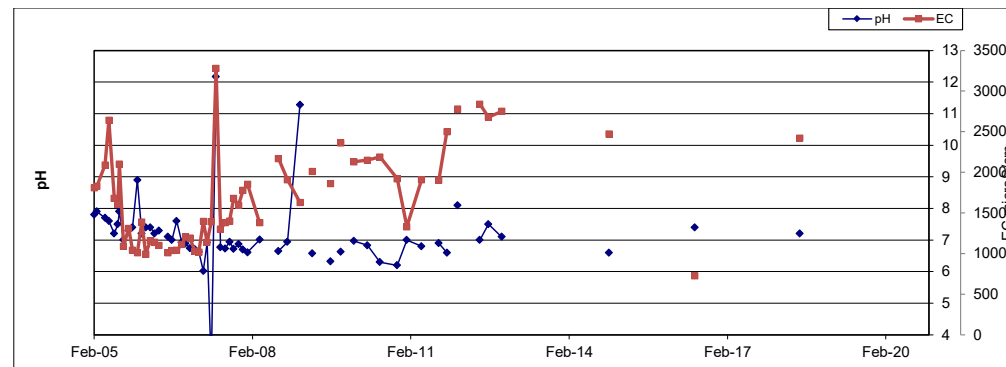
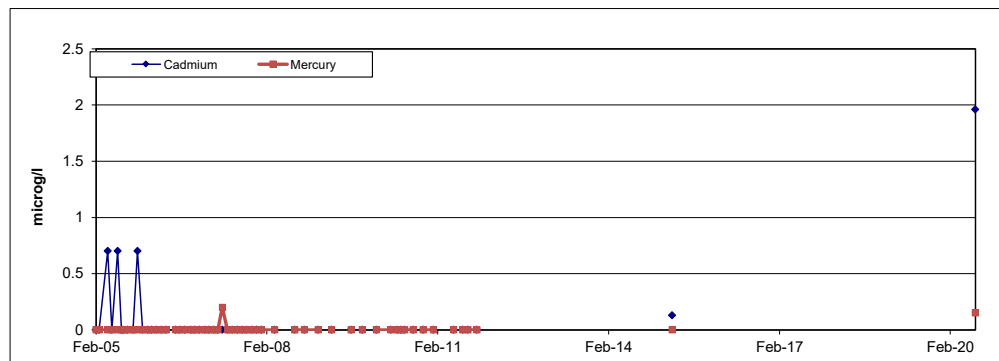


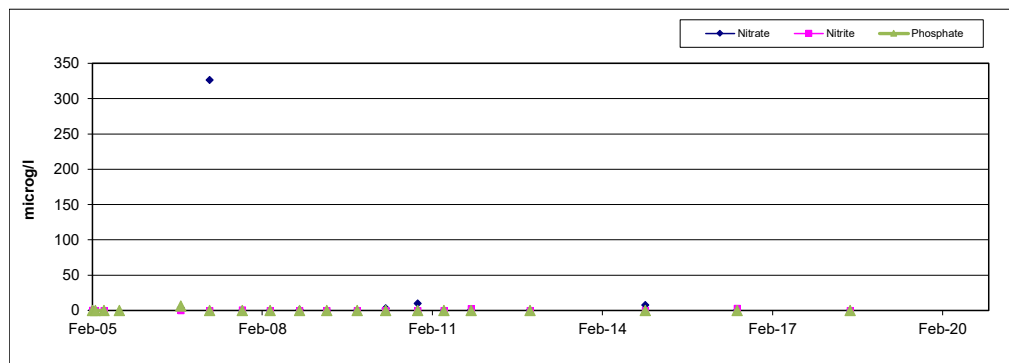
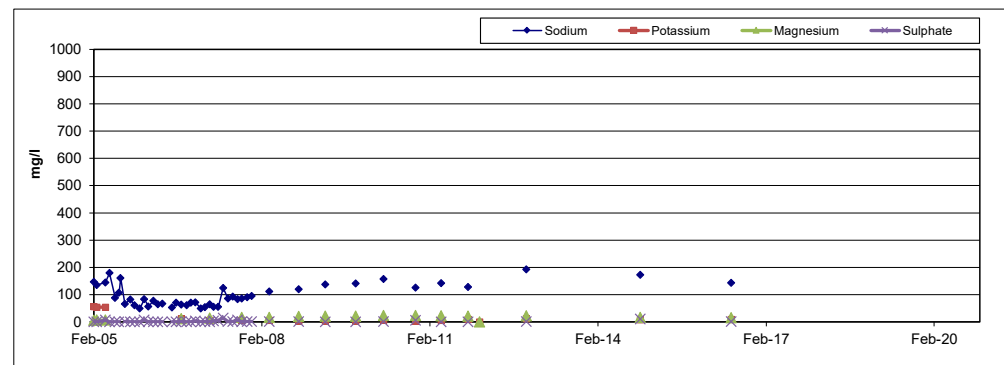
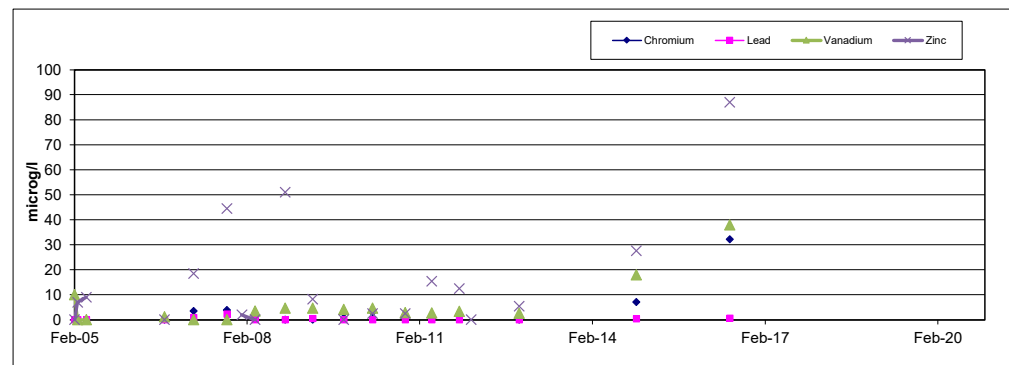
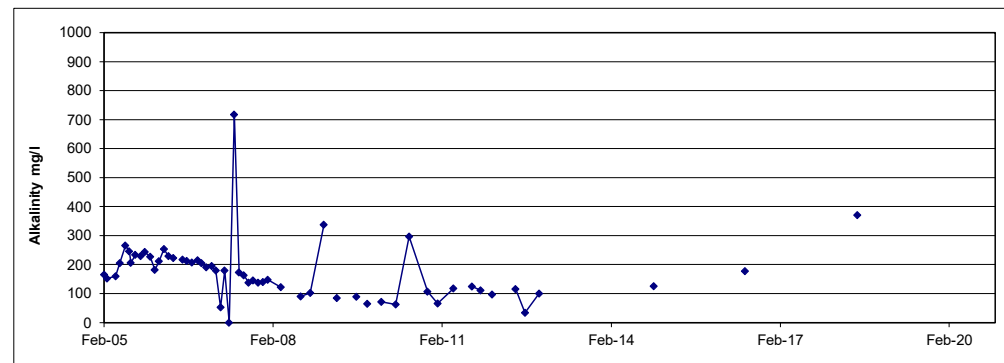
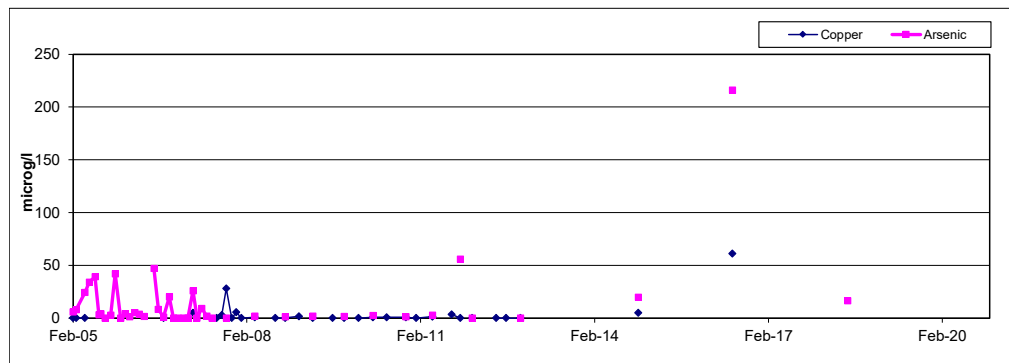


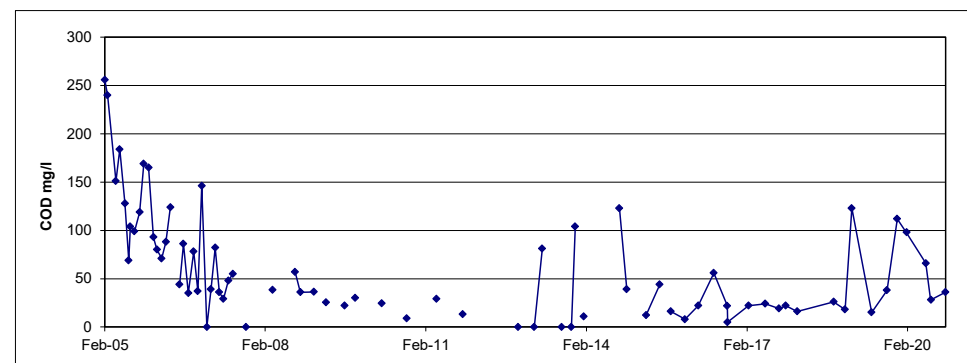
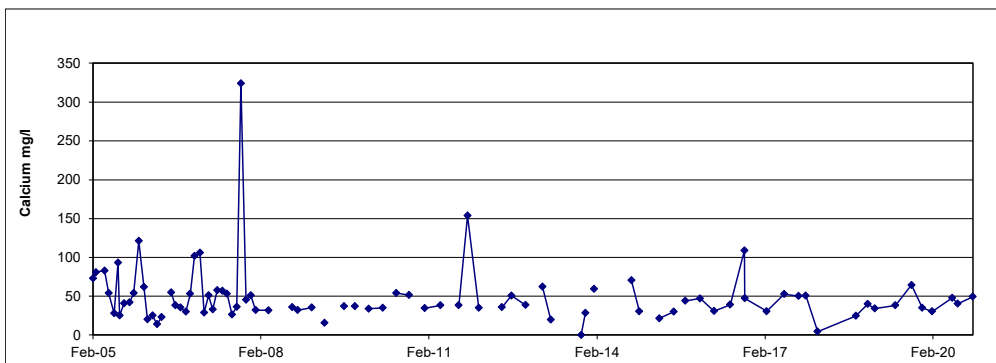
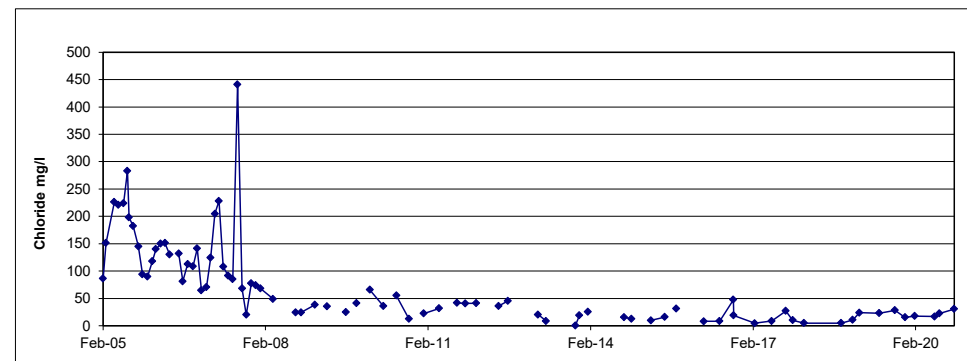
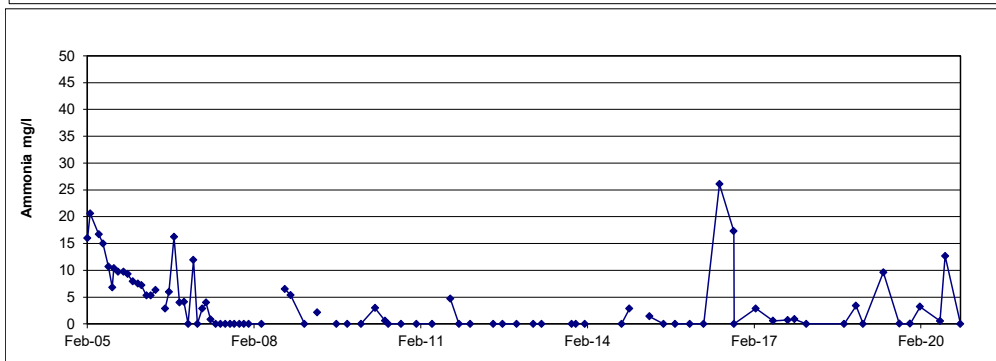
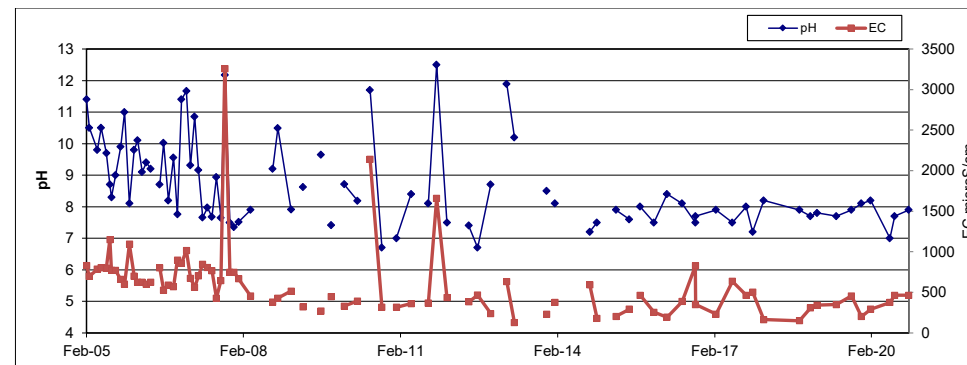
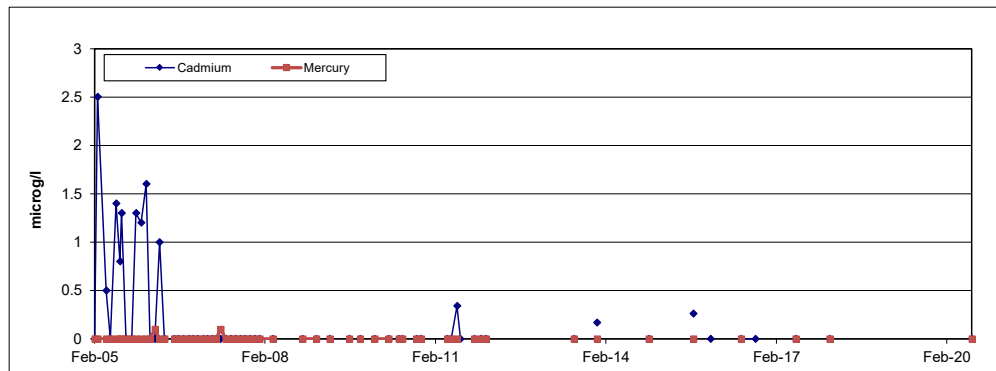


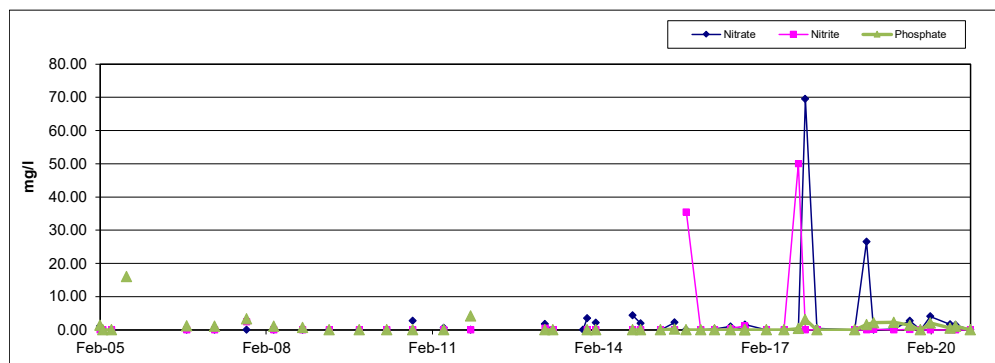
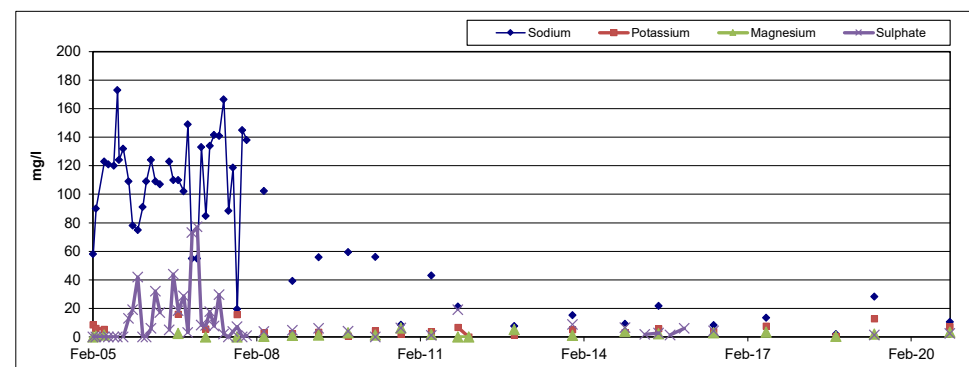
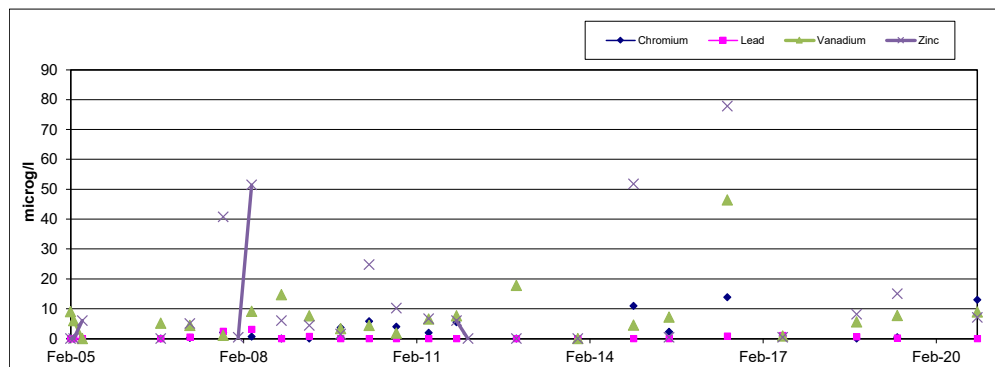
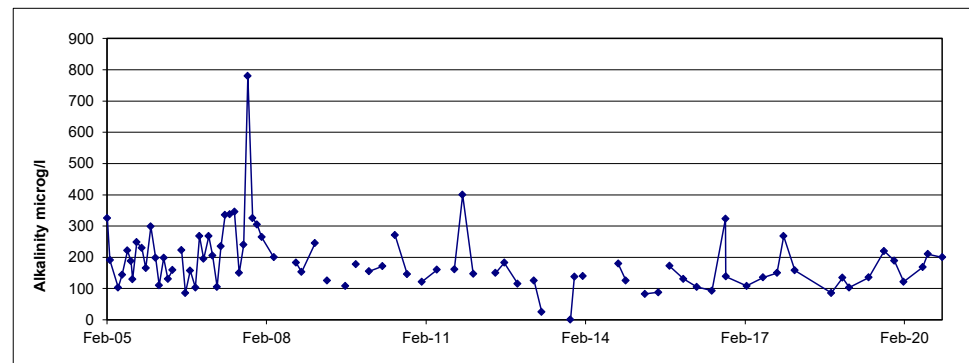
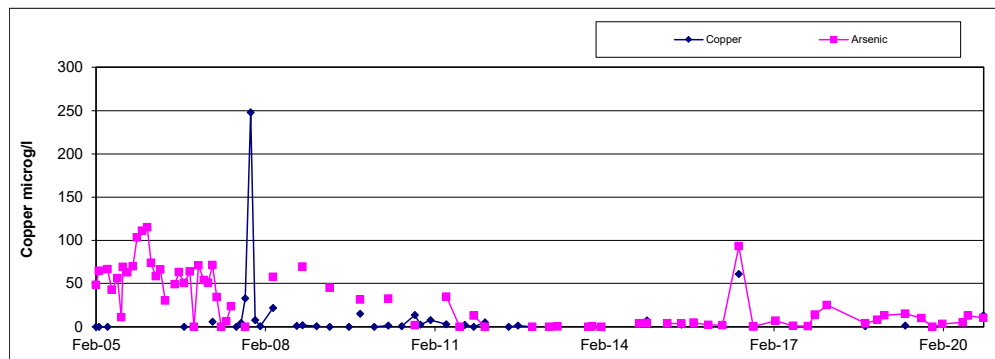


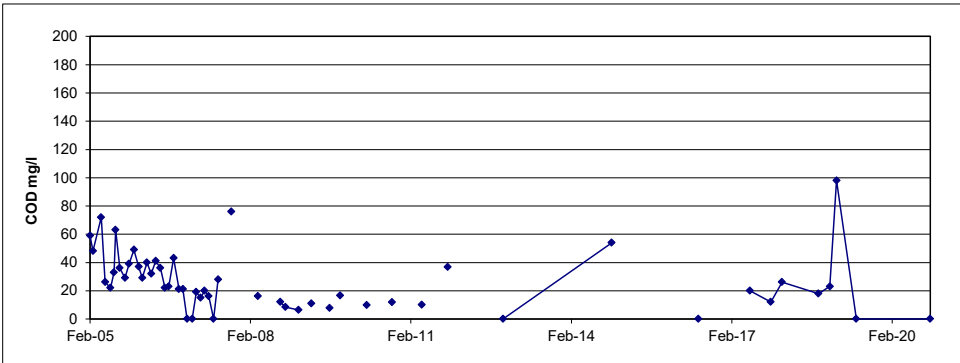
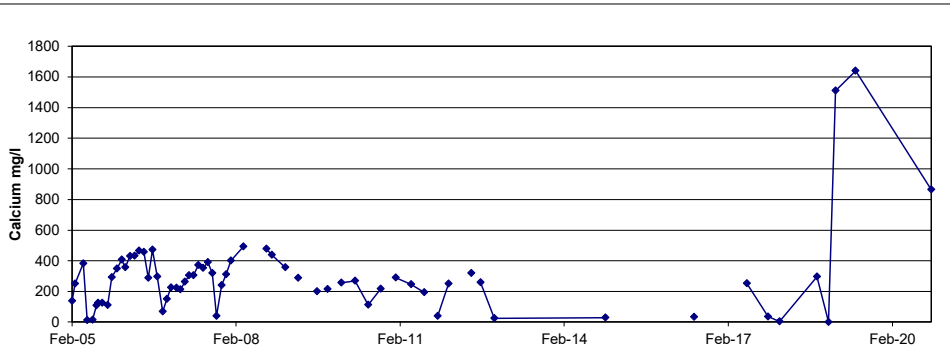
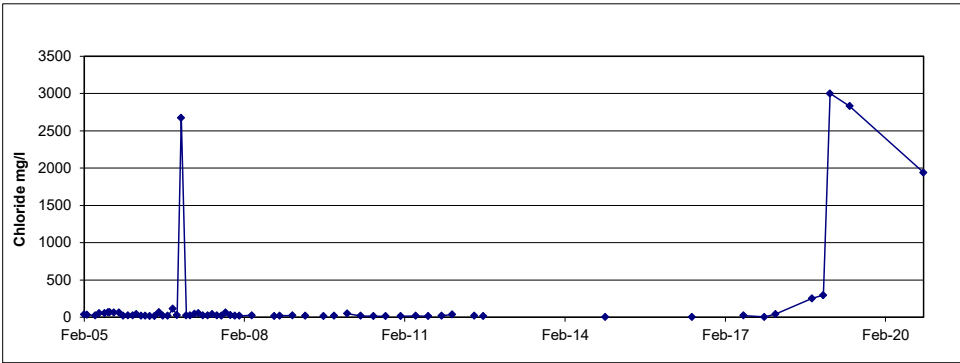
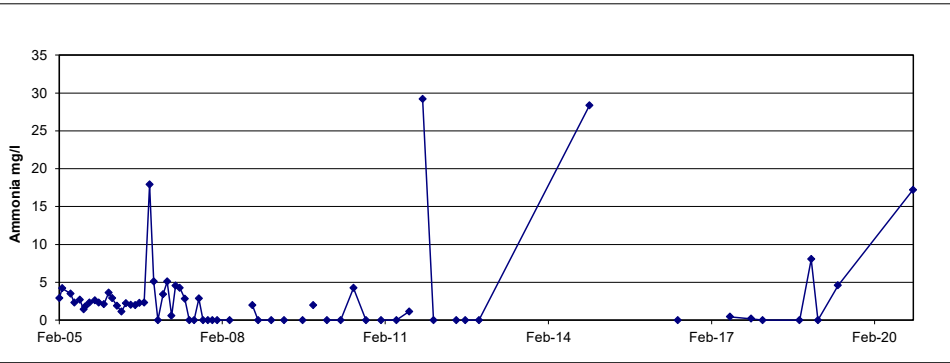
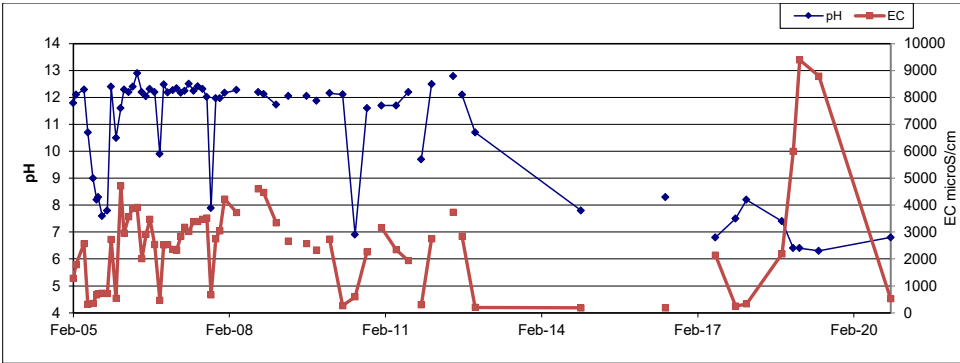
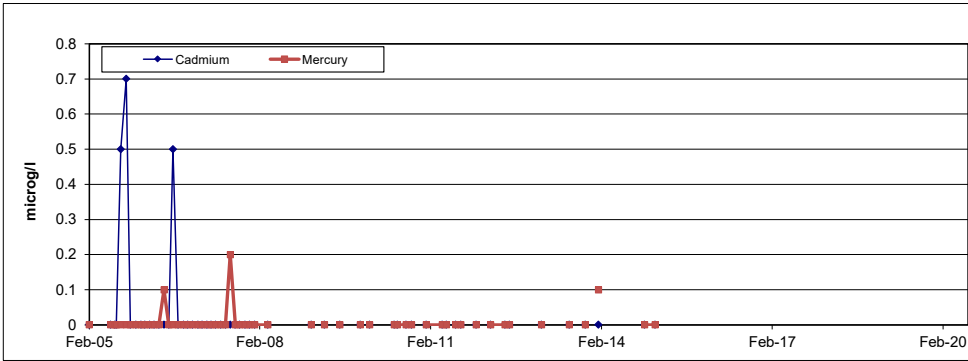


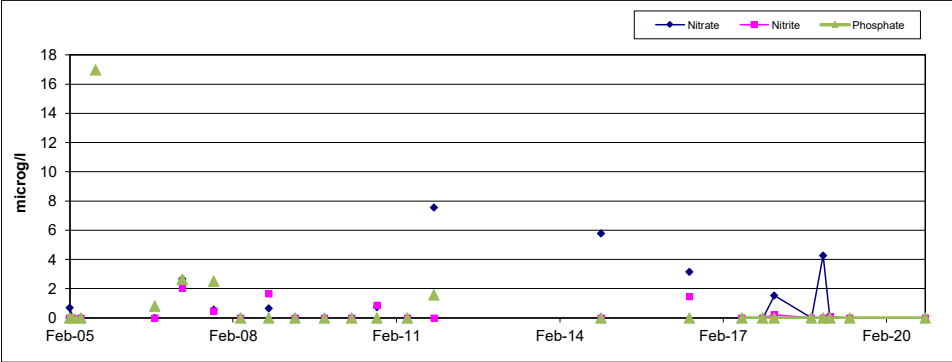
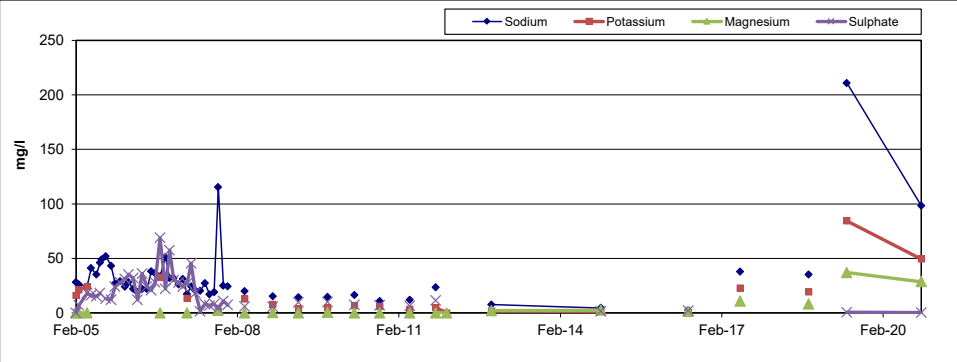
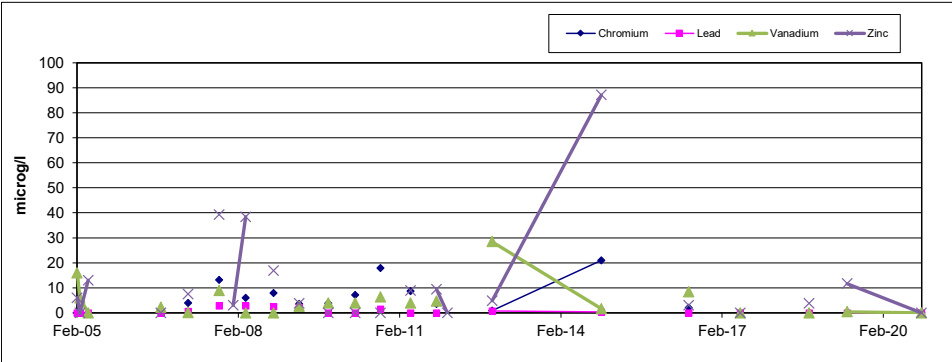
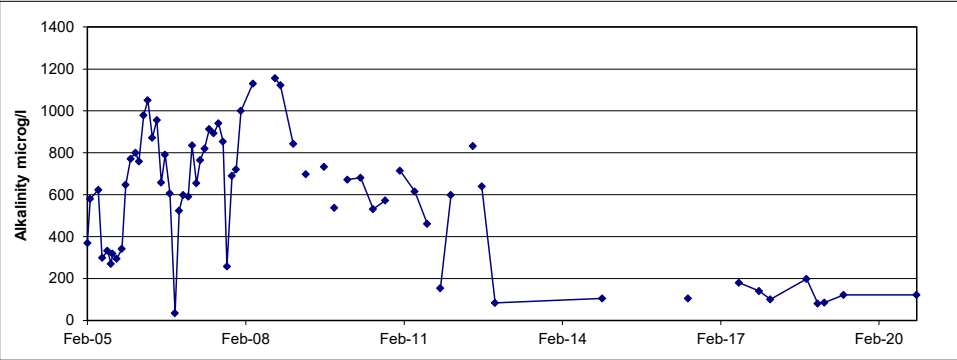
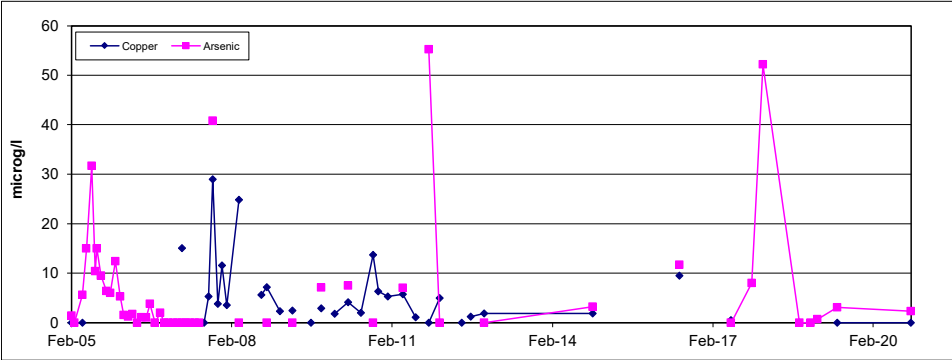


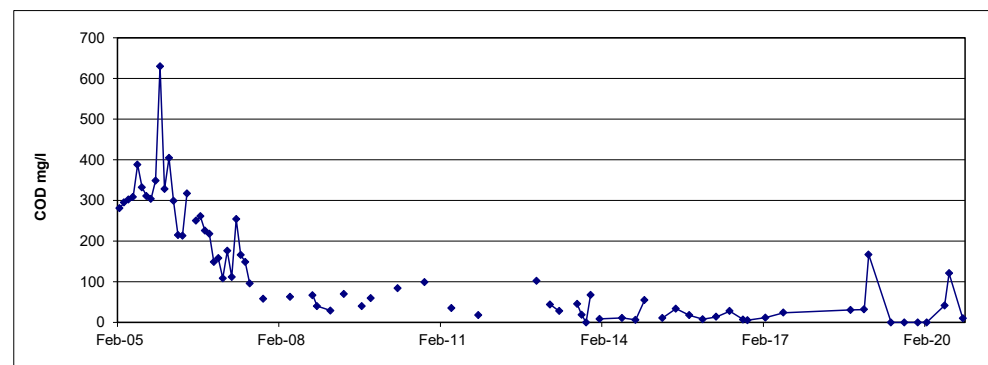
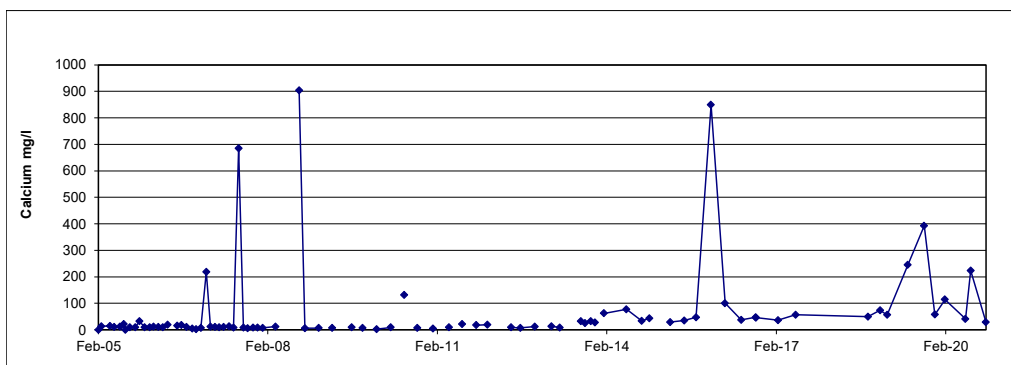
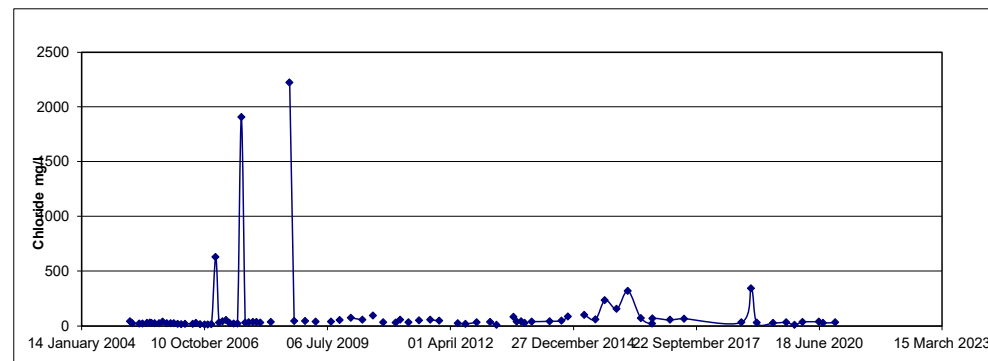
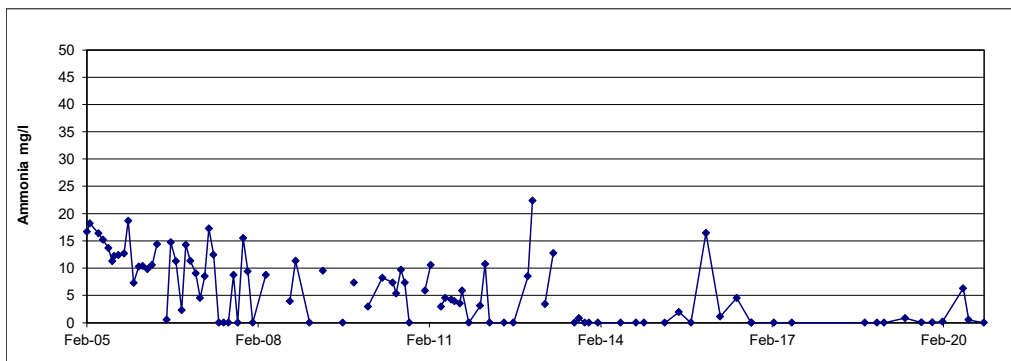
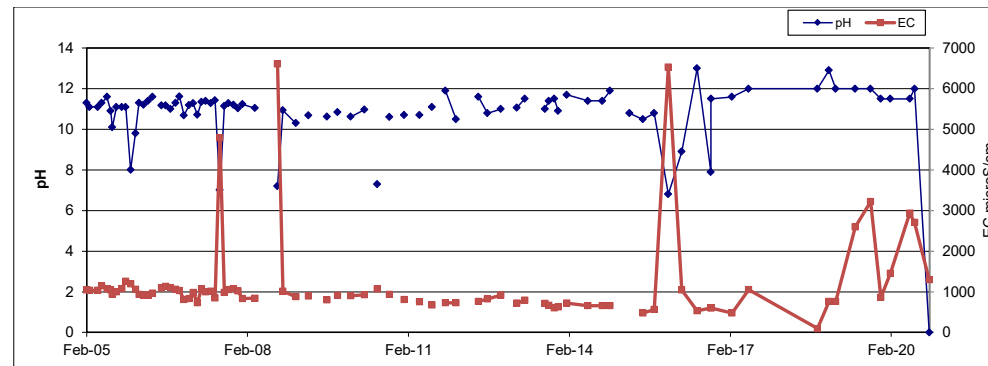
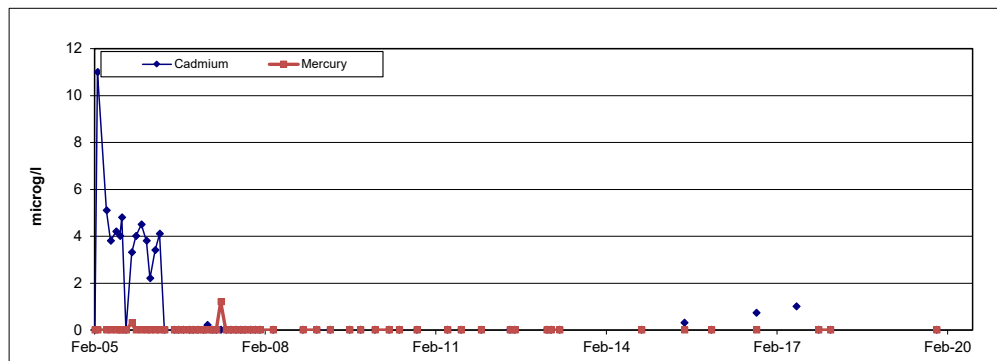


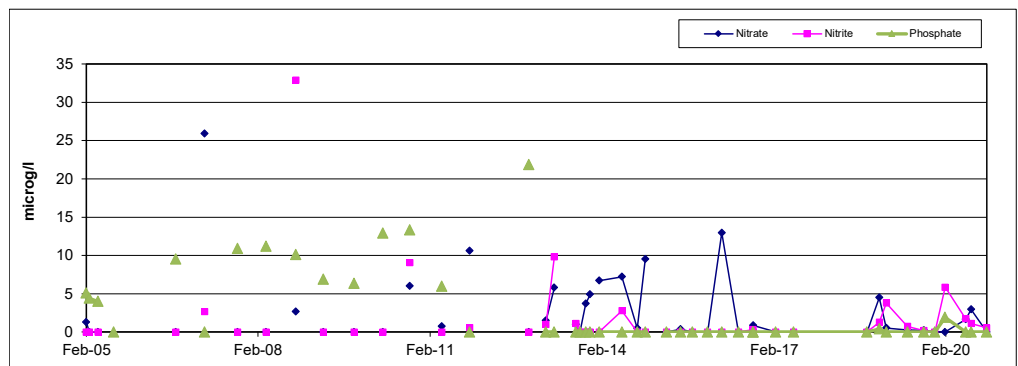
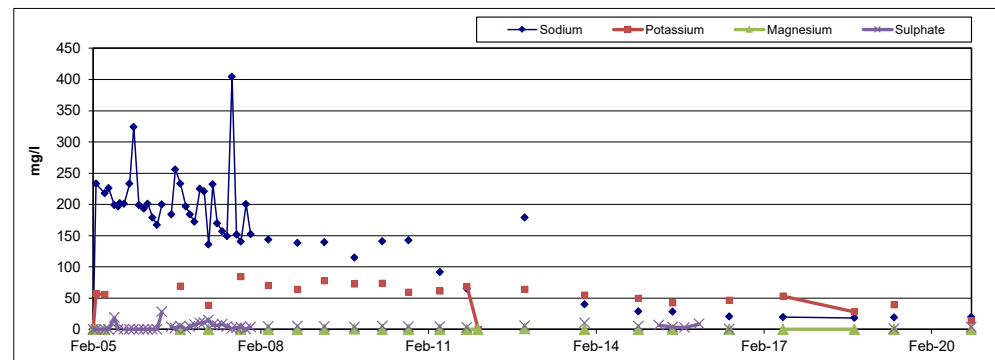
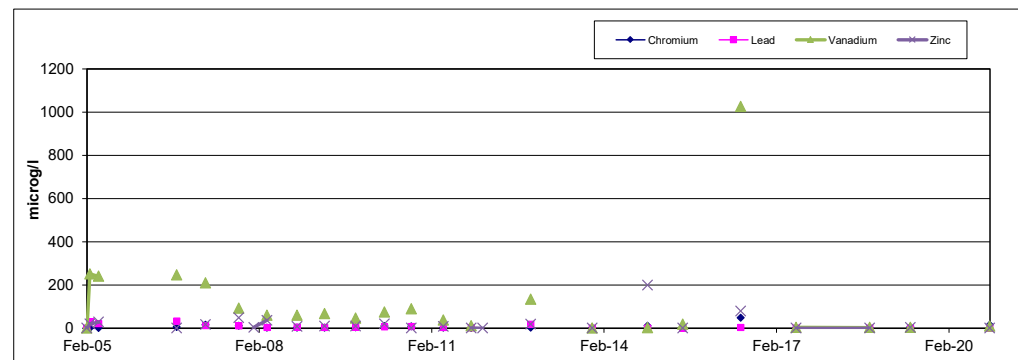
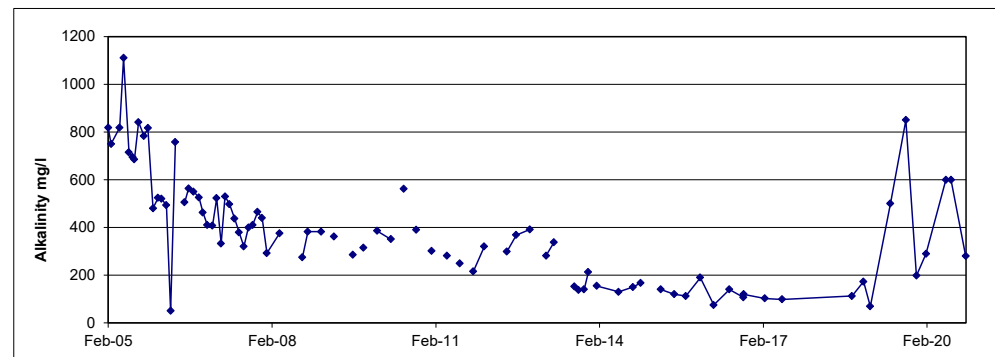
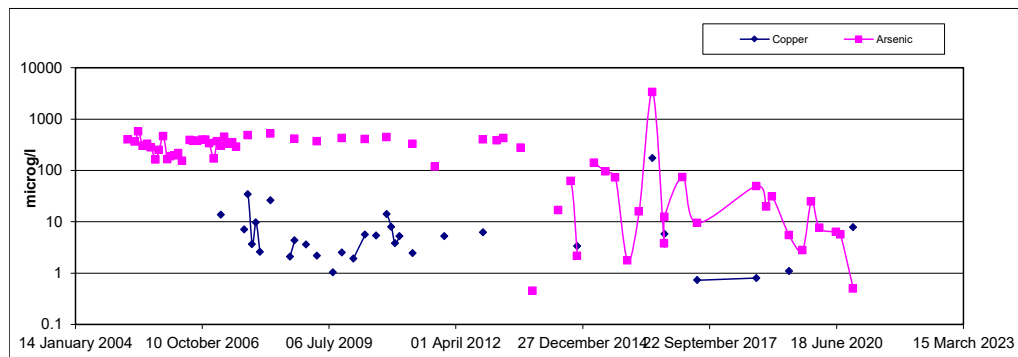


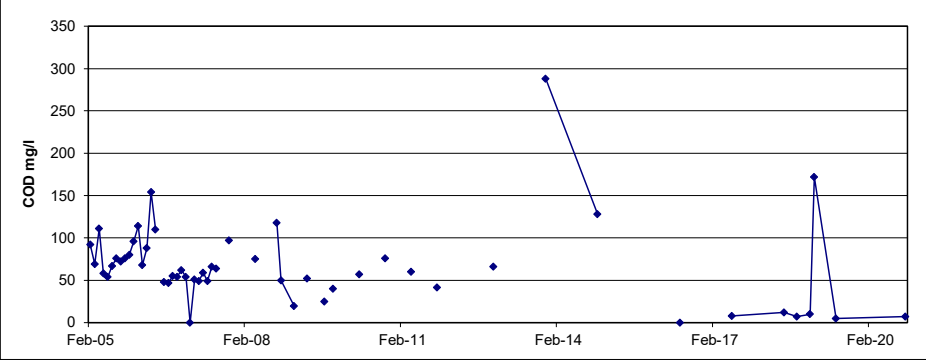
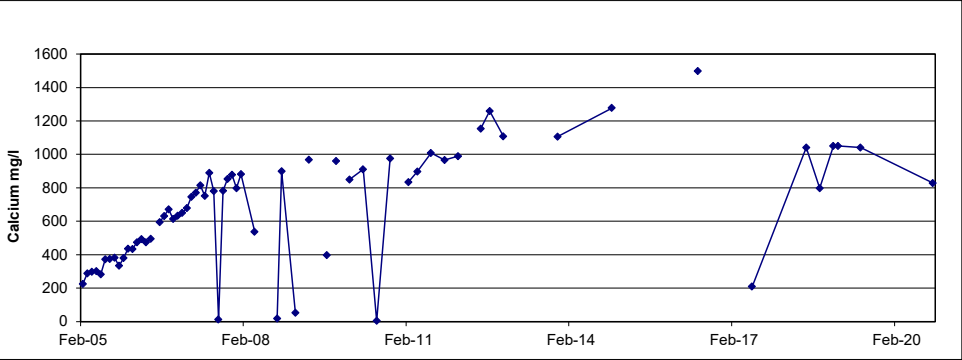
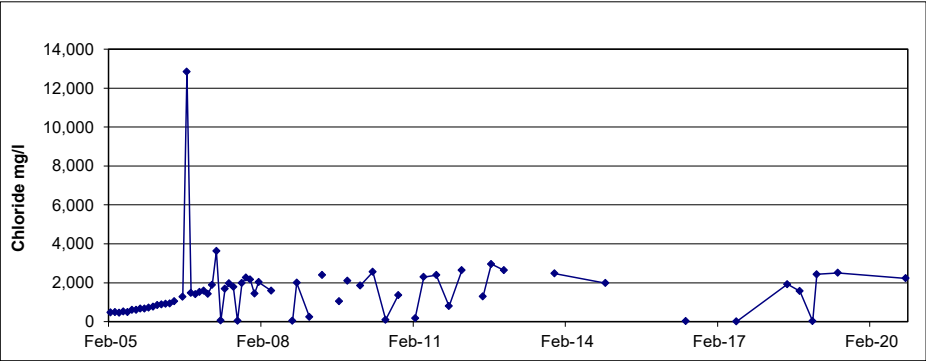
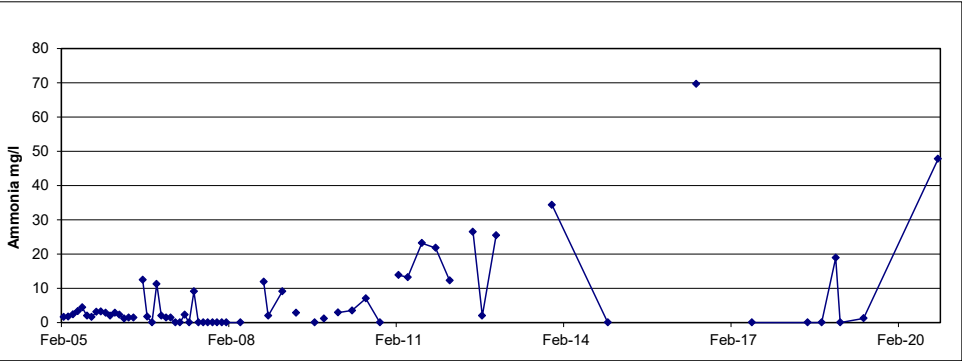
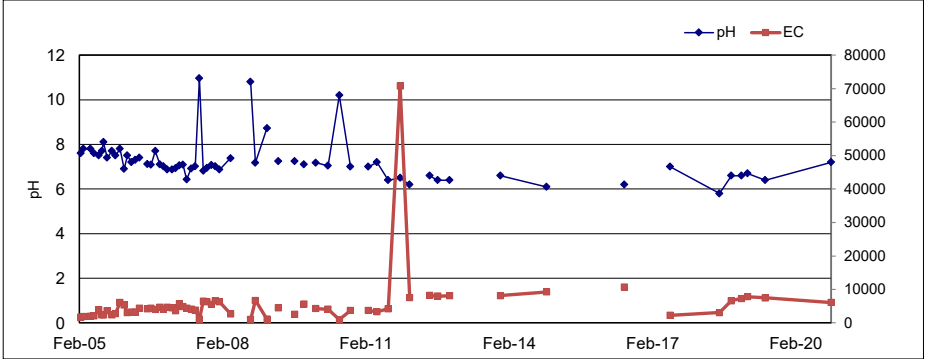
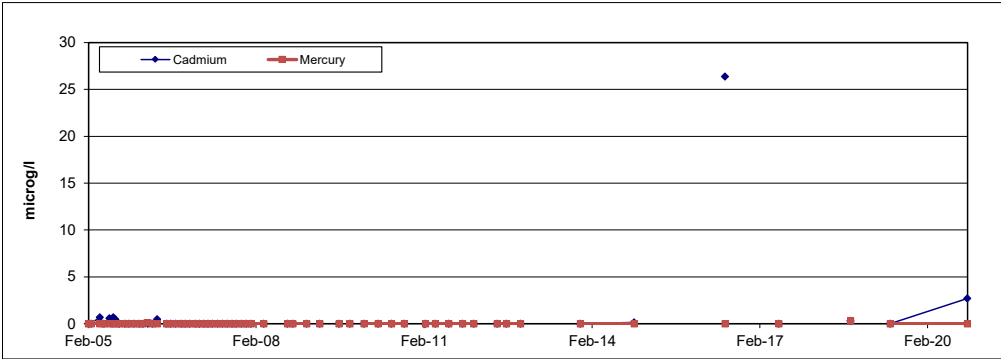


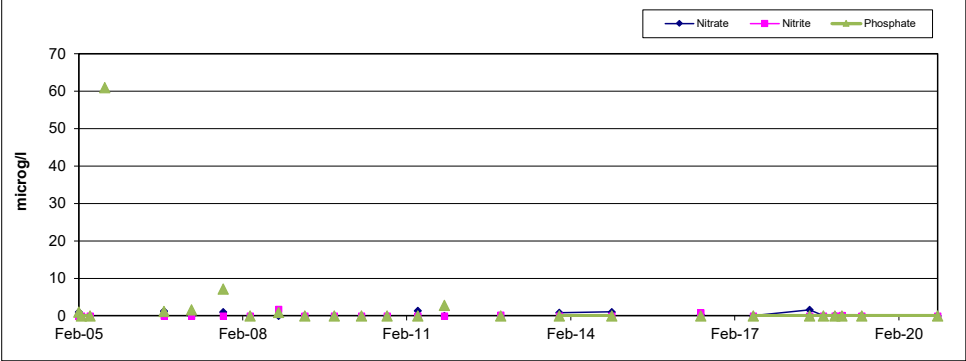
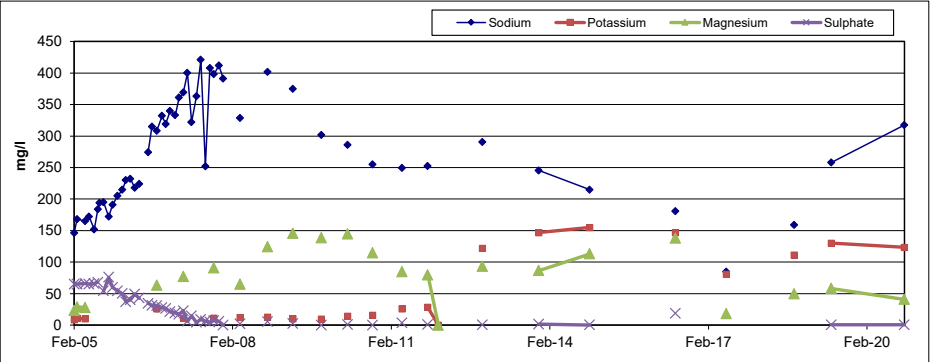
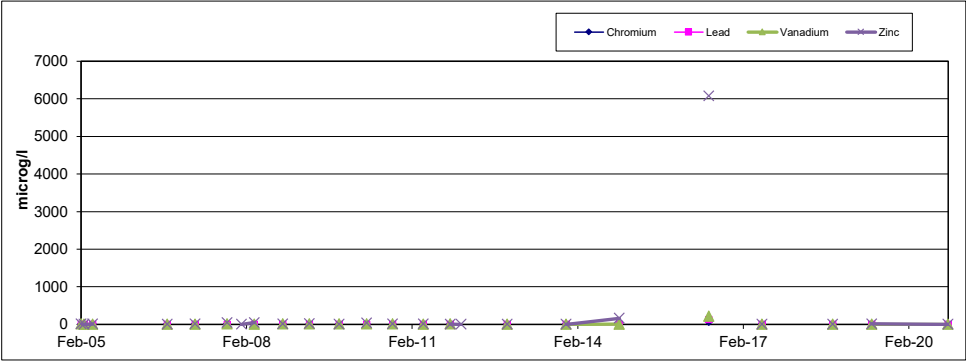
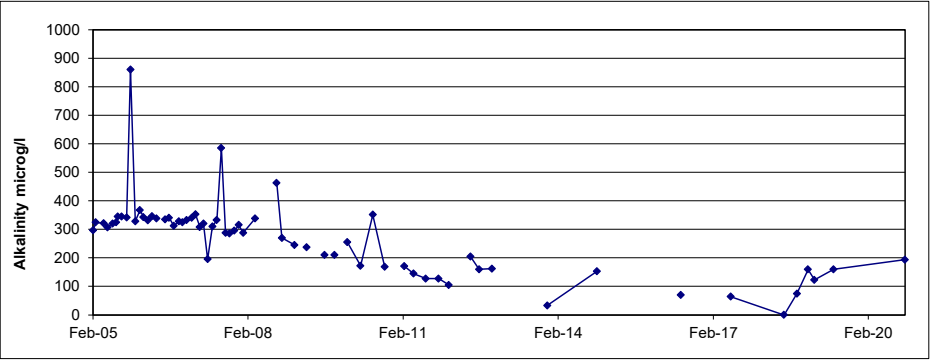
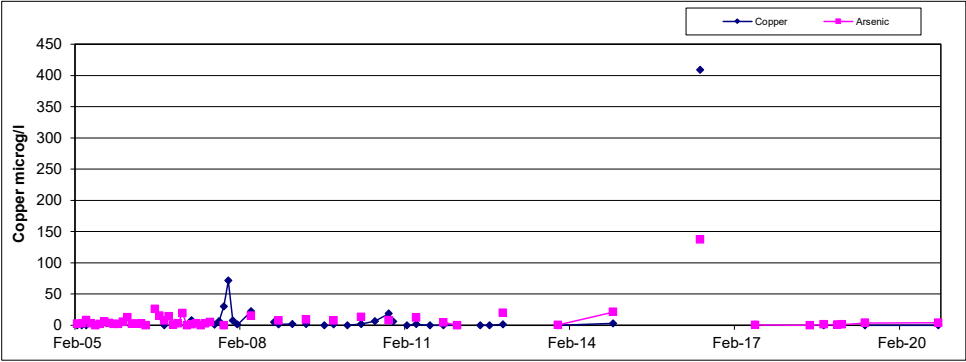


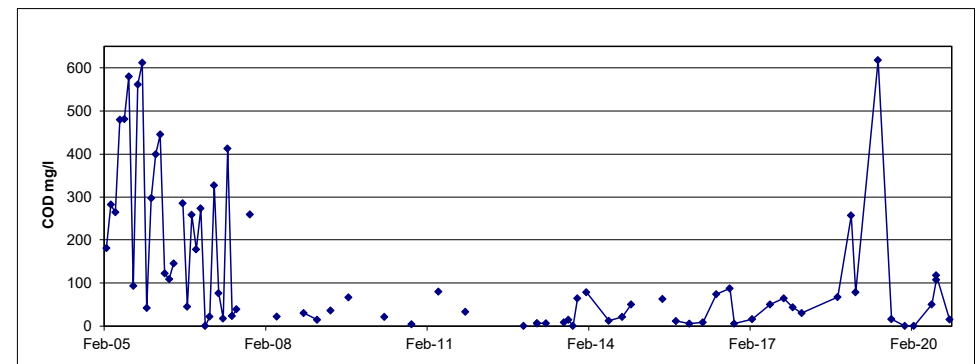
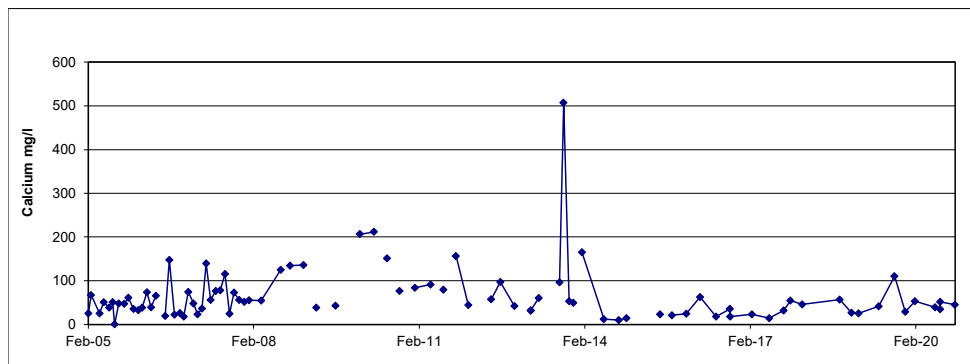
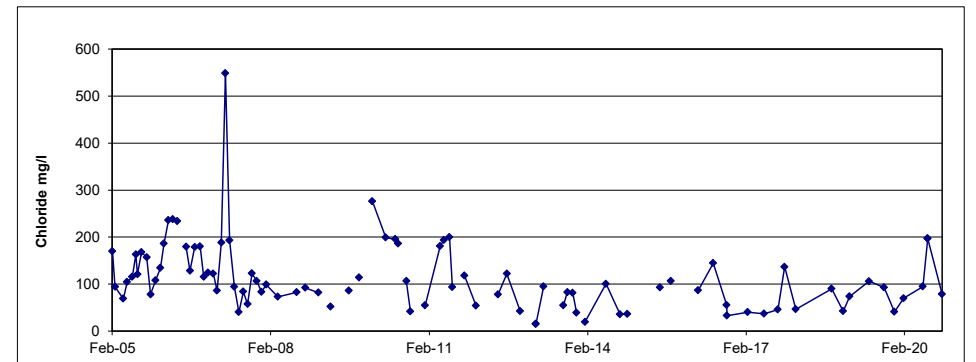
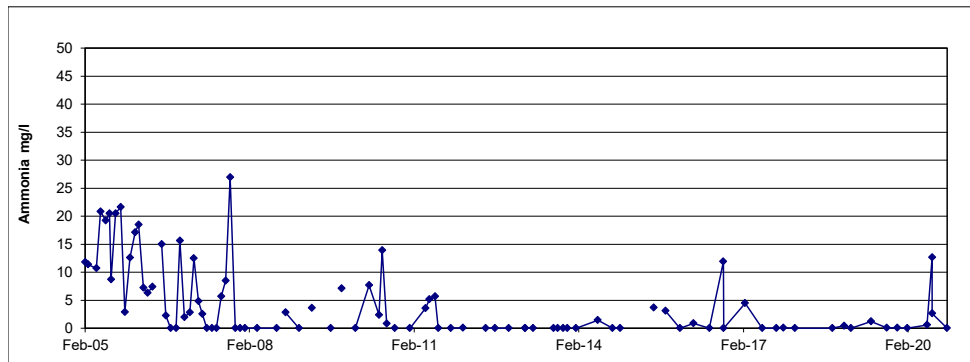
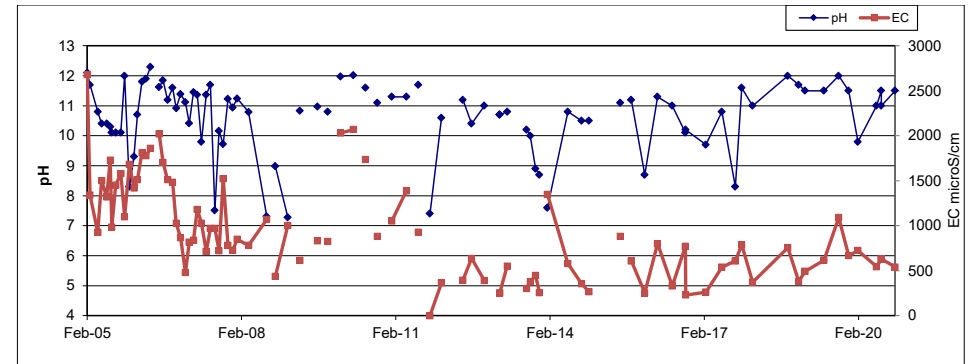
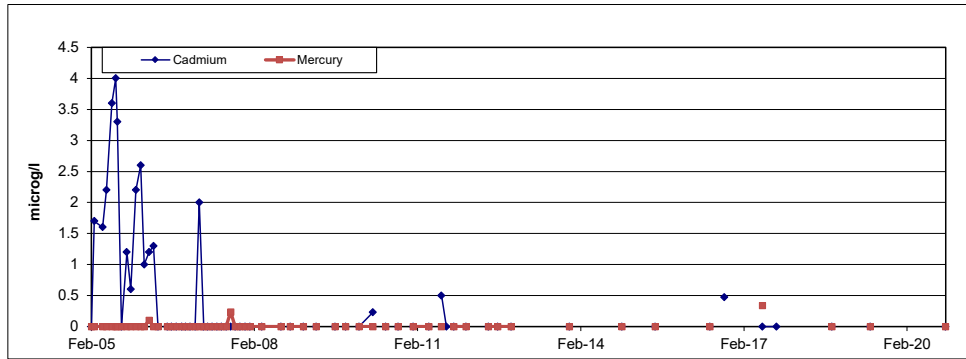


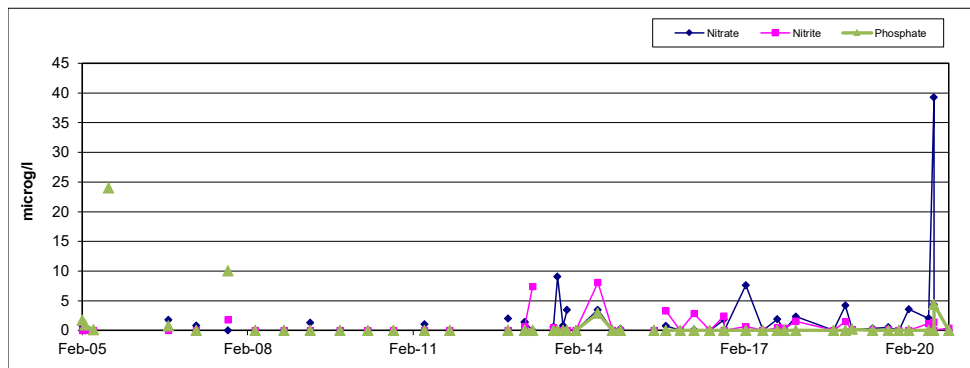
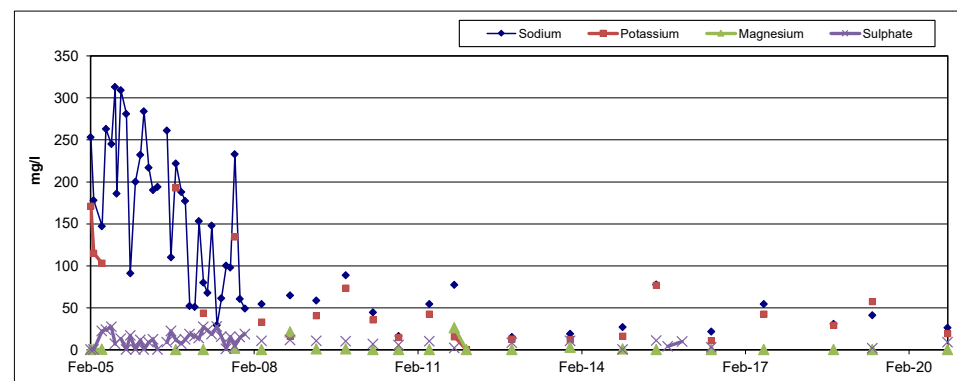
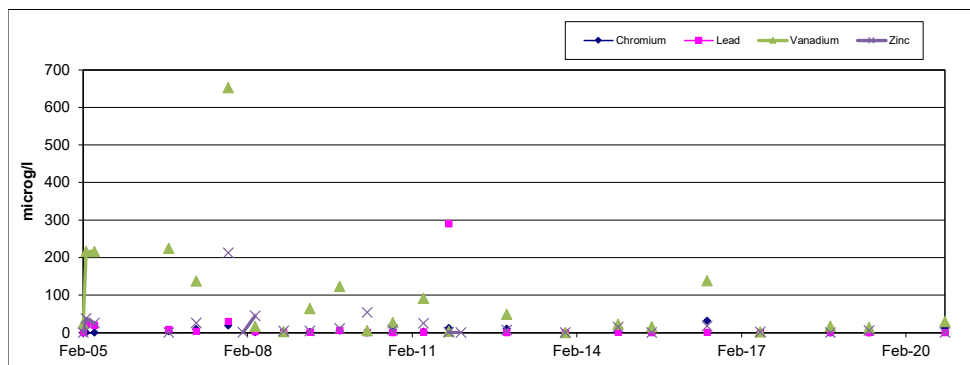
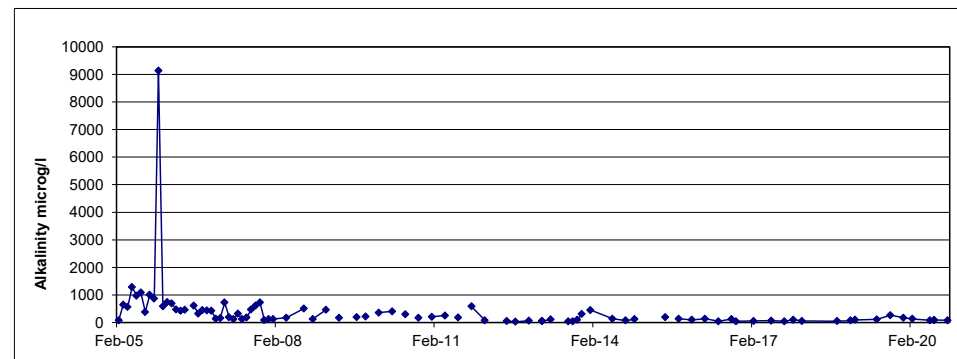
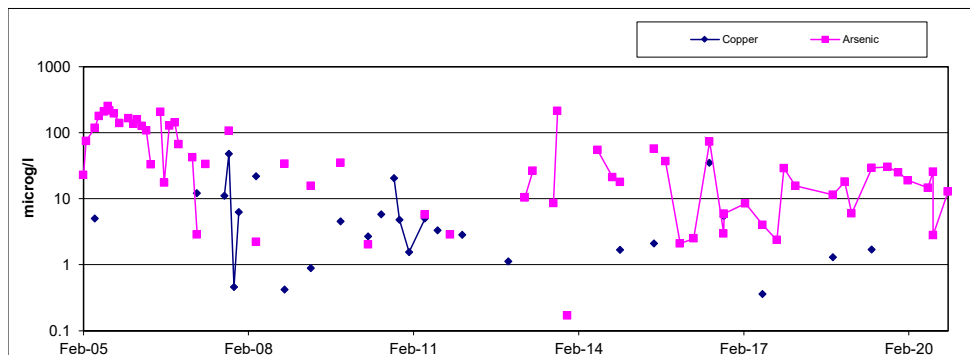


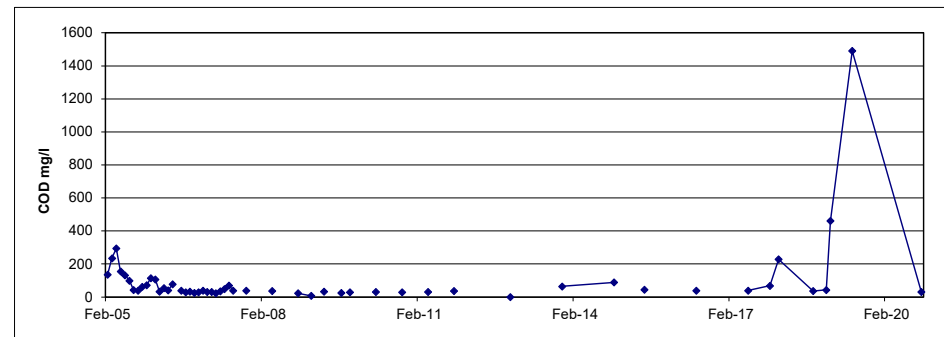
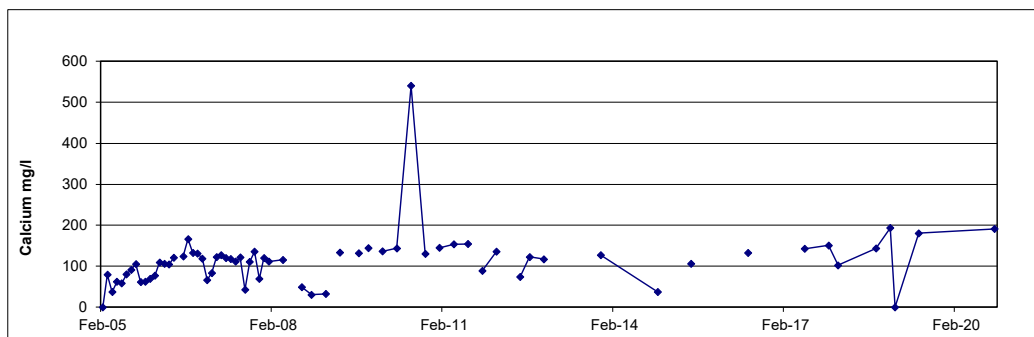
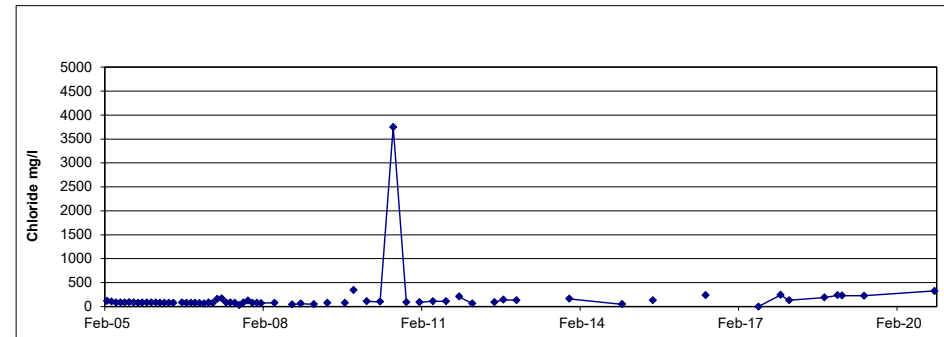
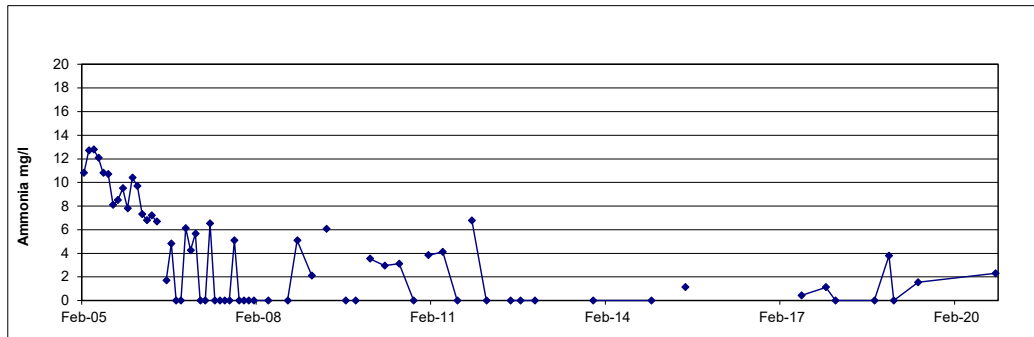
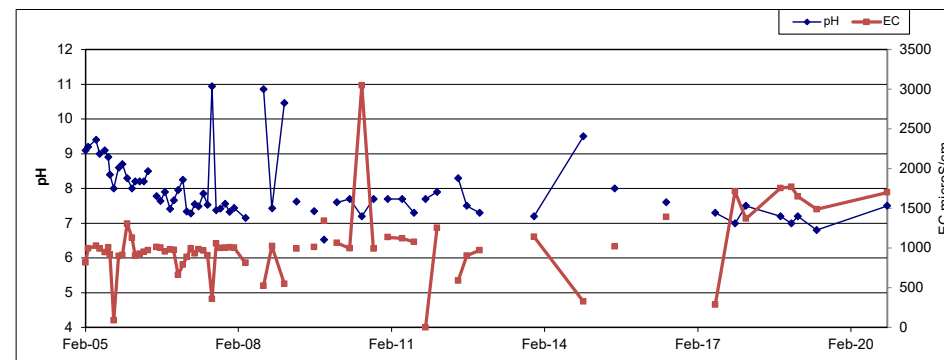
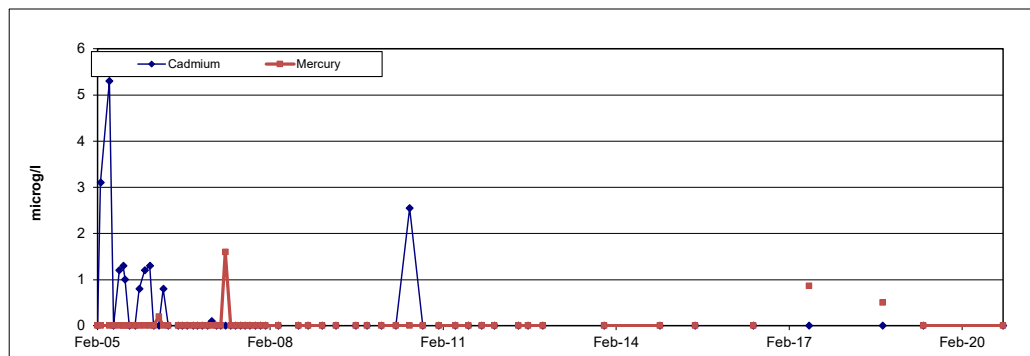


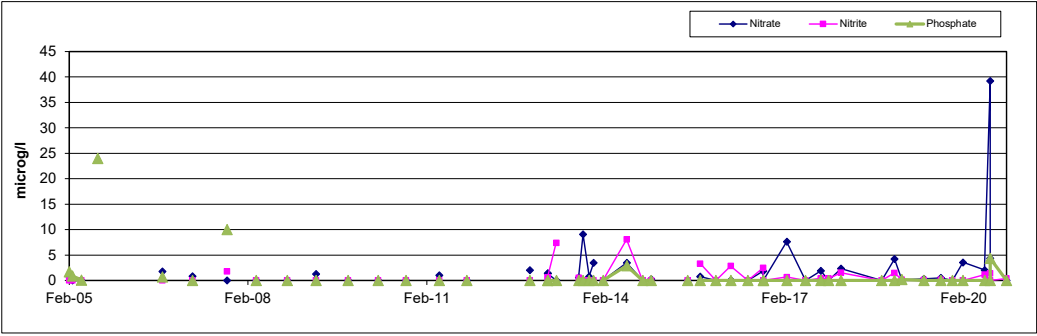
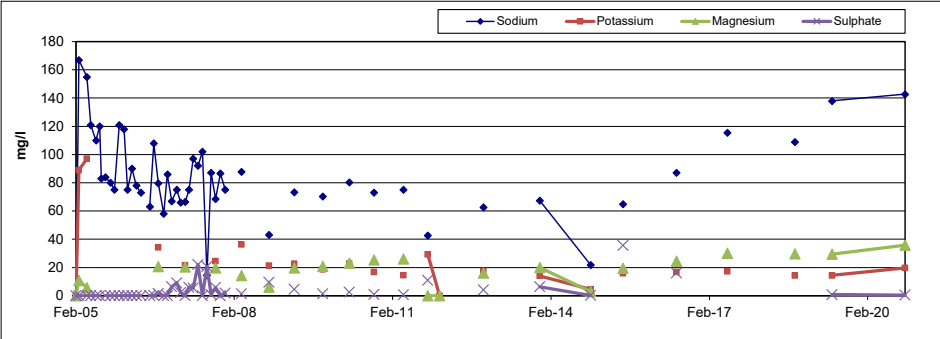
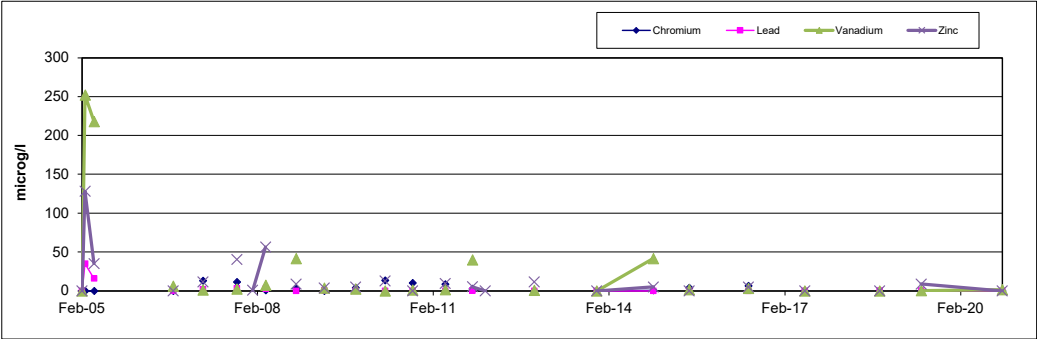
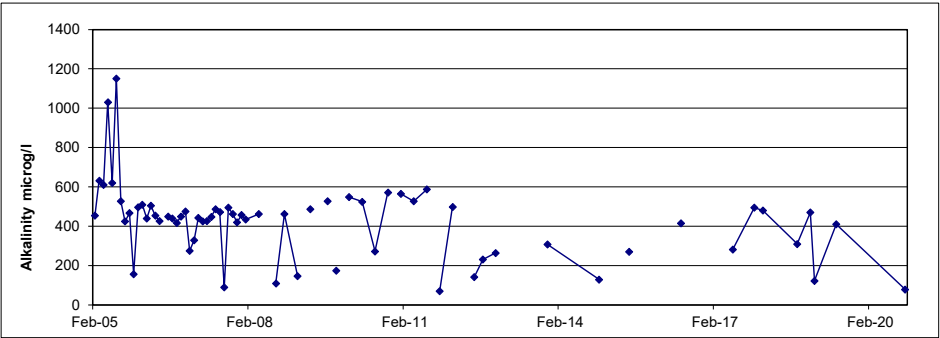
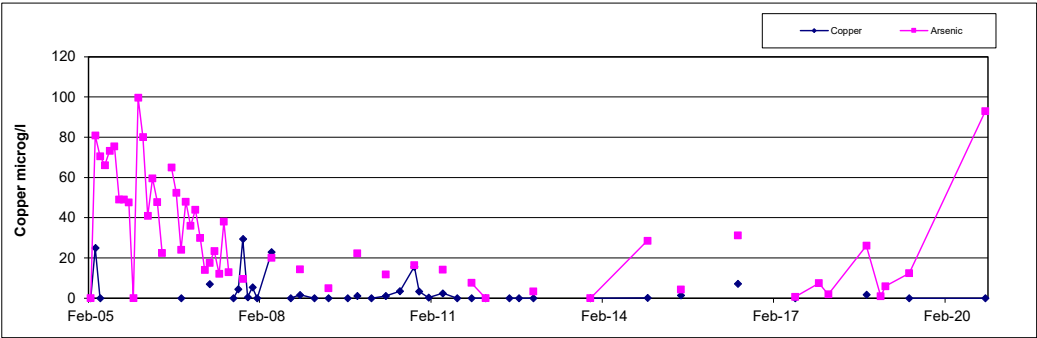


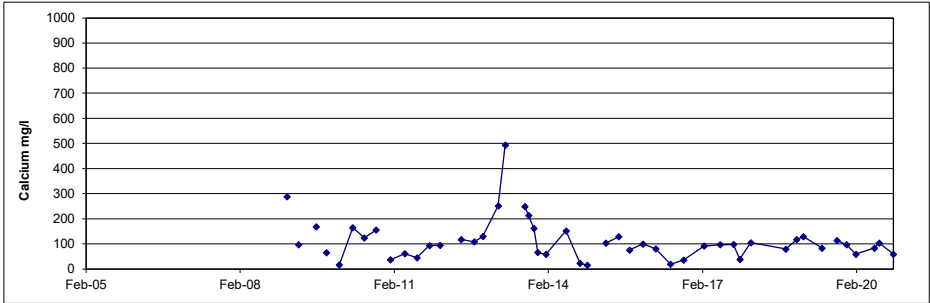
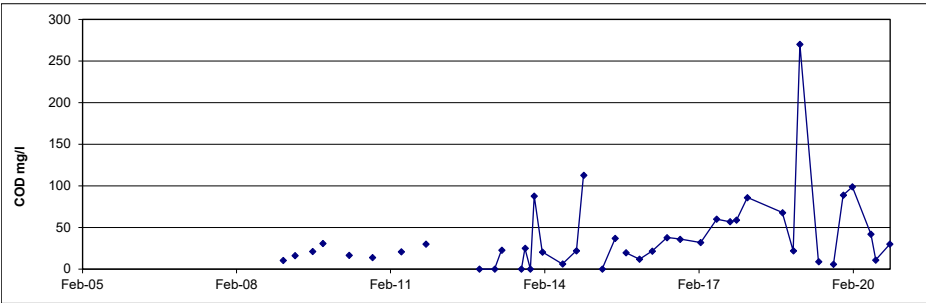
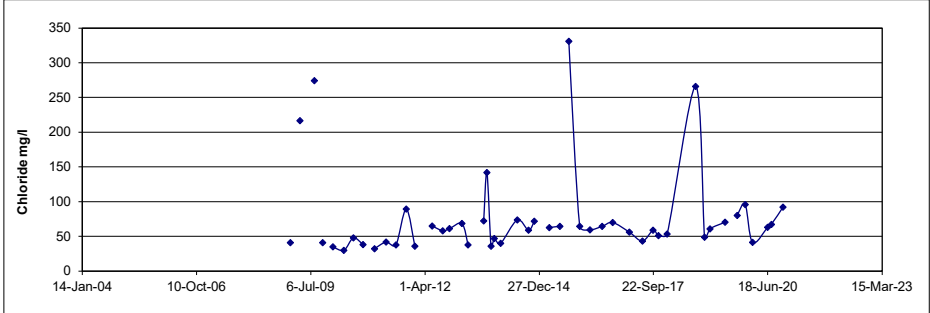
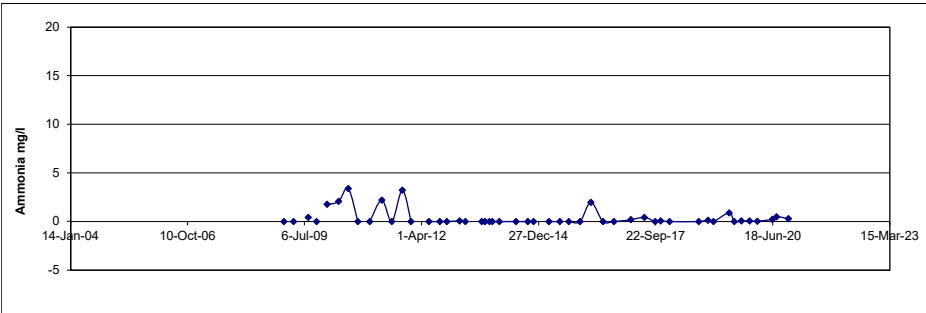
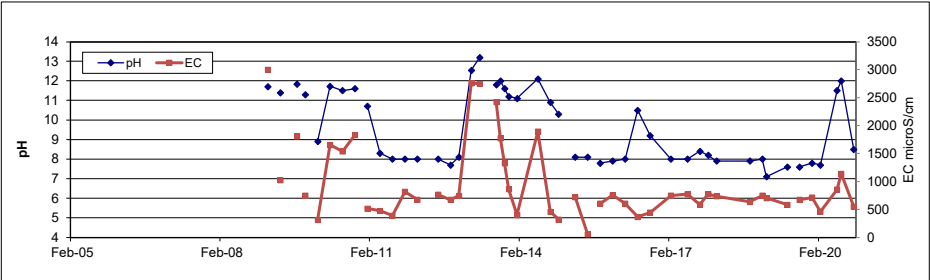
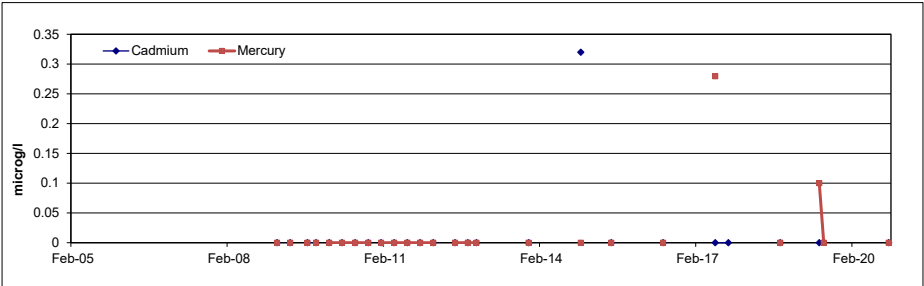


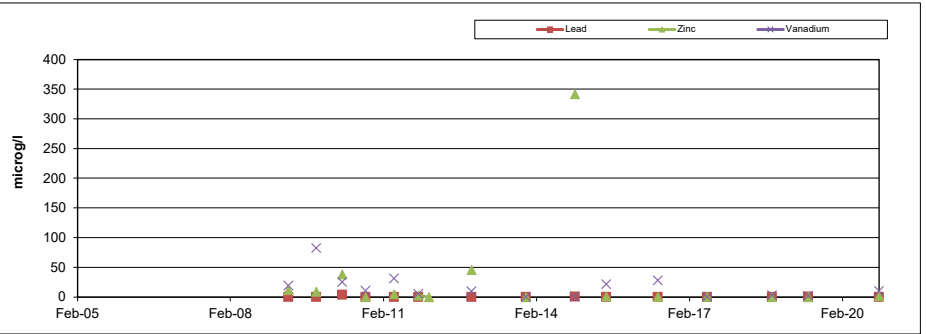
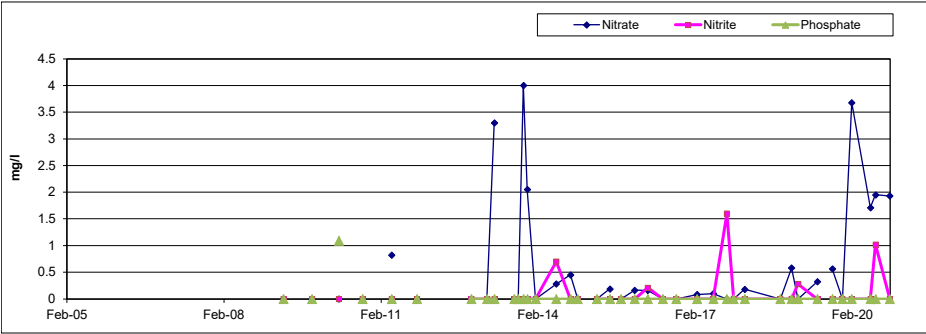
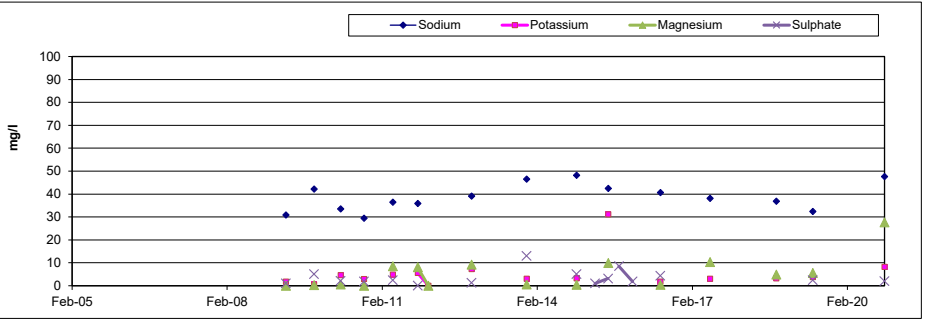
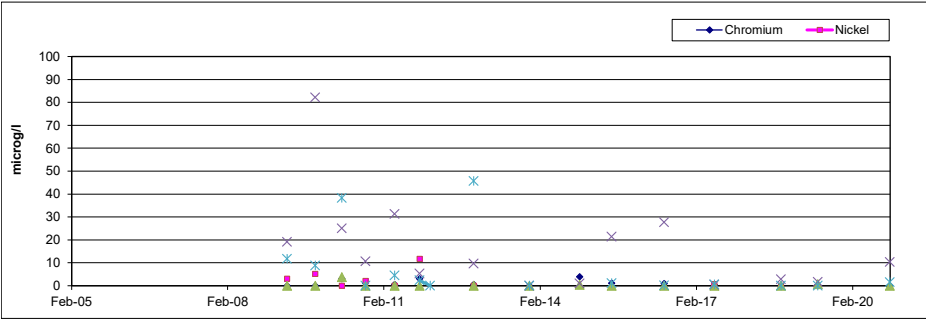
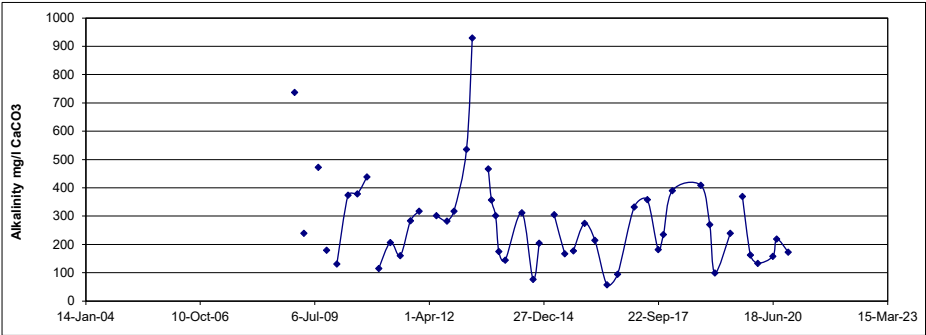
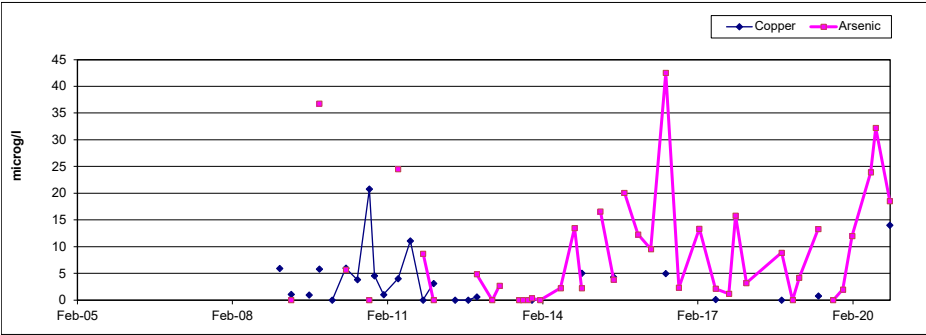


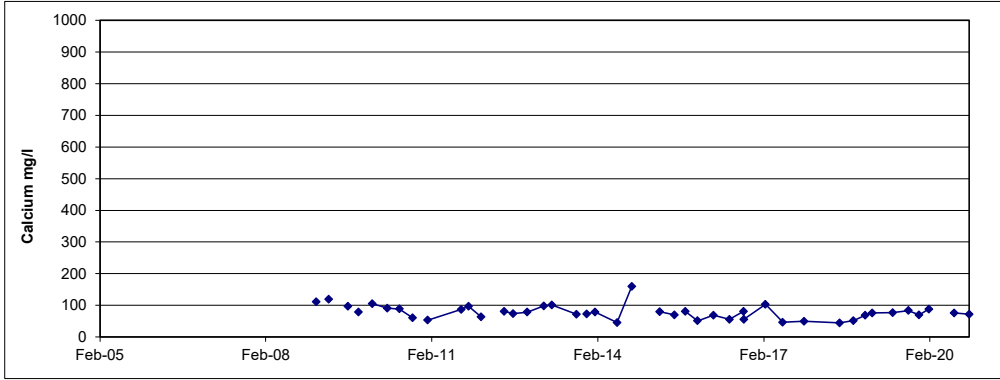
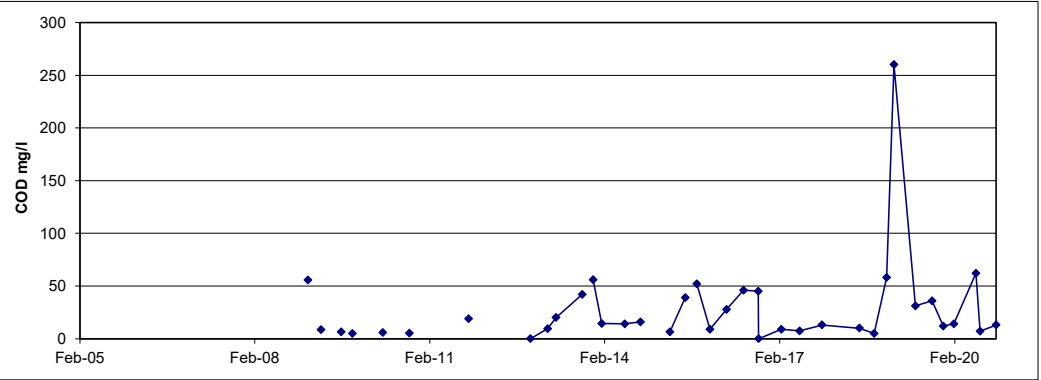
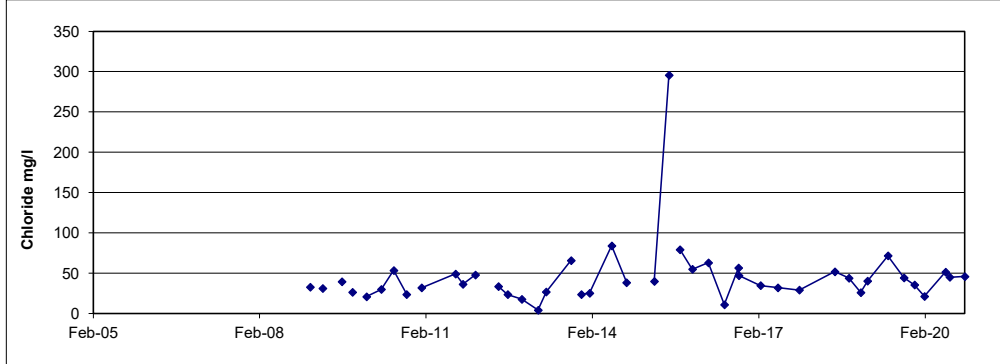
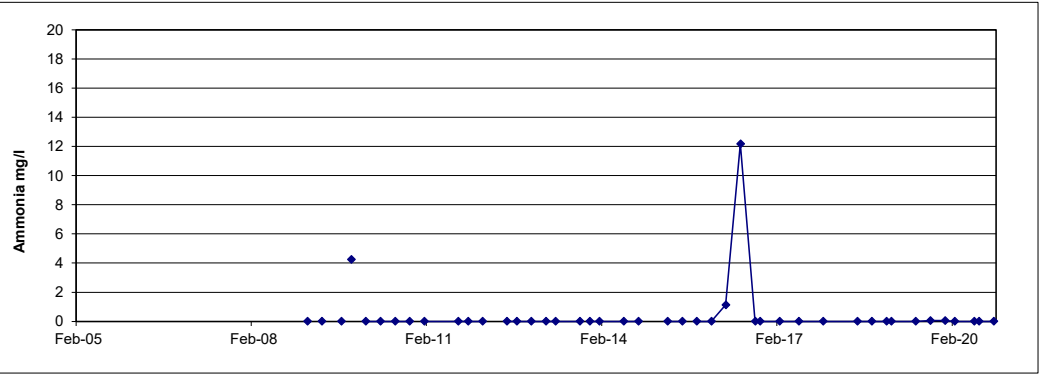
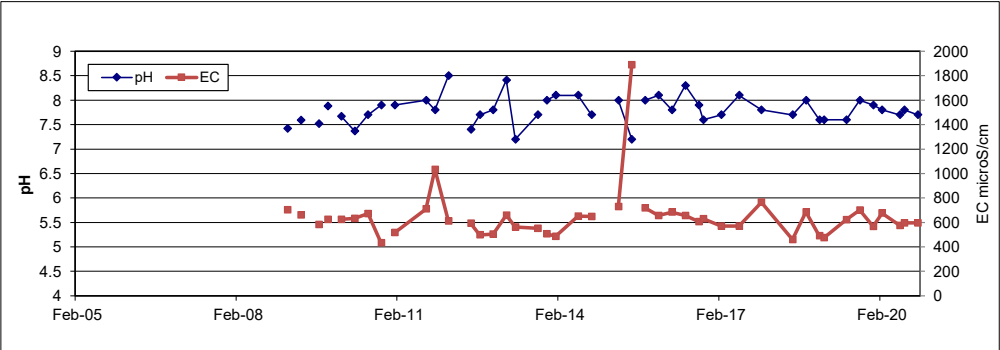
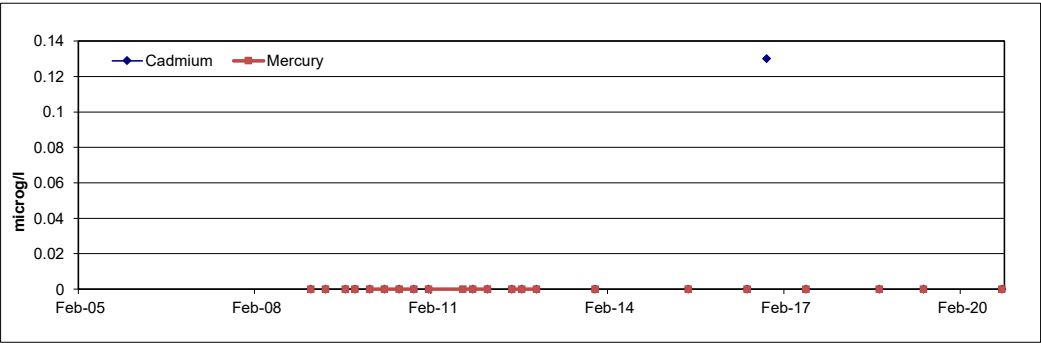


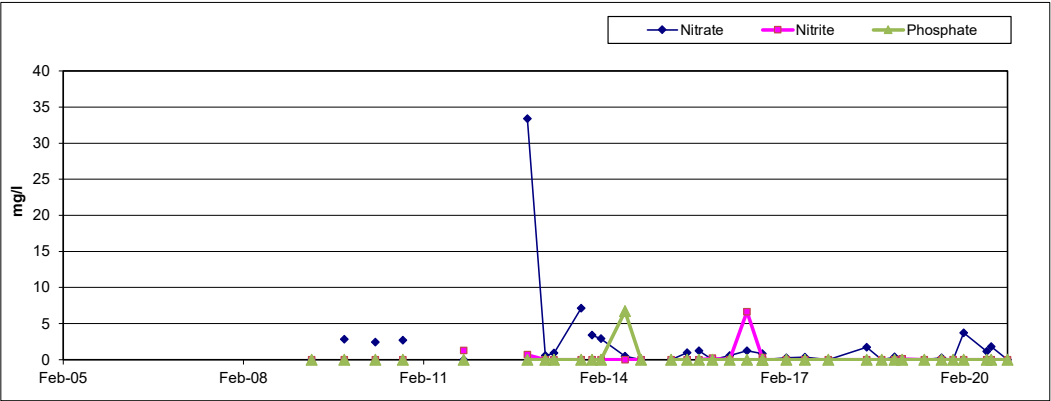
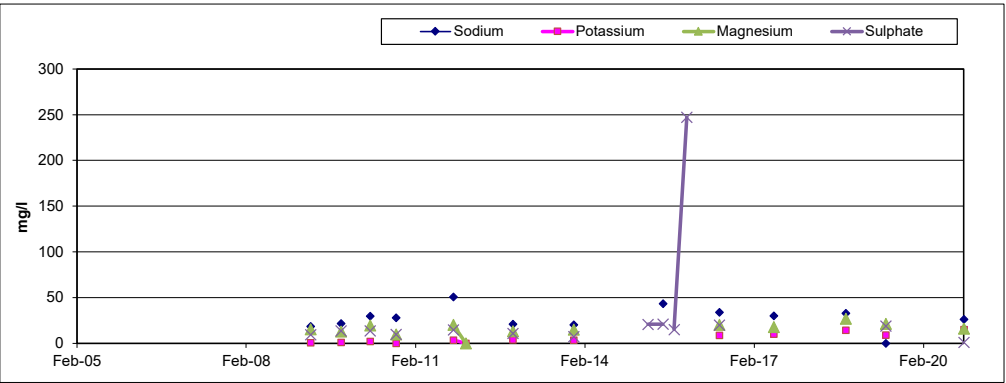
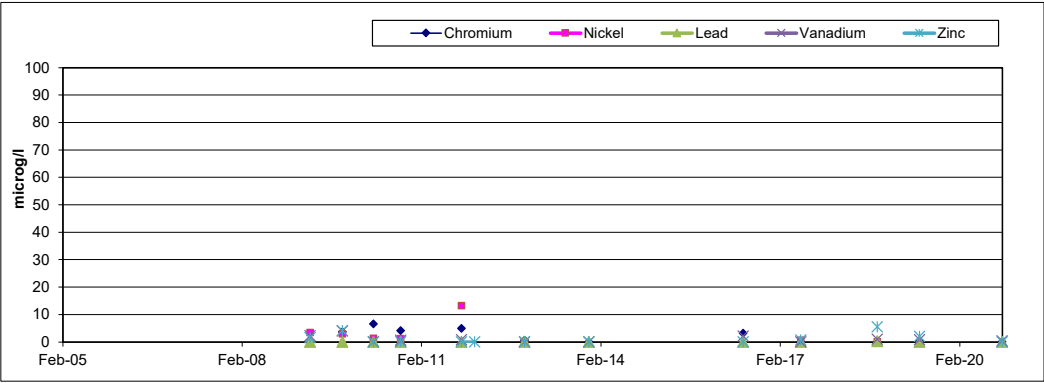
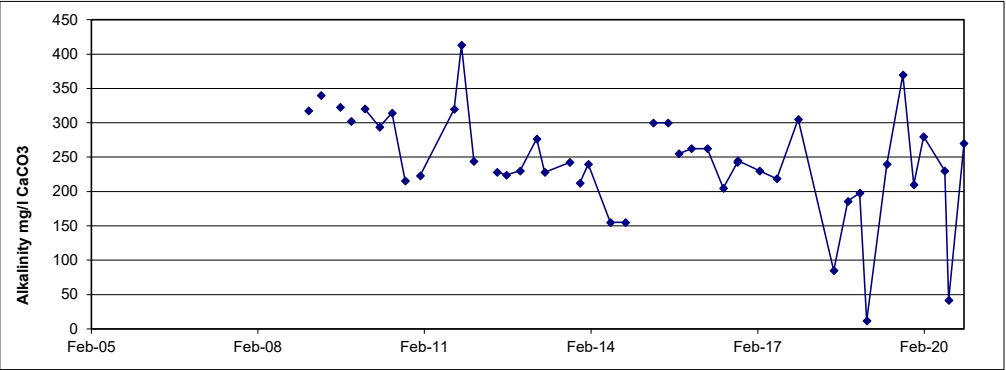
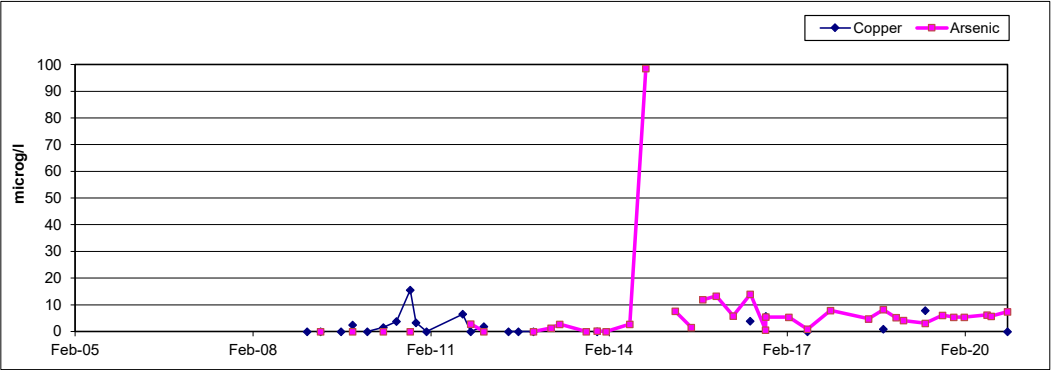












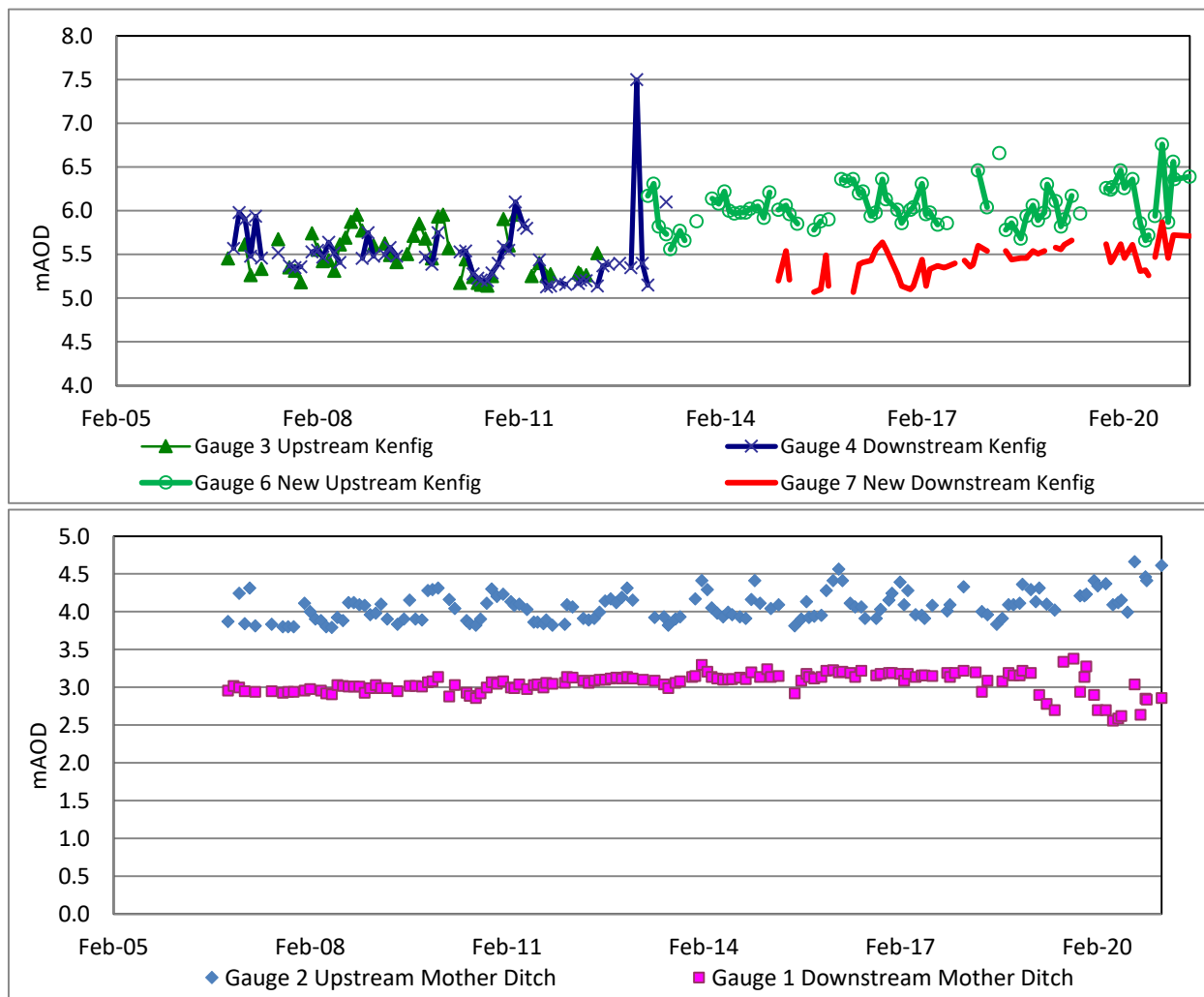
**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

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Environmental
Monitoring**

**Appendix 7
Temporal Variation of
Surface Water Levels**

Report Number 2092r1v1d0221



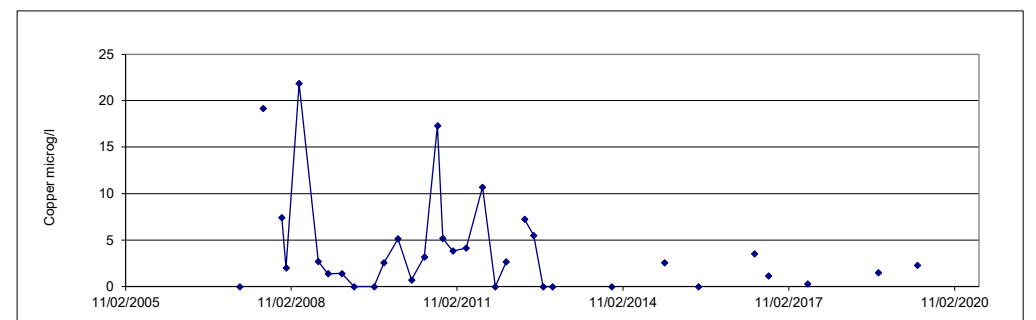
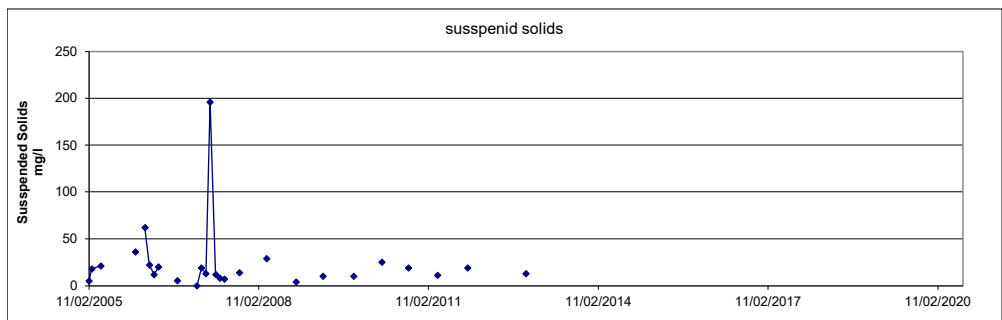
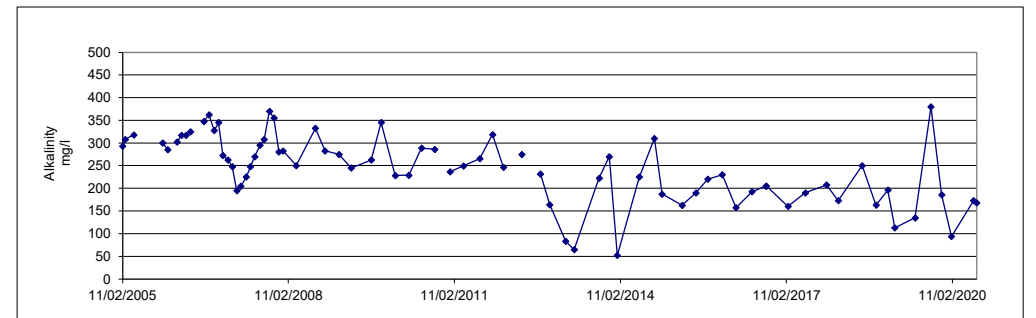
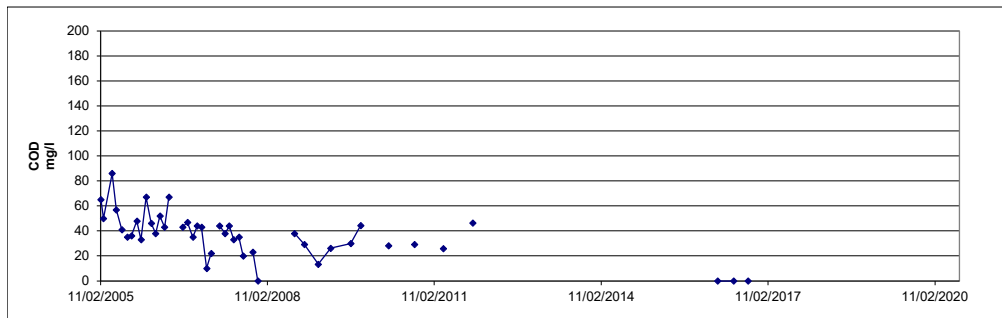
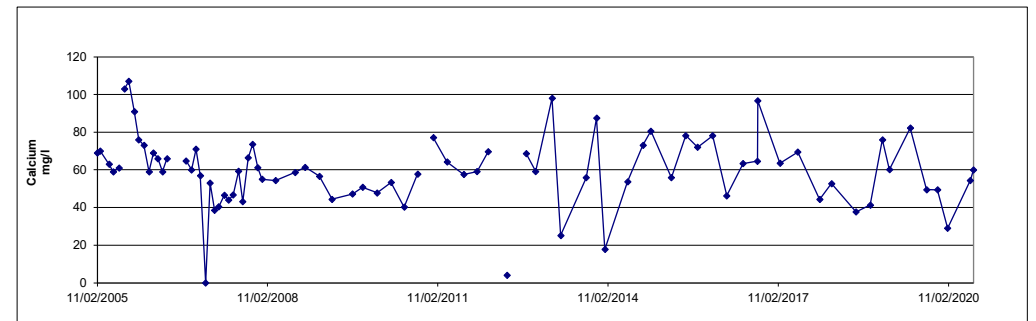
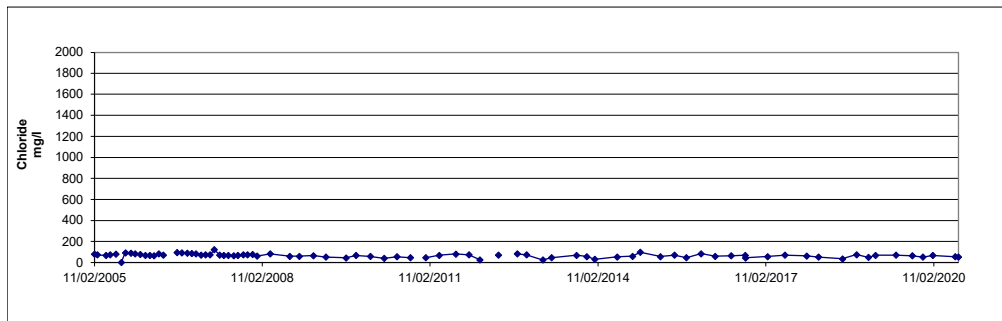
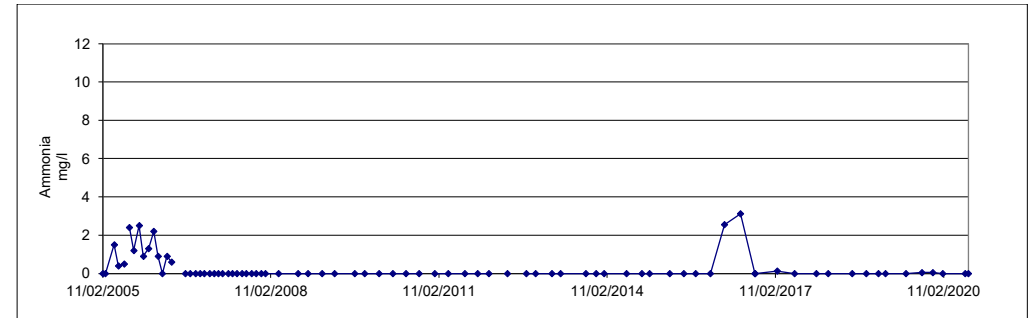
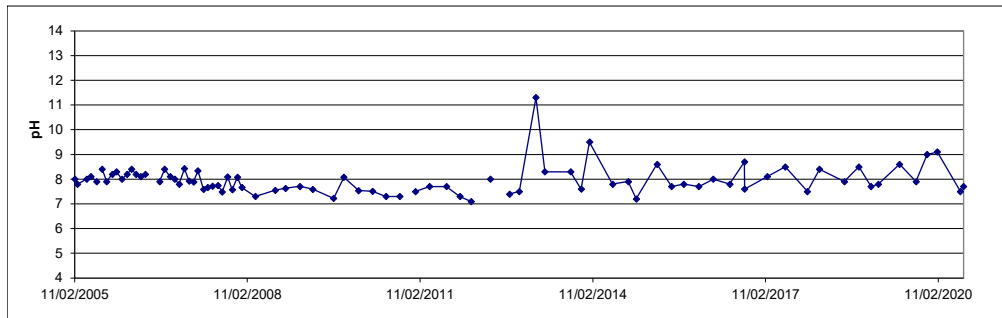
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LANDFILL, PORT
TALBOT**

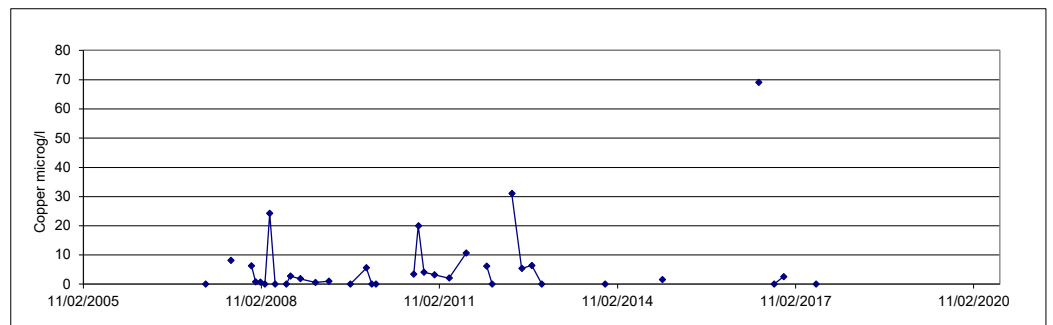
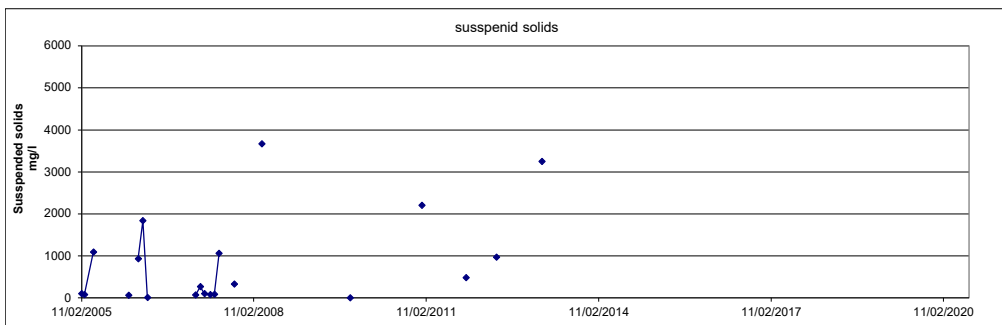
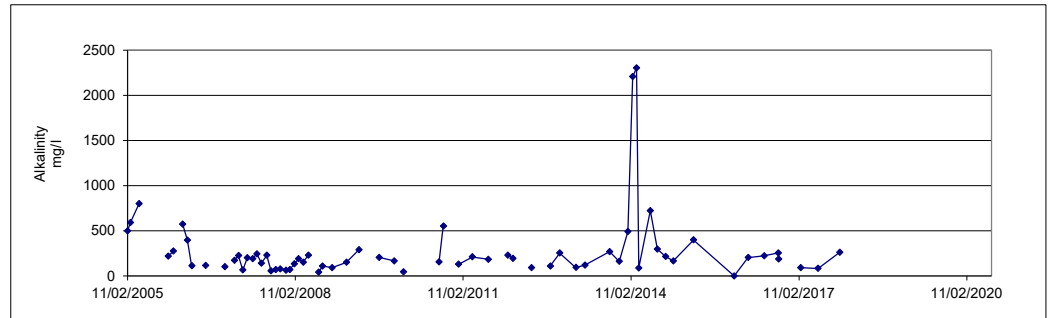
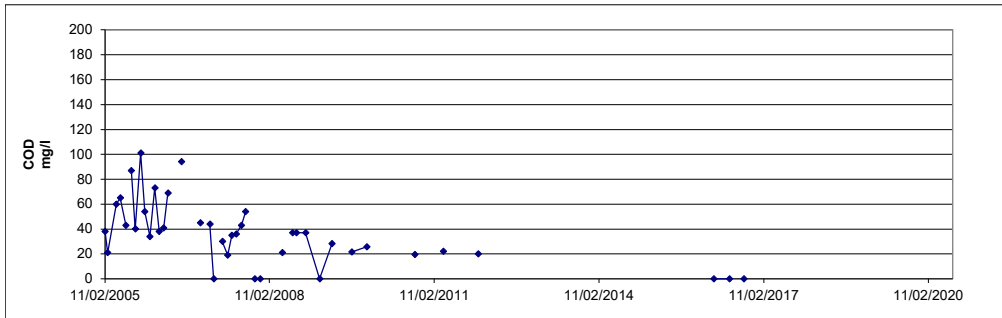
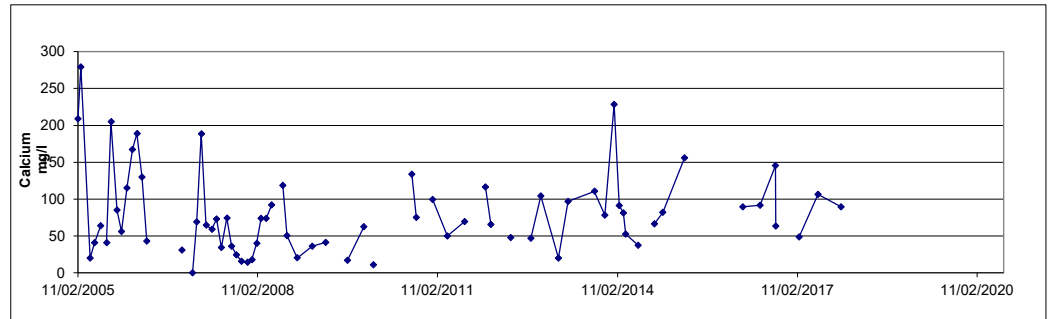
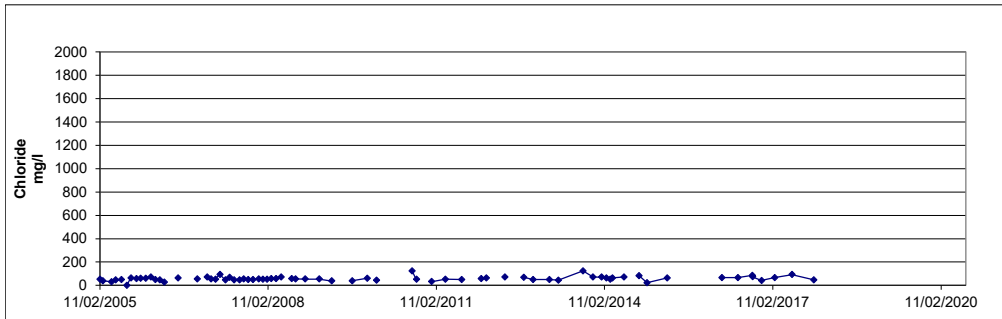
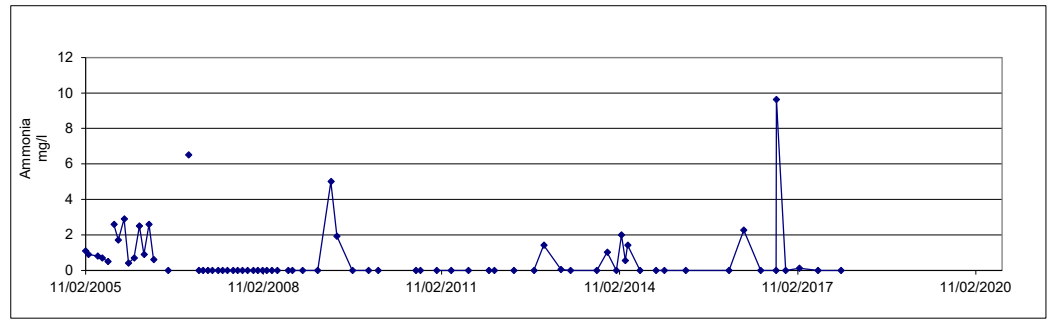
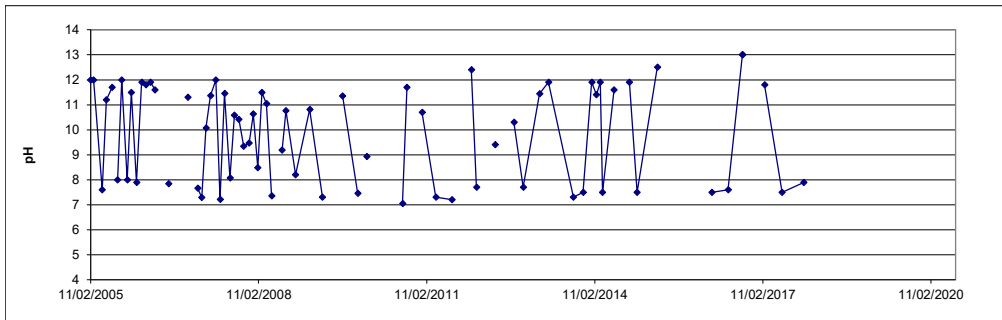
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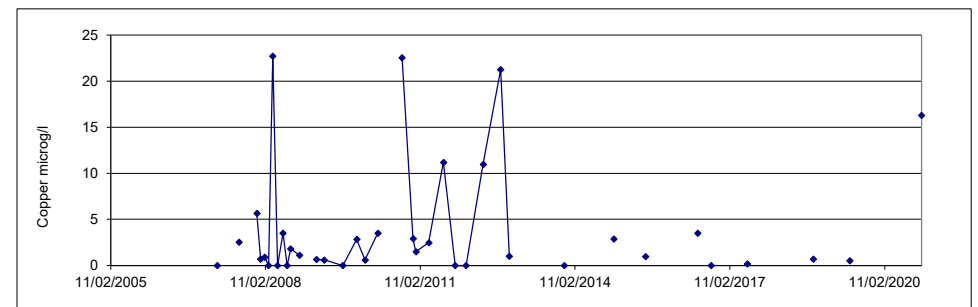
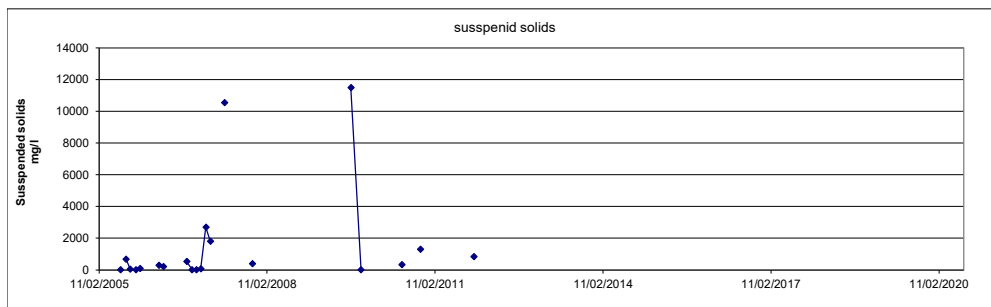
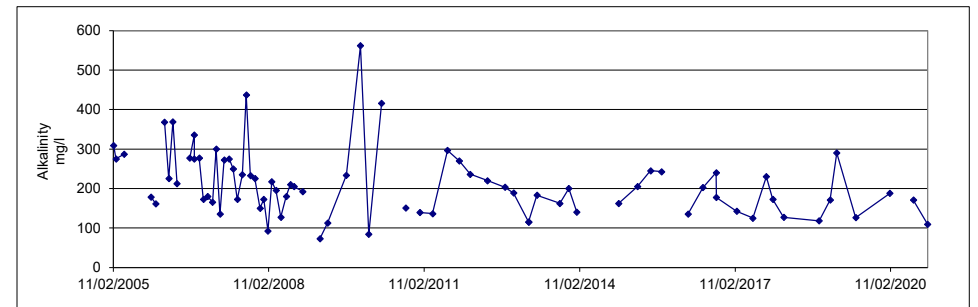
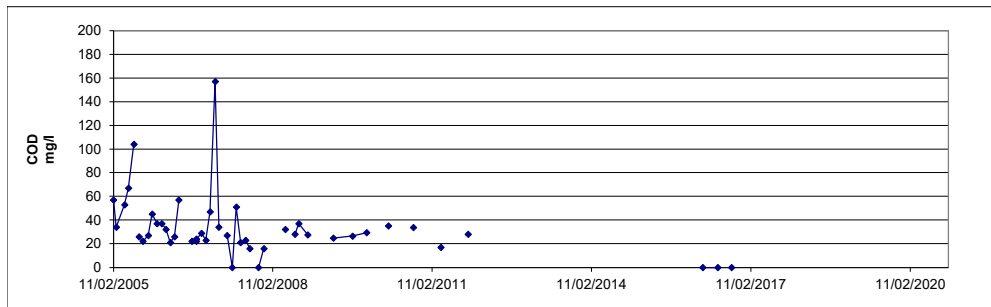
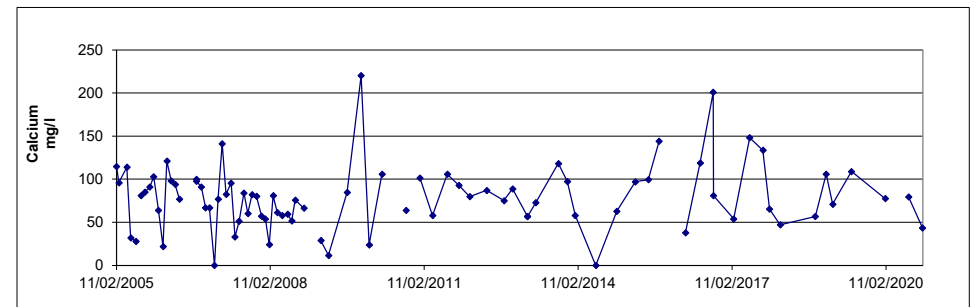
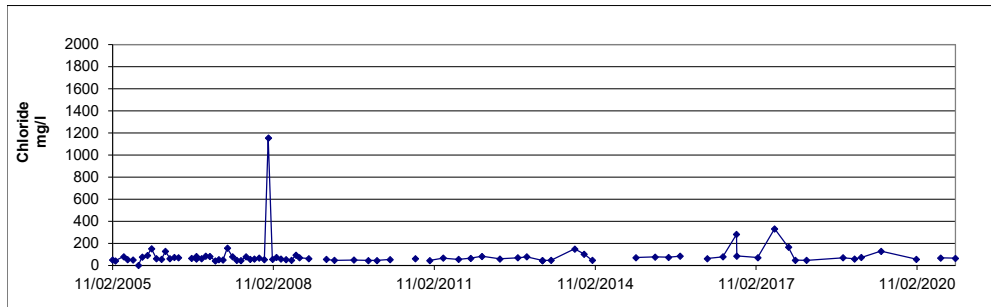
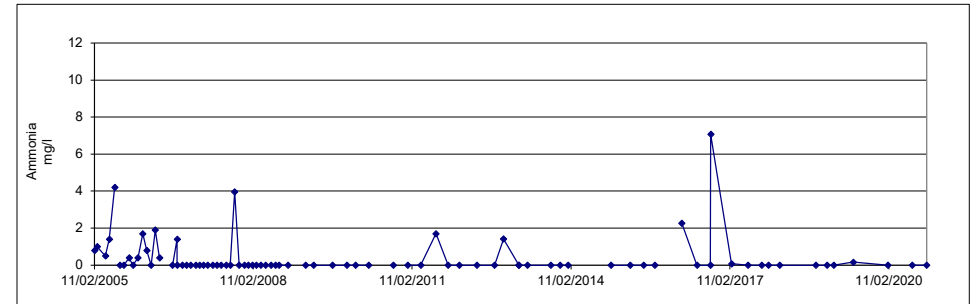
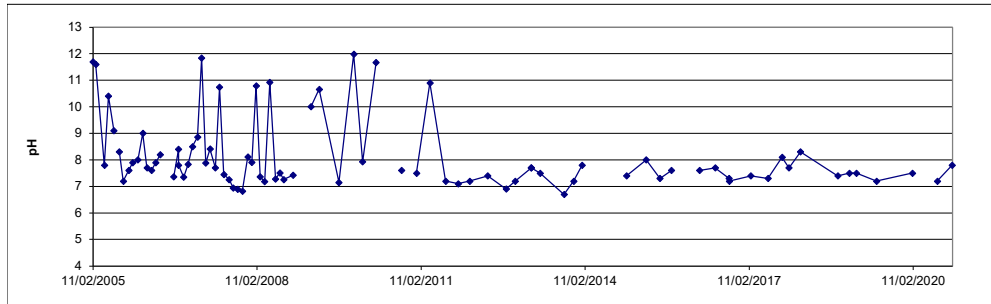
**2020 Annual Review of
Environmental
Monitoring**

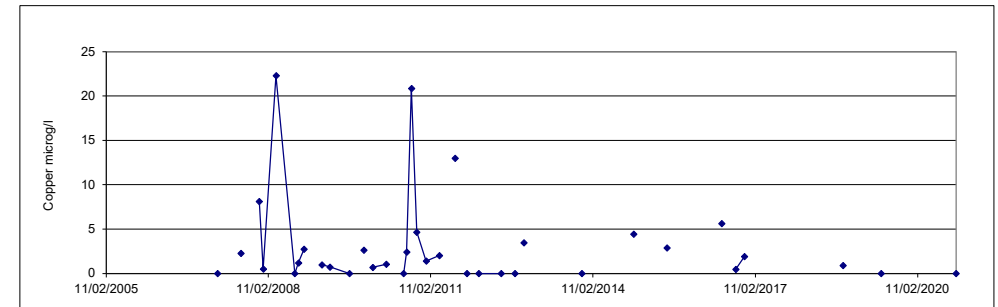
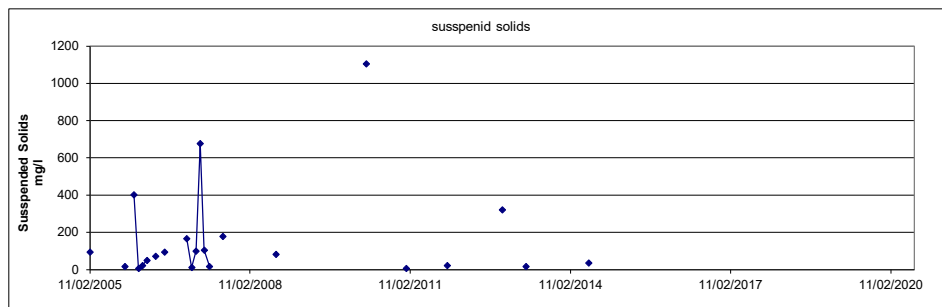
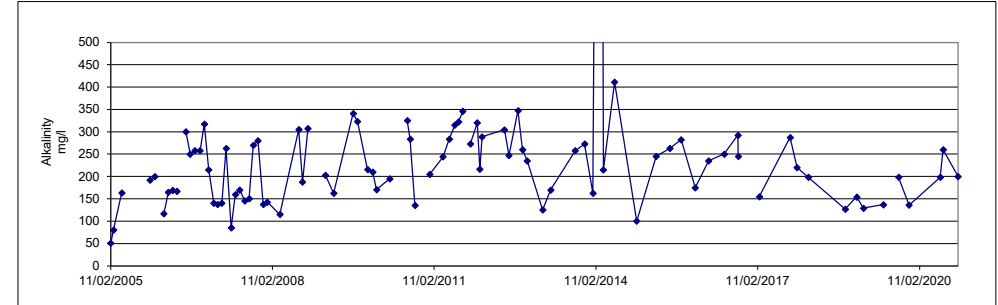
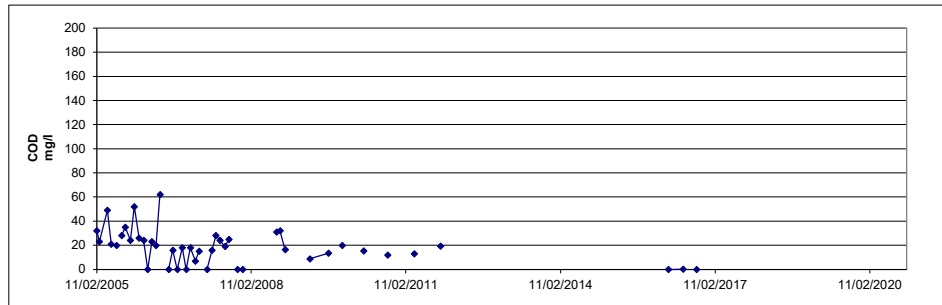
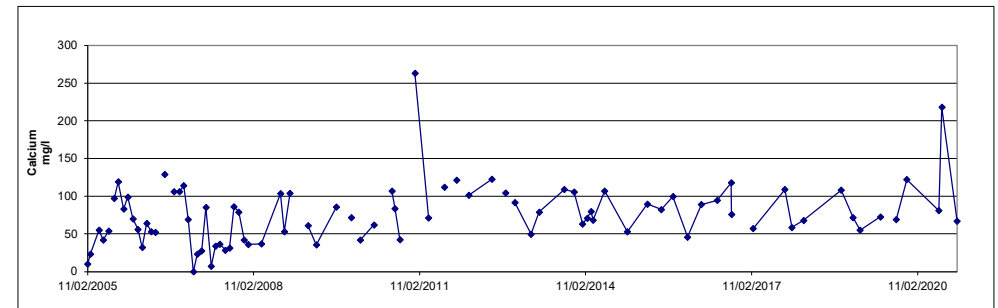
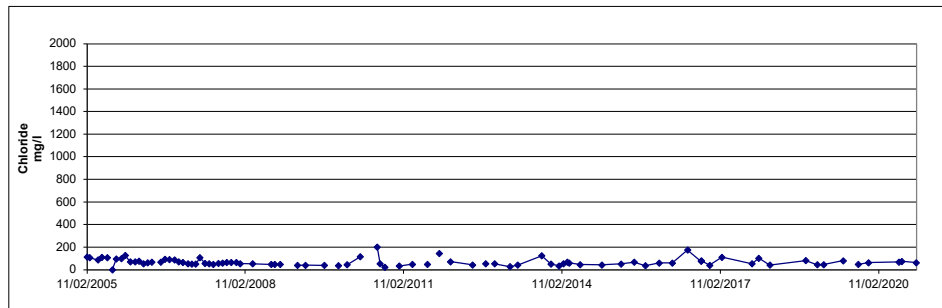
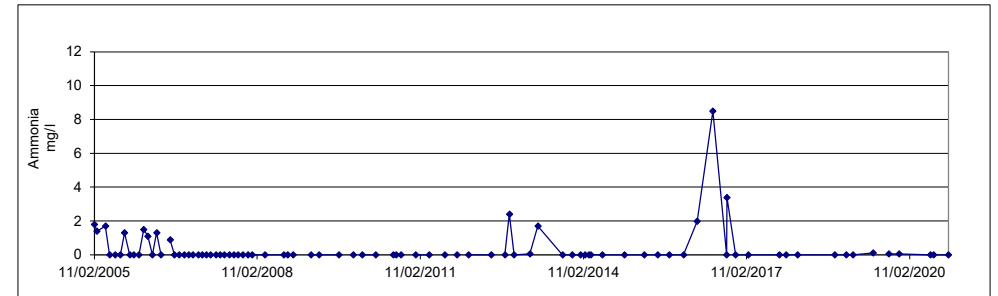
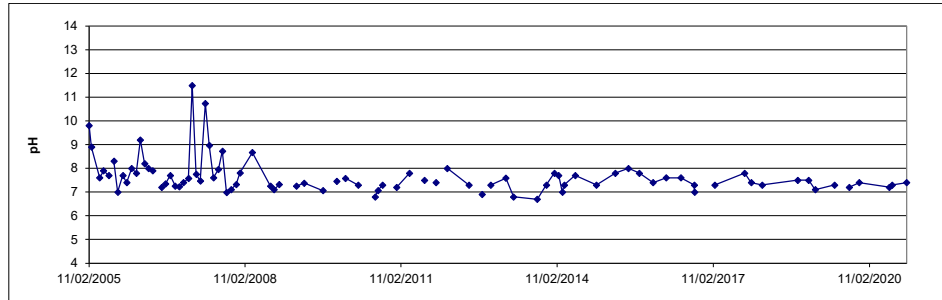
**Appendix 8
Temporal Variation of
Surface Water
Chemistry**

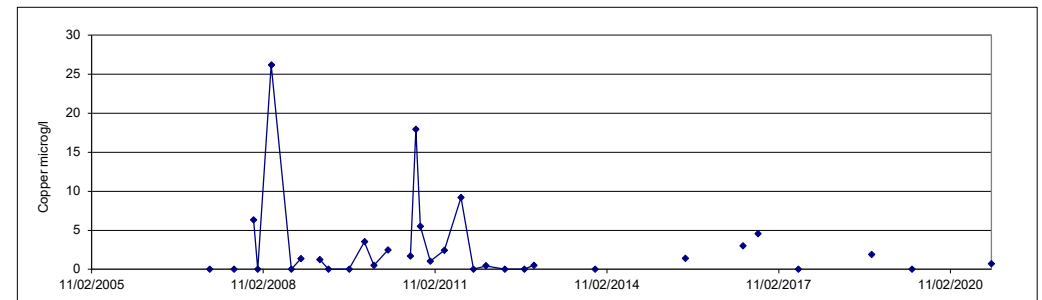
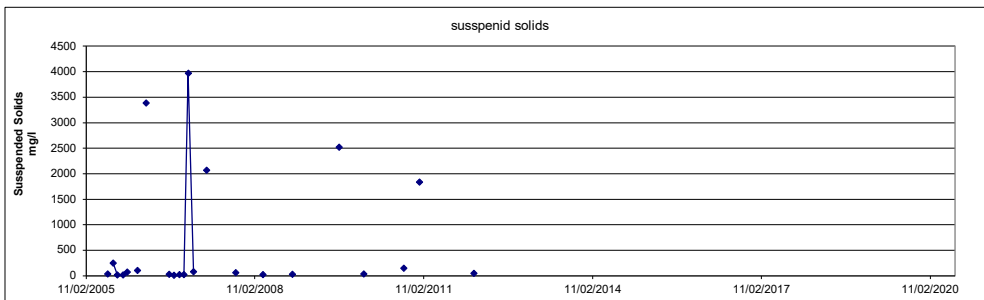
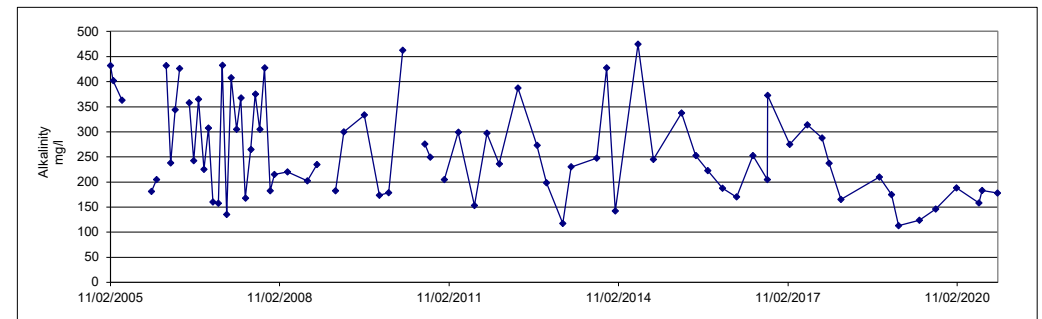
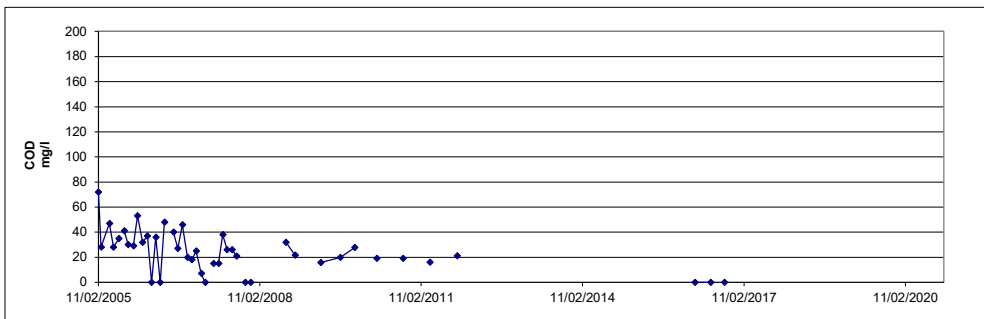
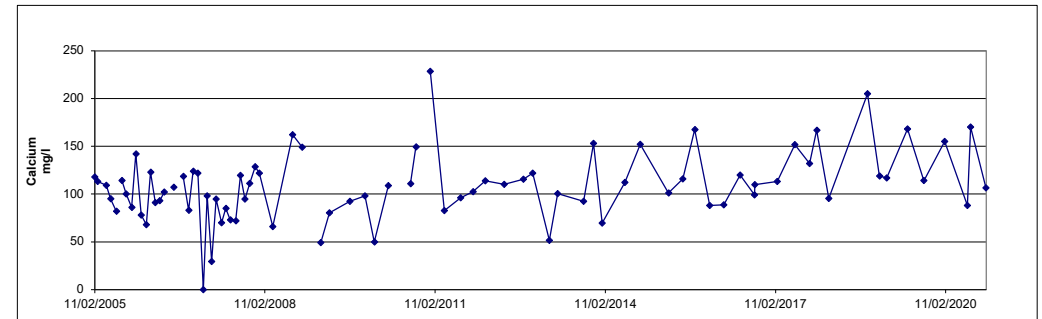
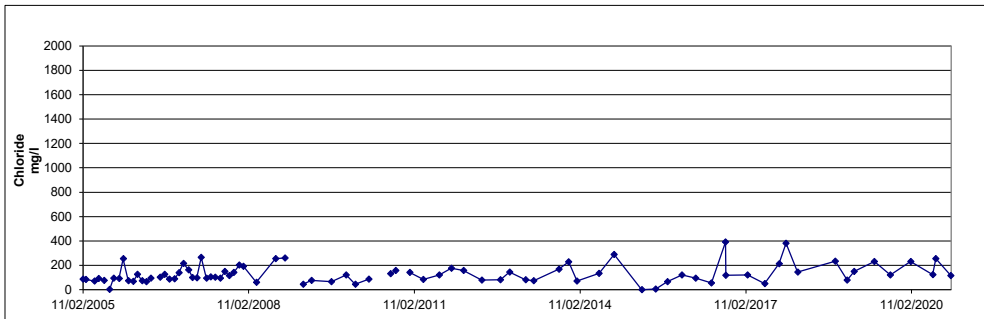
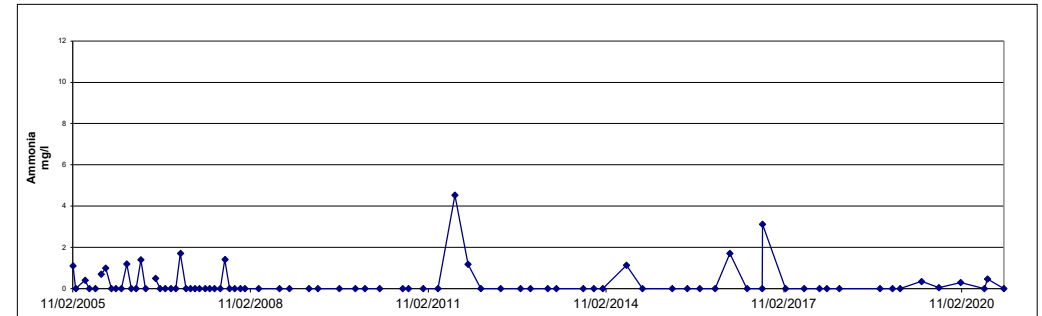
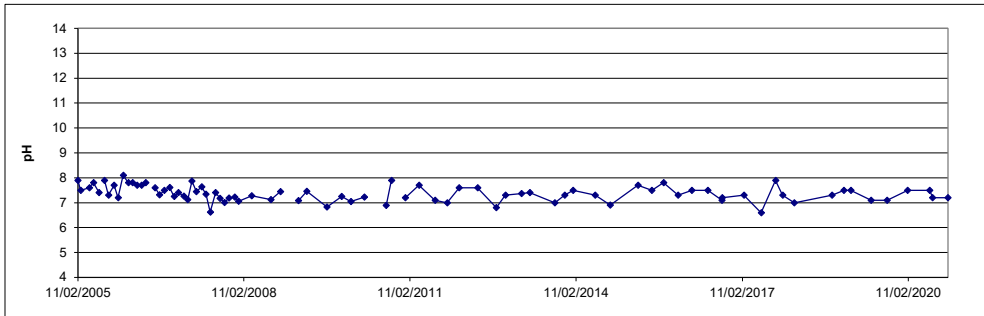
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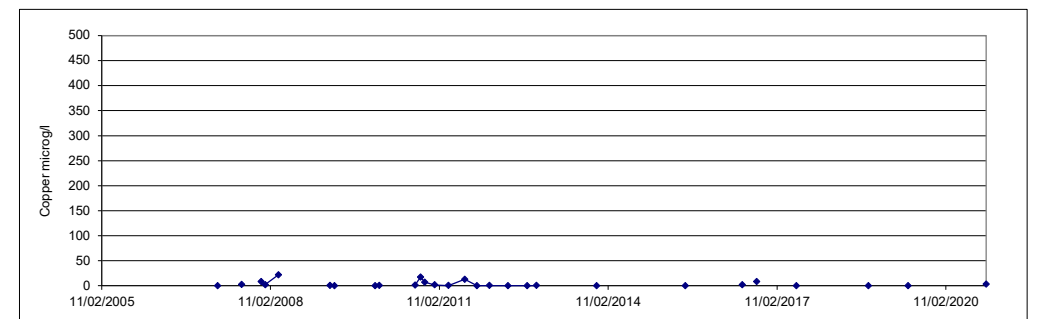
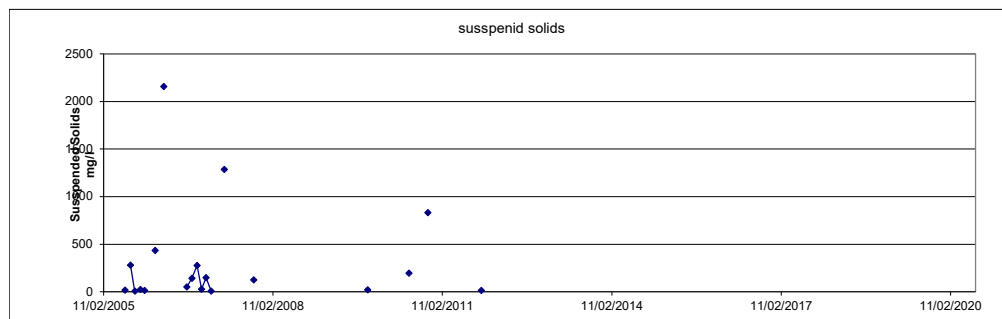
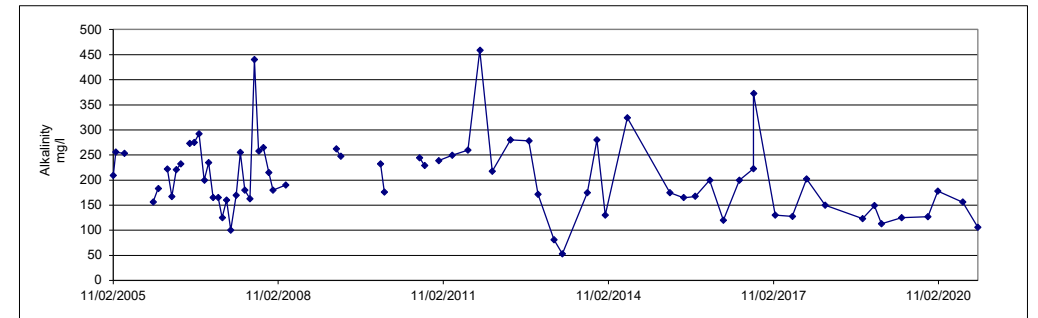
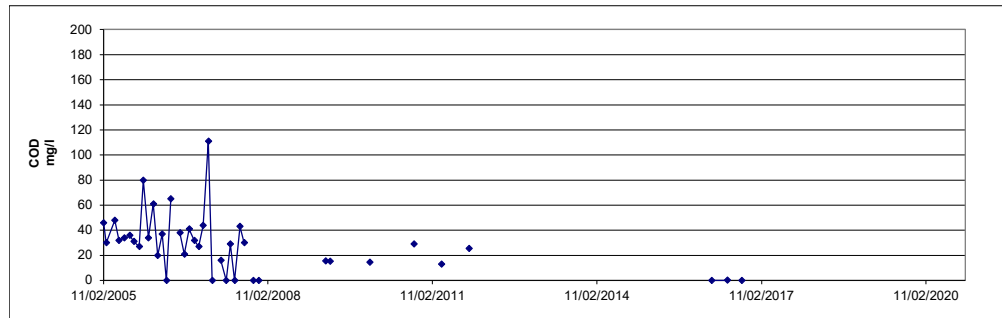
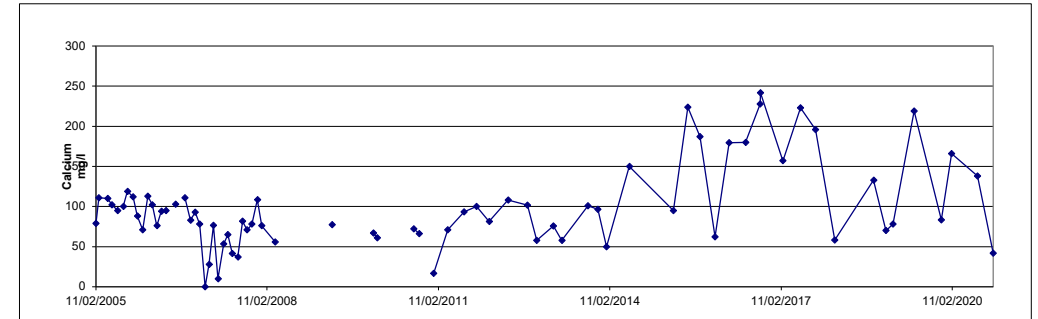
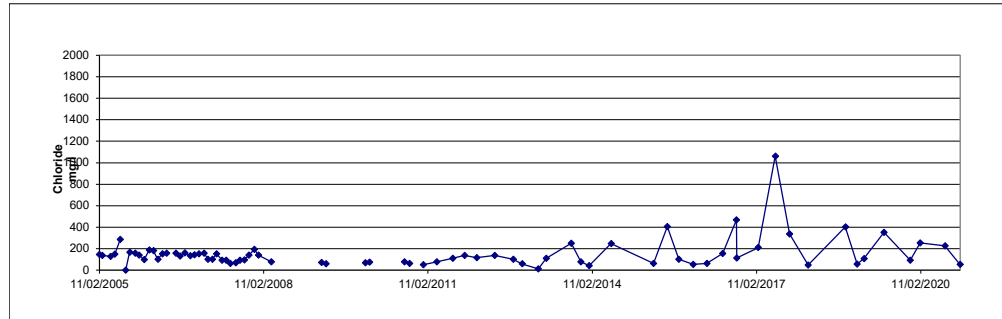
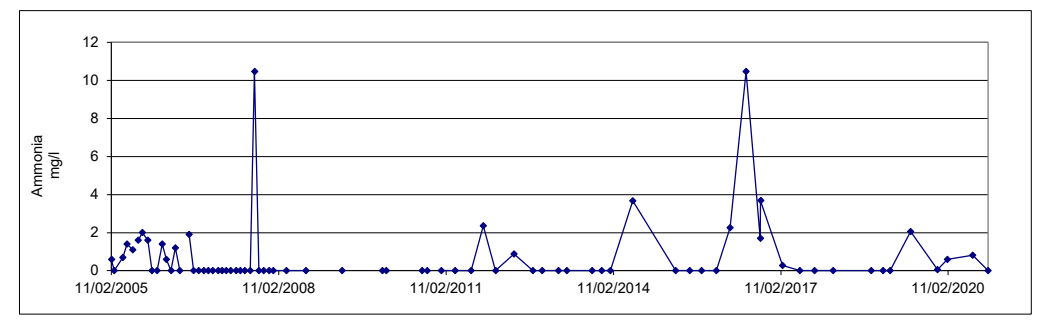
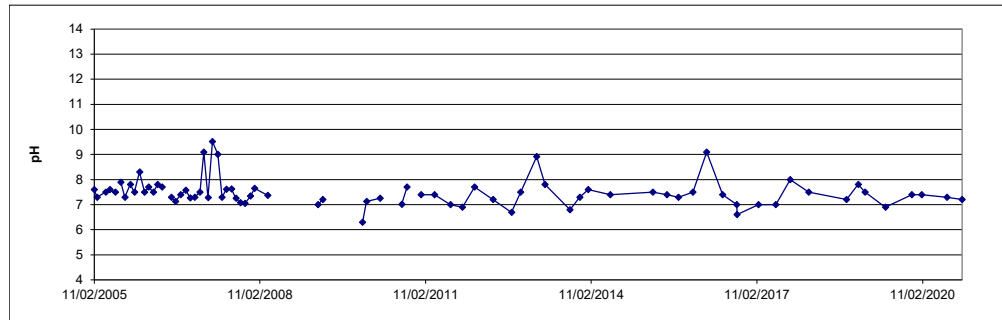


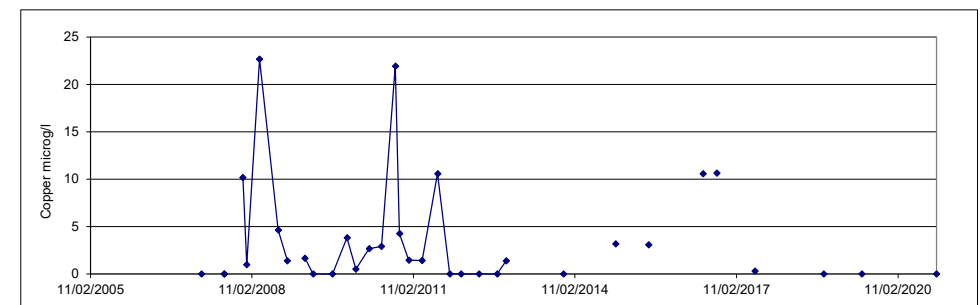
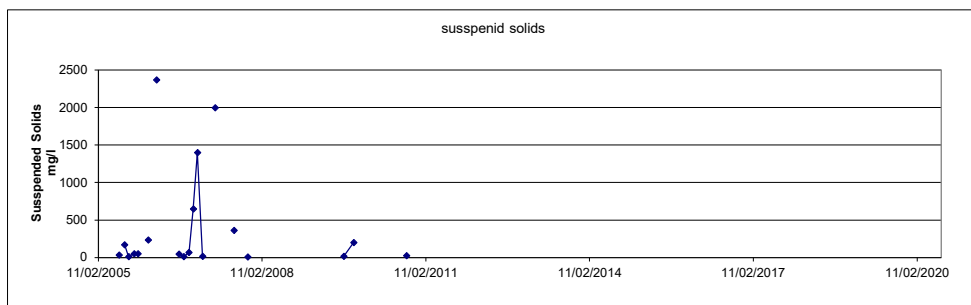
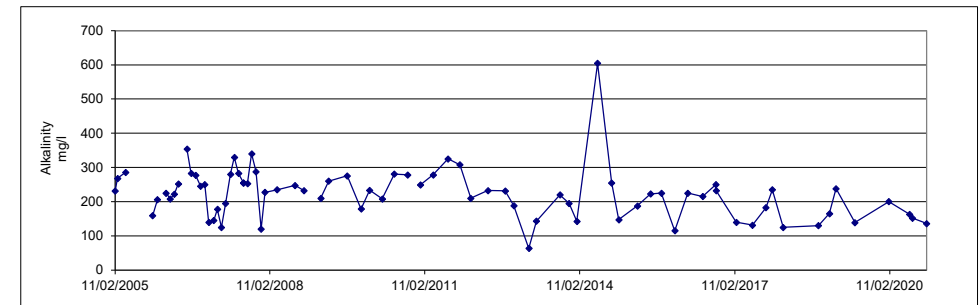
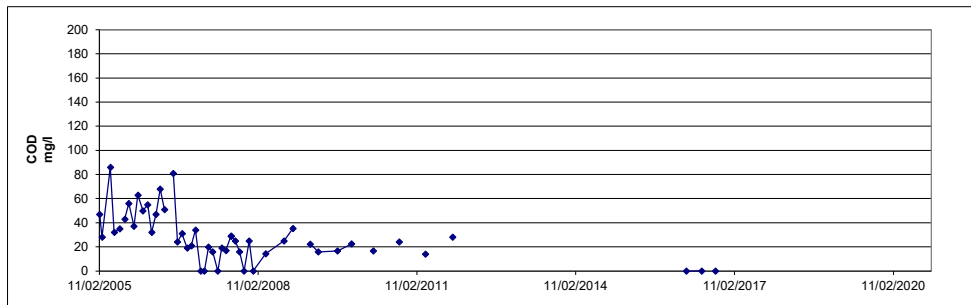
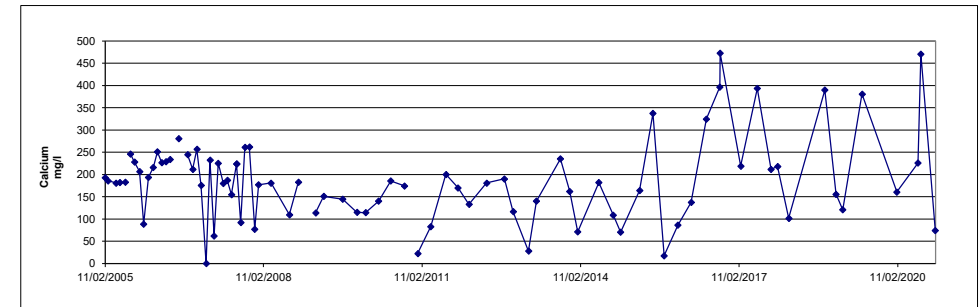
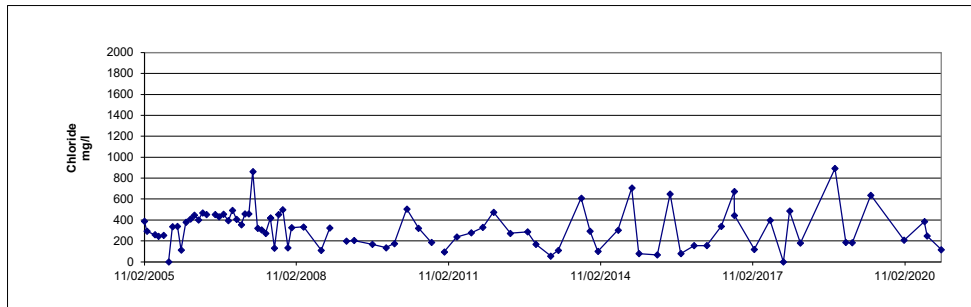
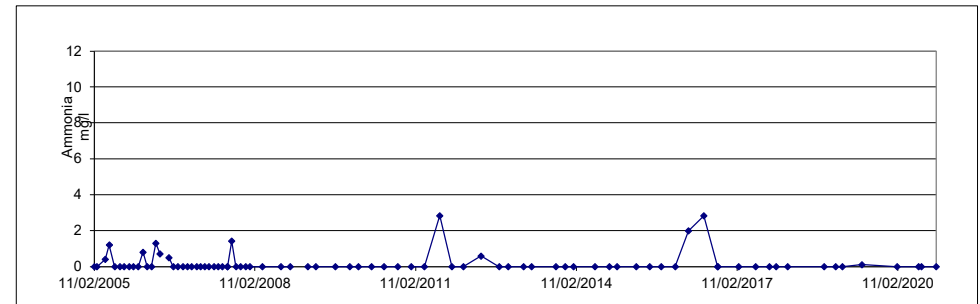
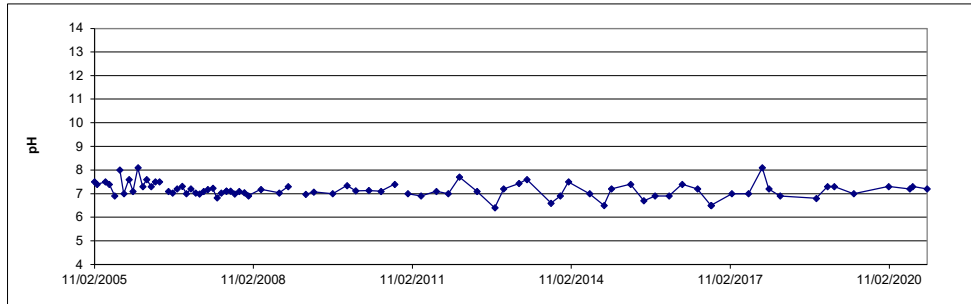


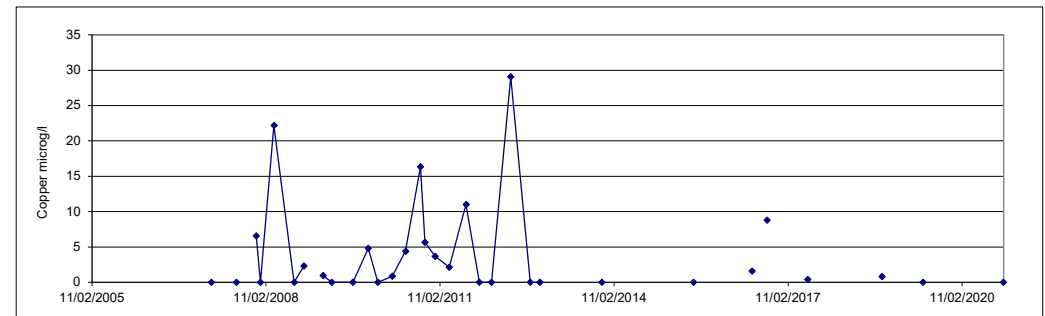
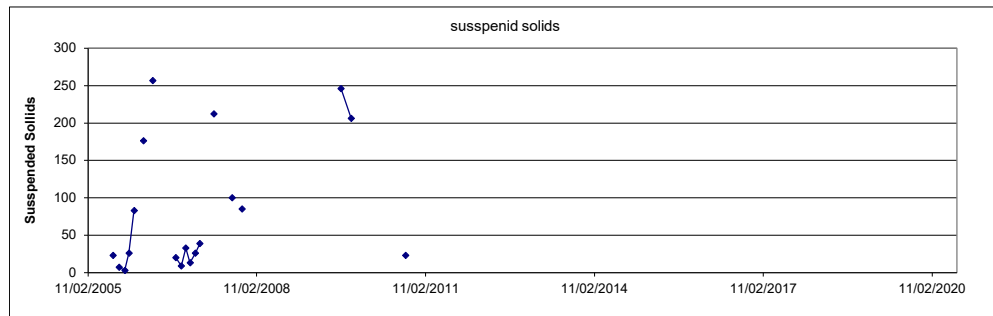
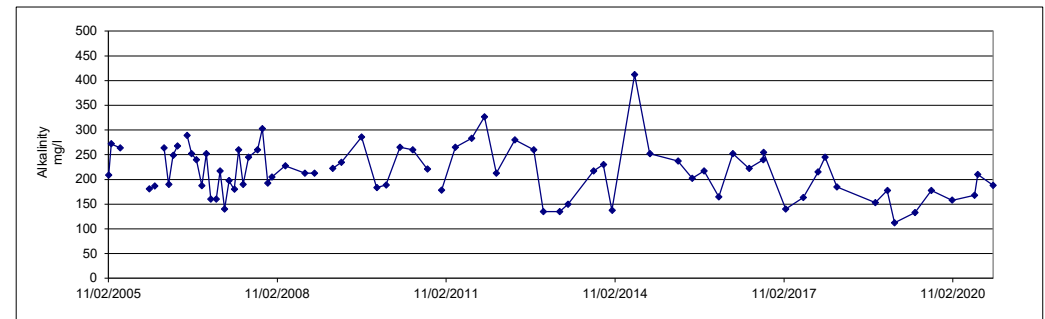
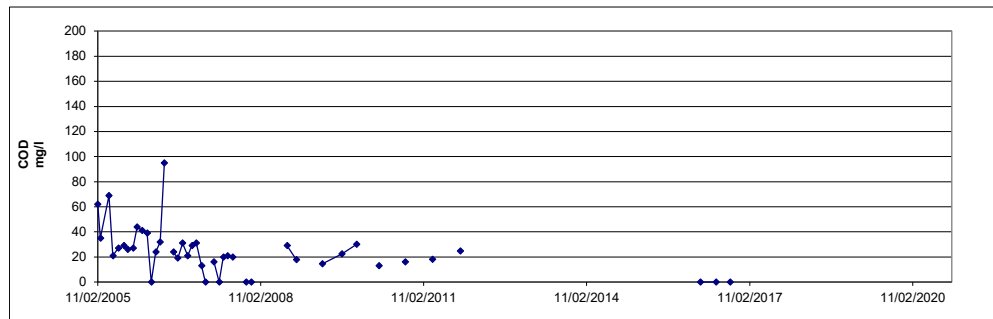
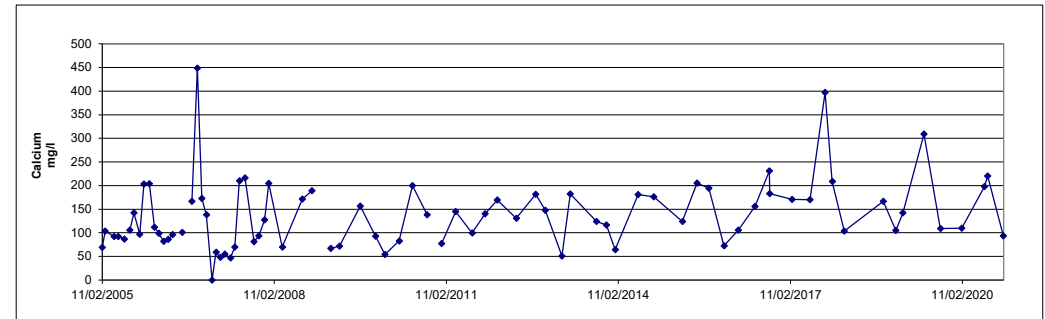
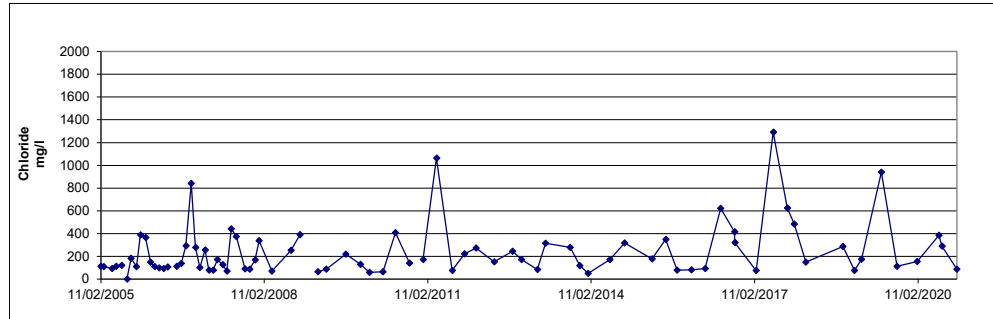
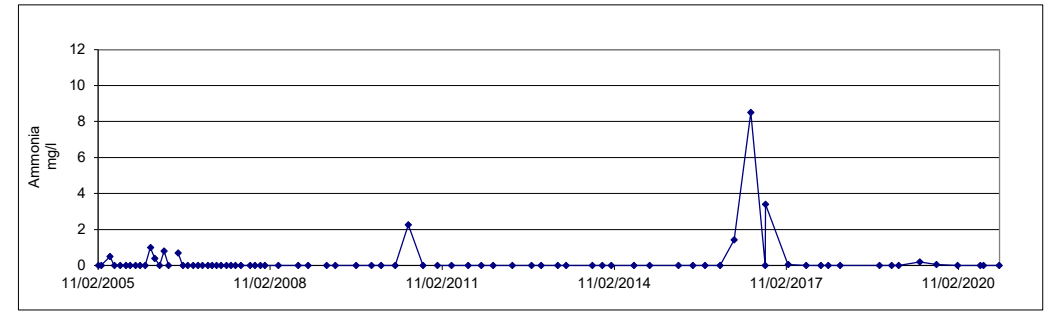
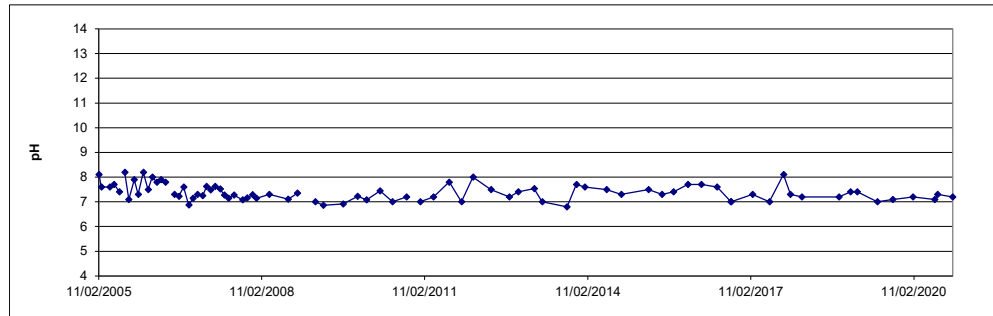


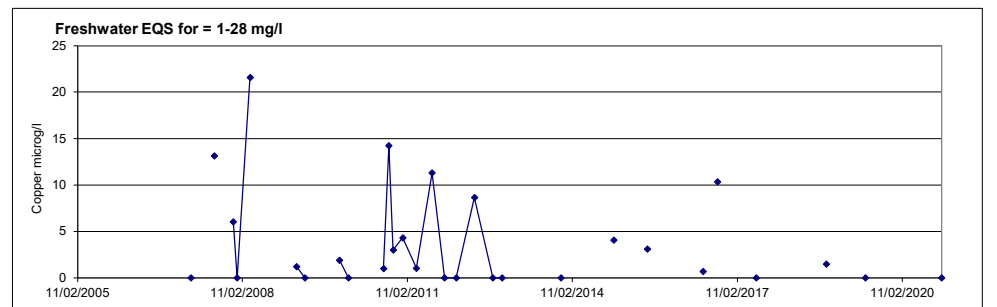
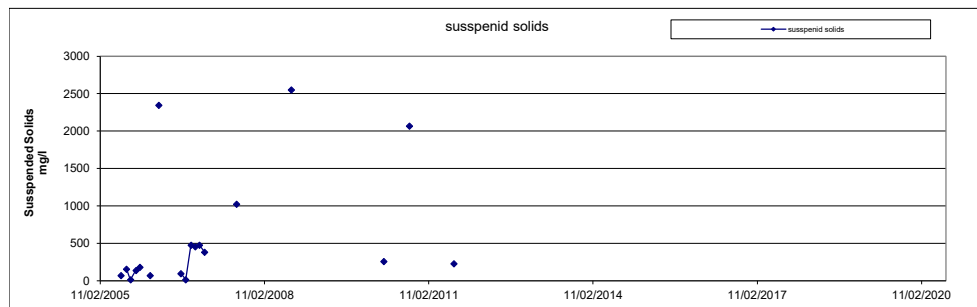
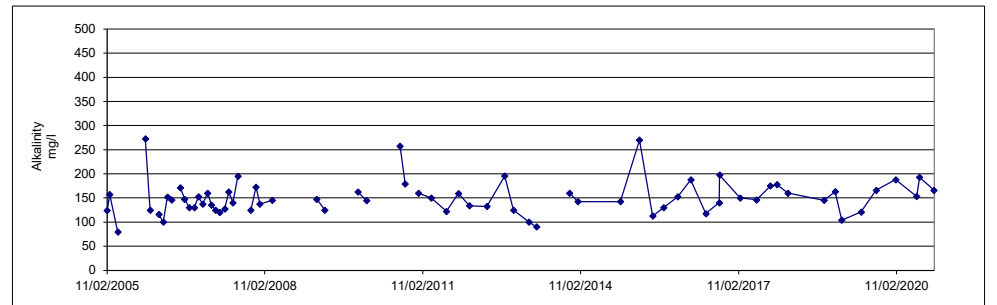
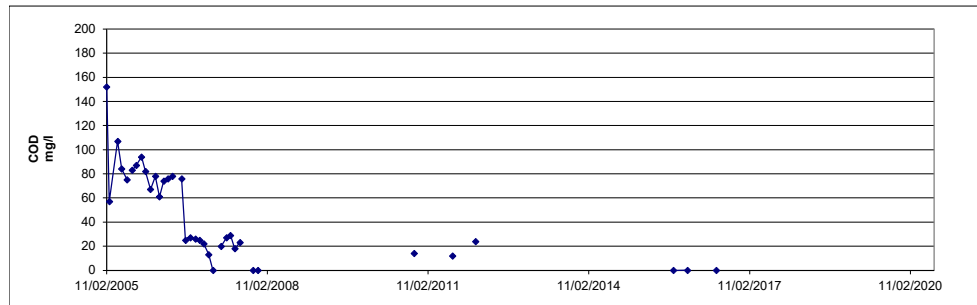
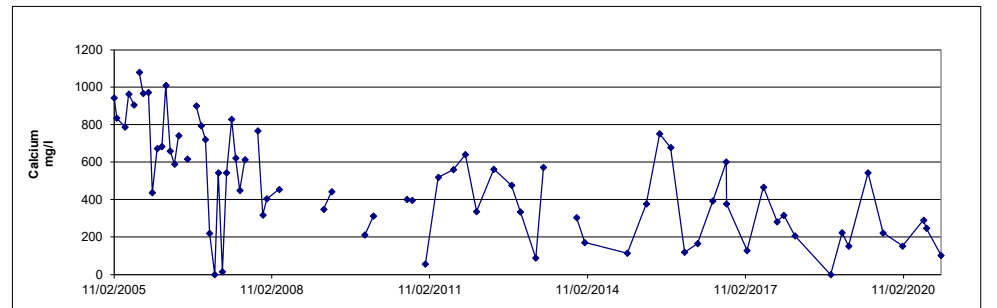
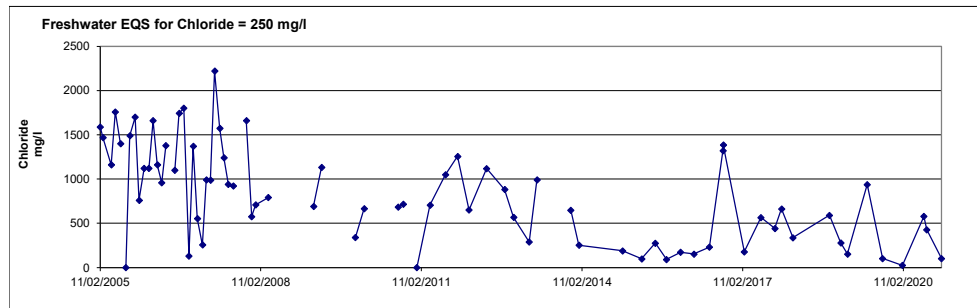
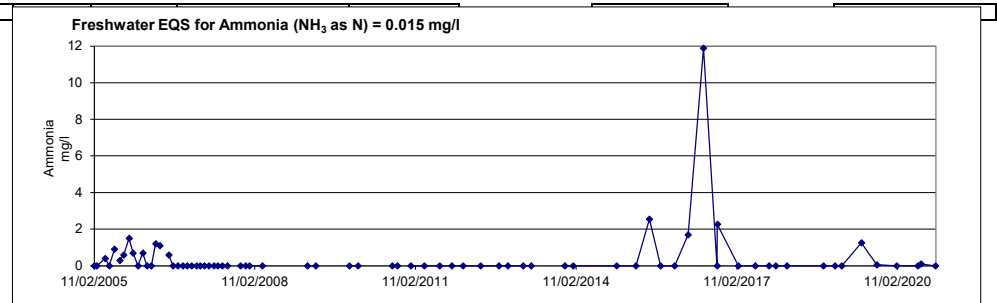
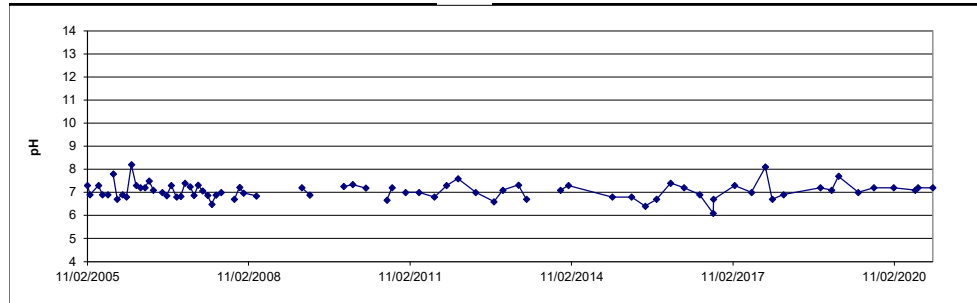


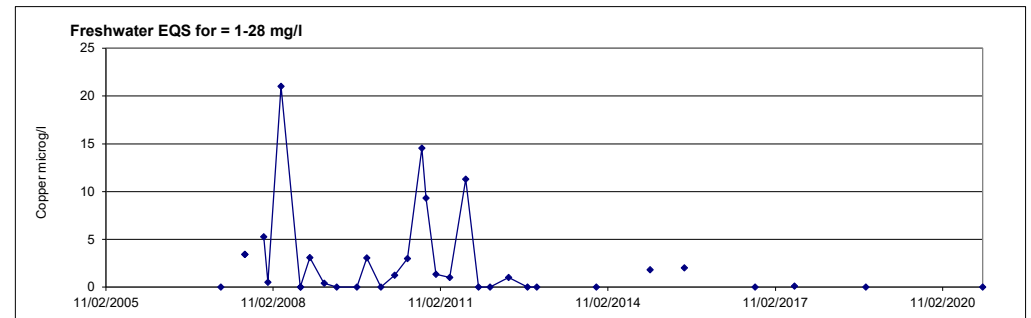
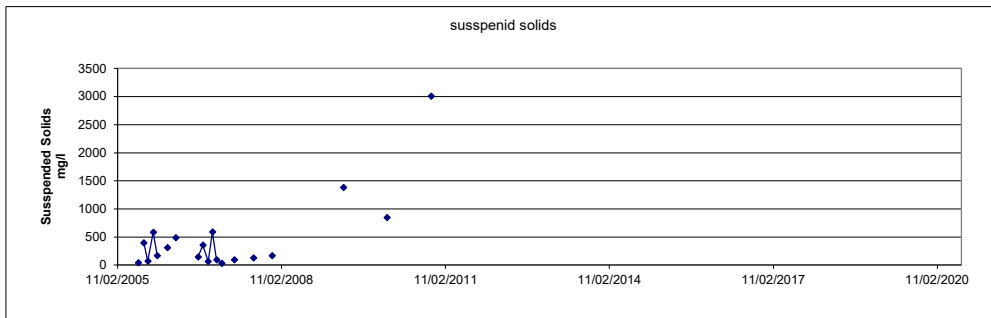
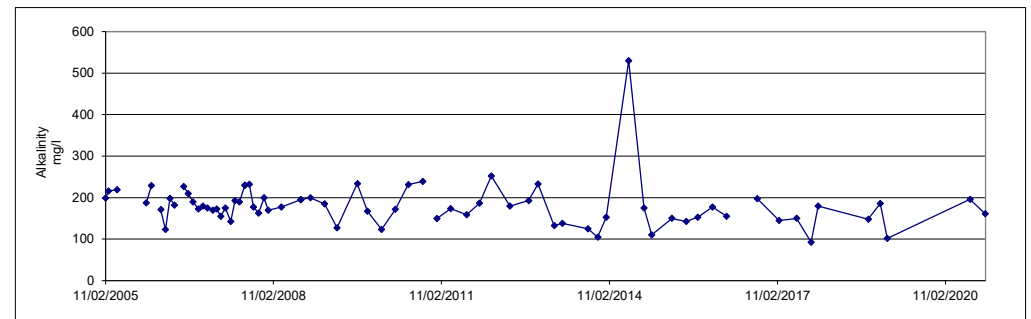
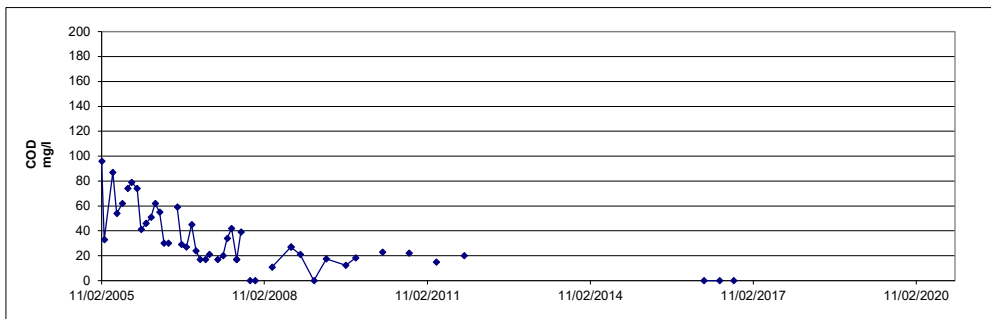
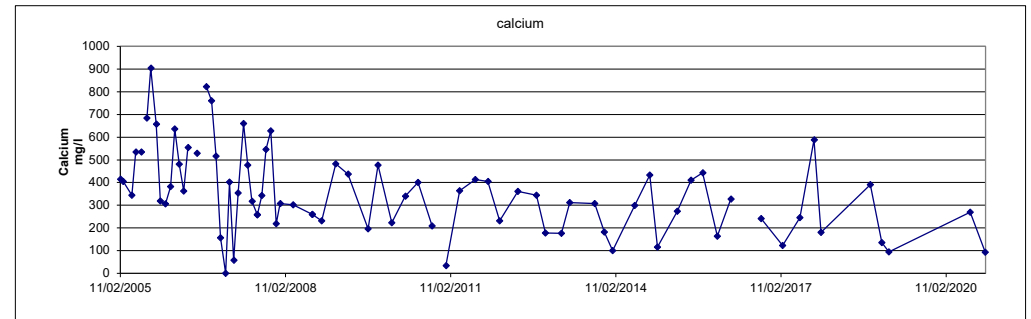
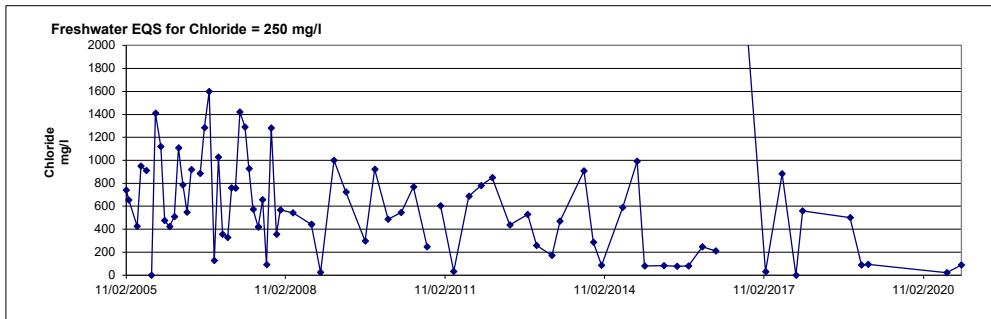
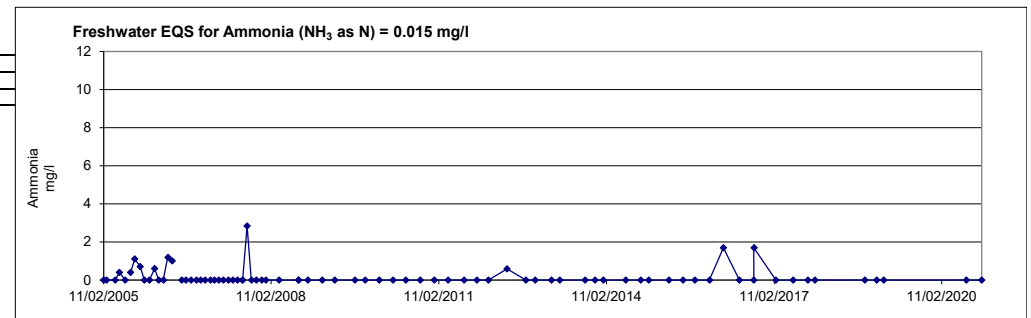
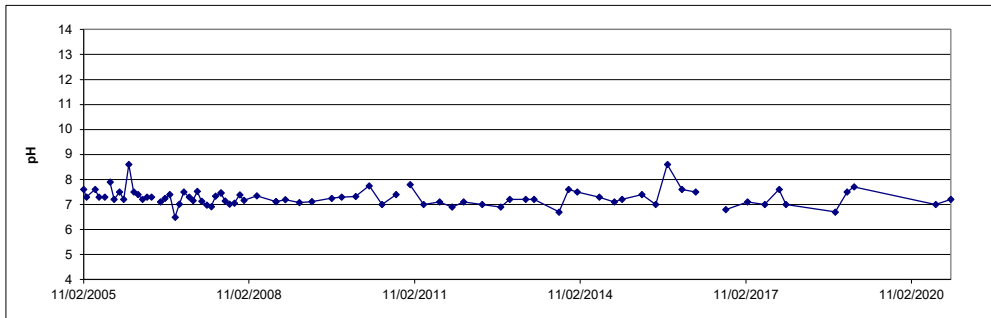


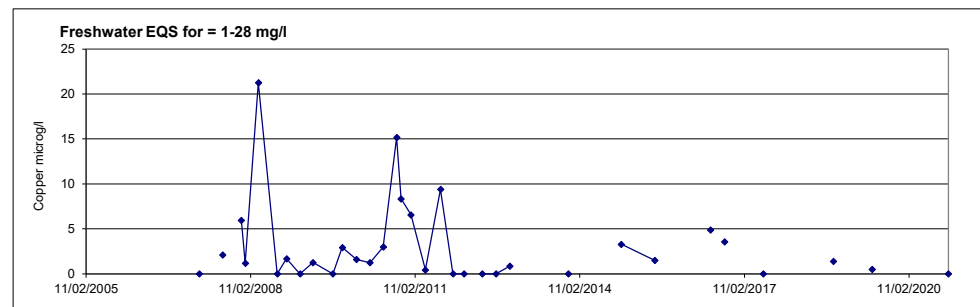
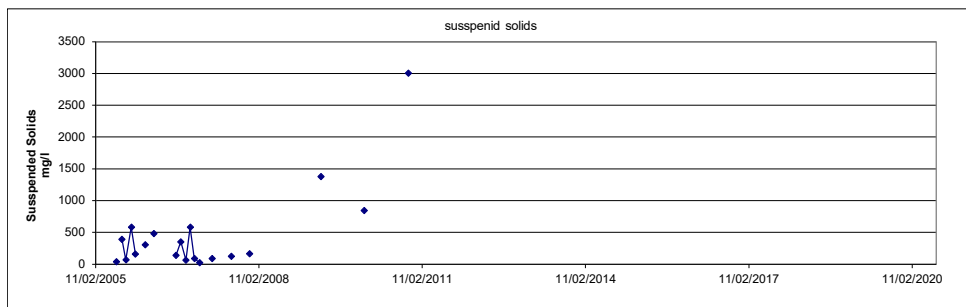
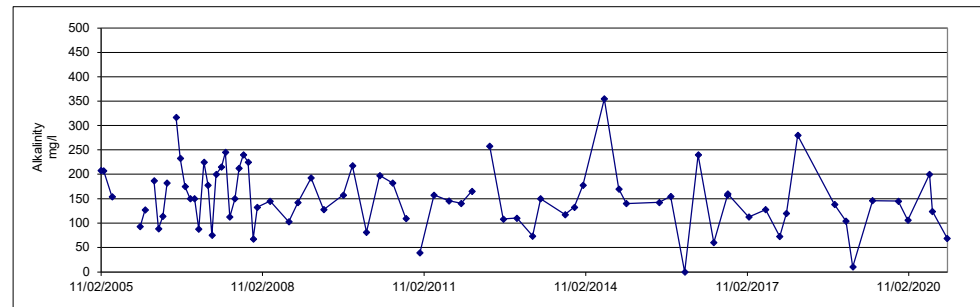
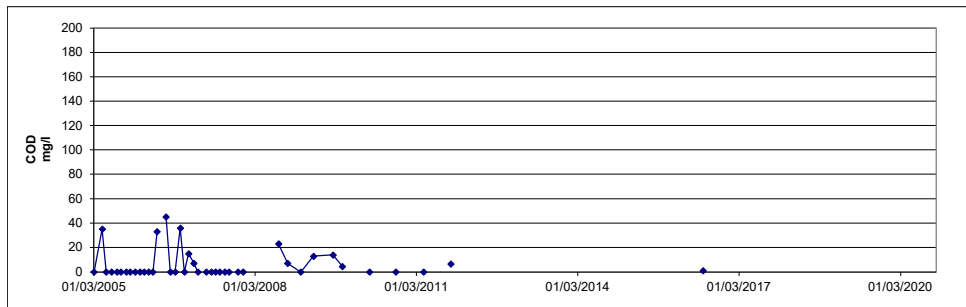
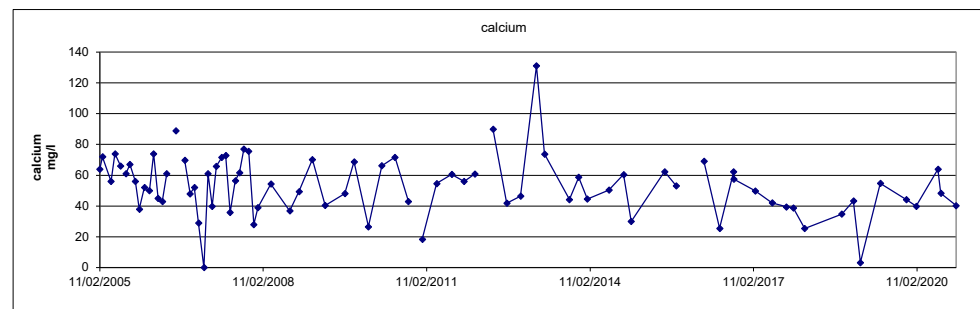
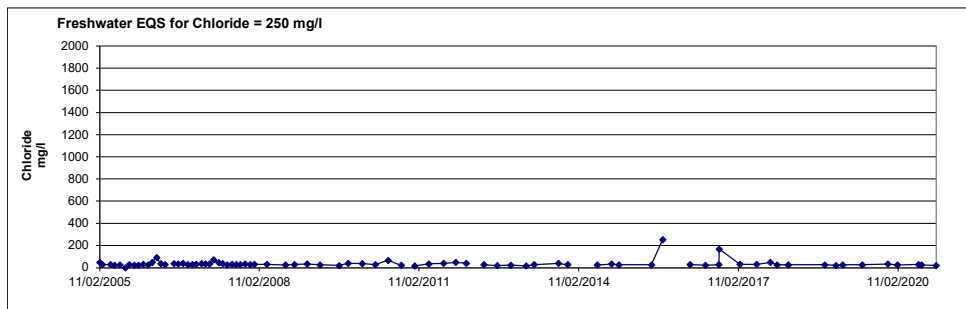
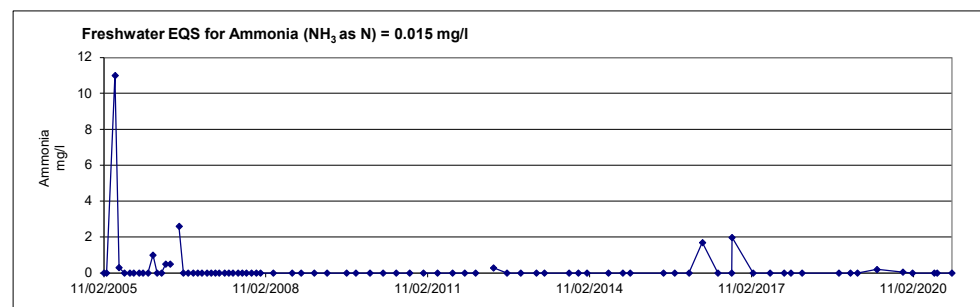
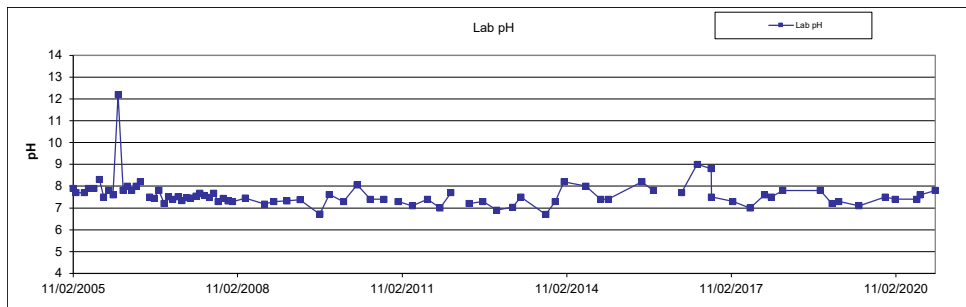


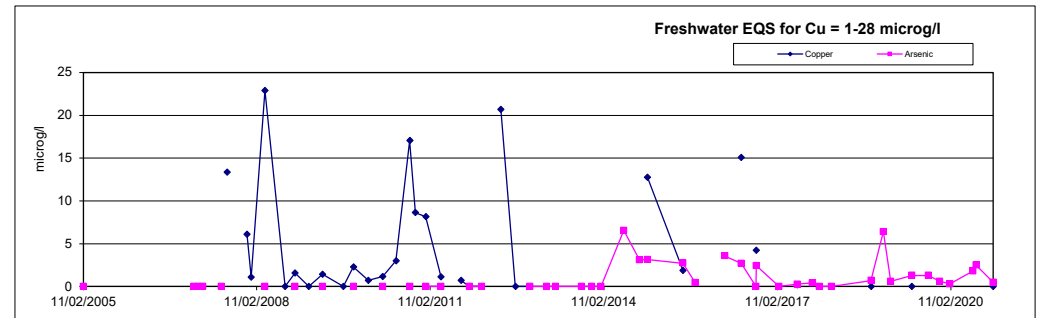
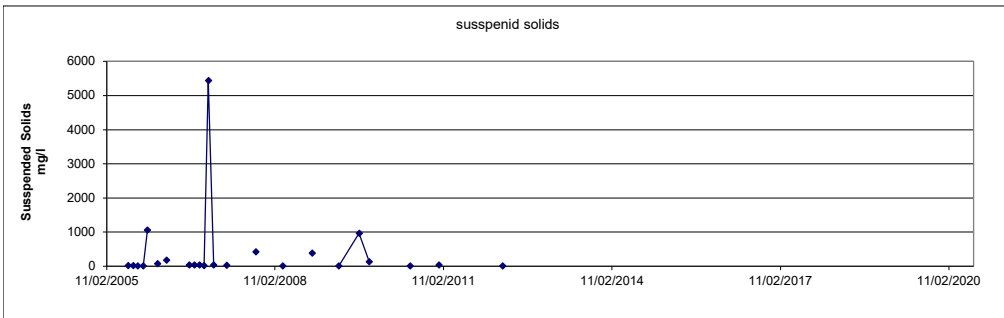
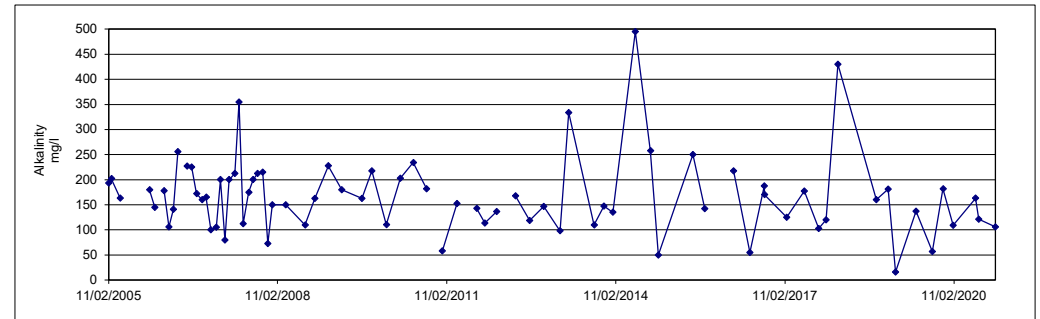
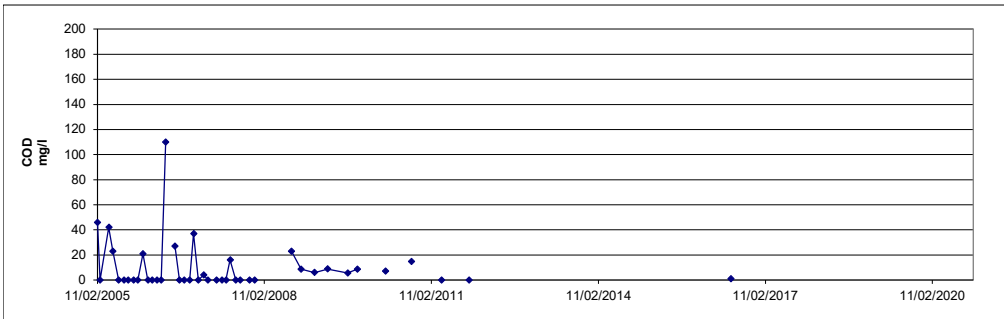
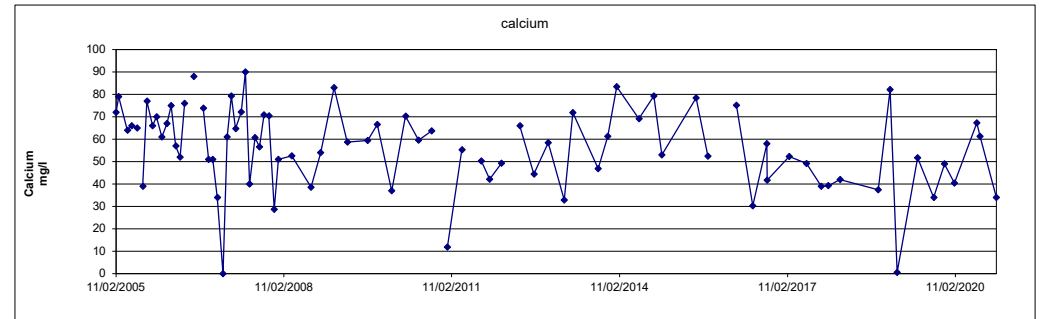
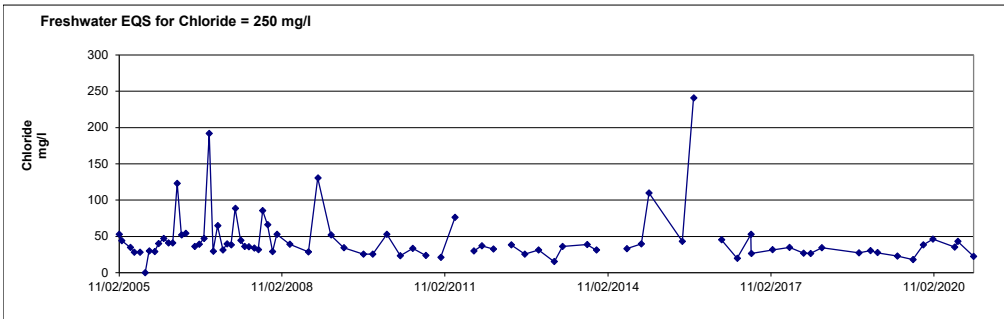
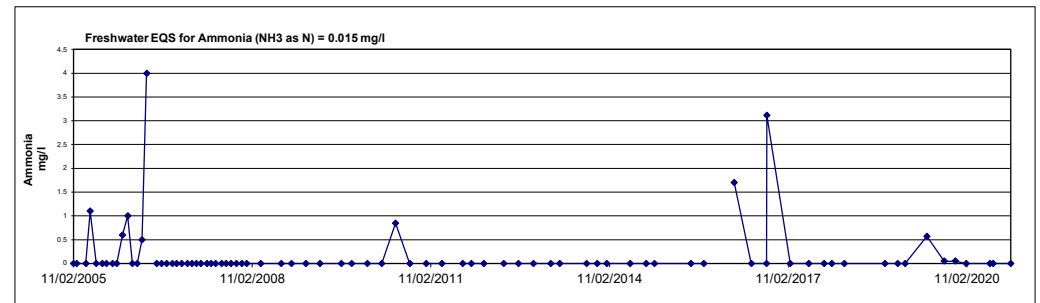
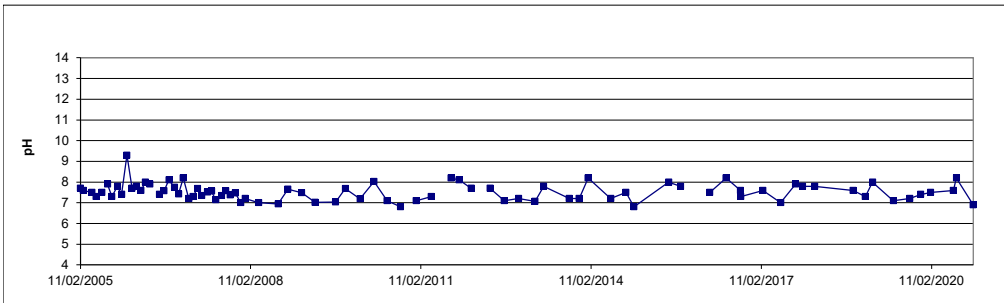












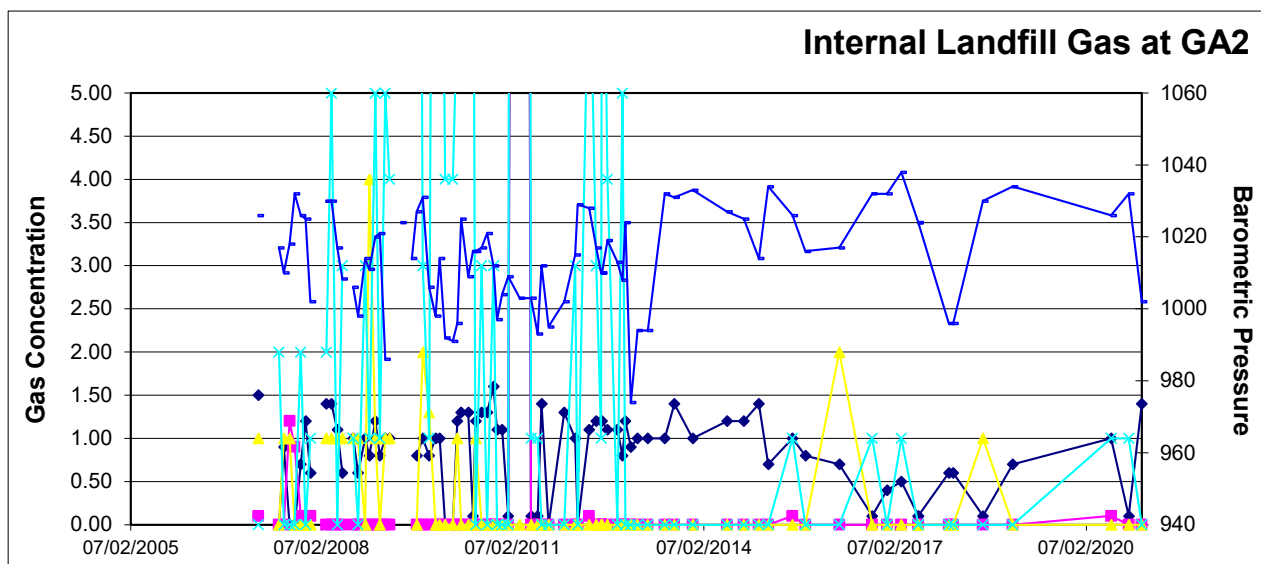
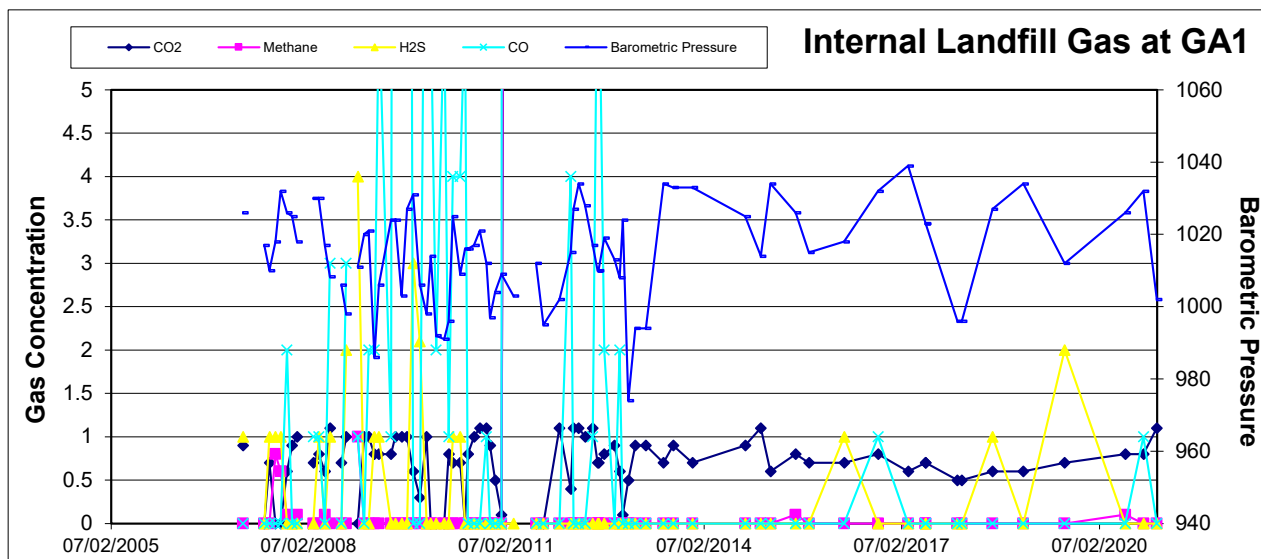
**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

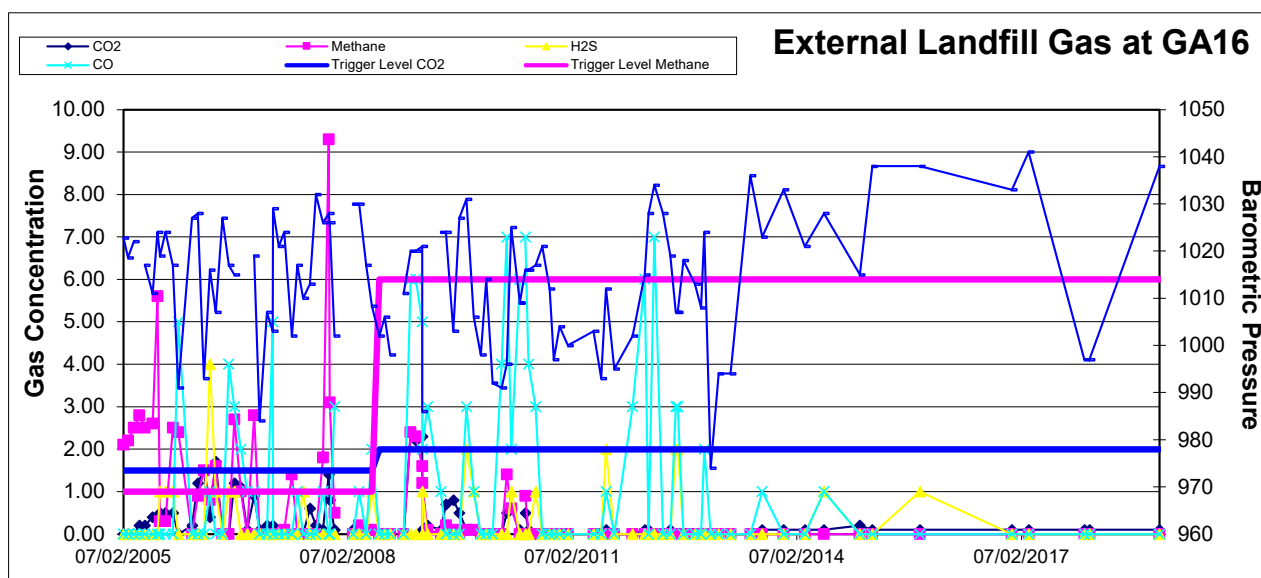
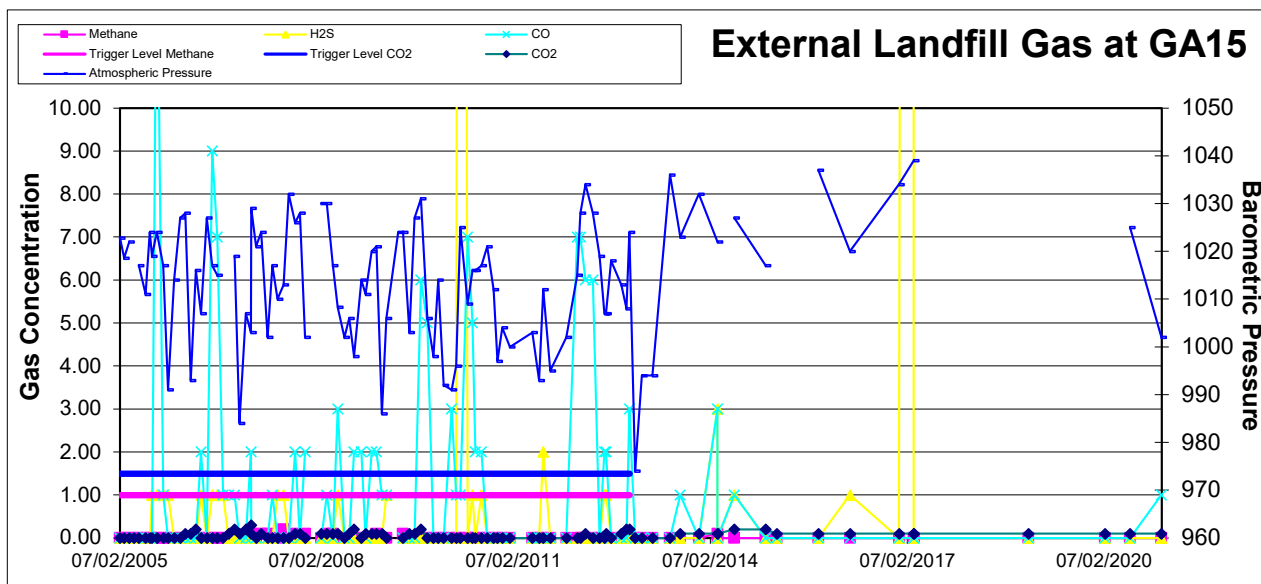
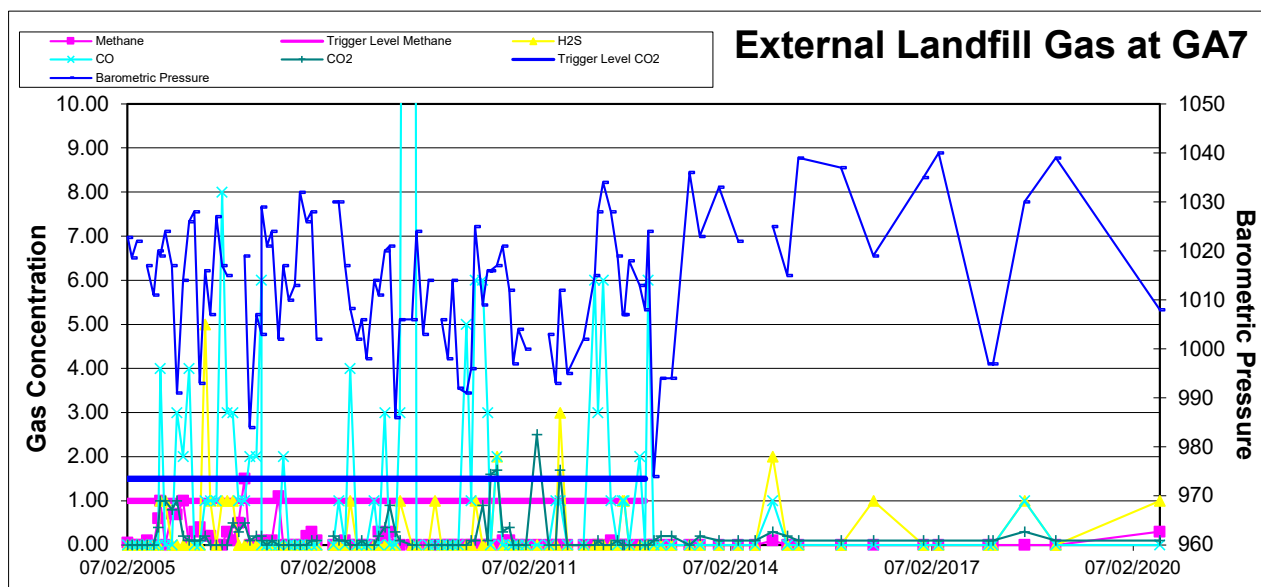
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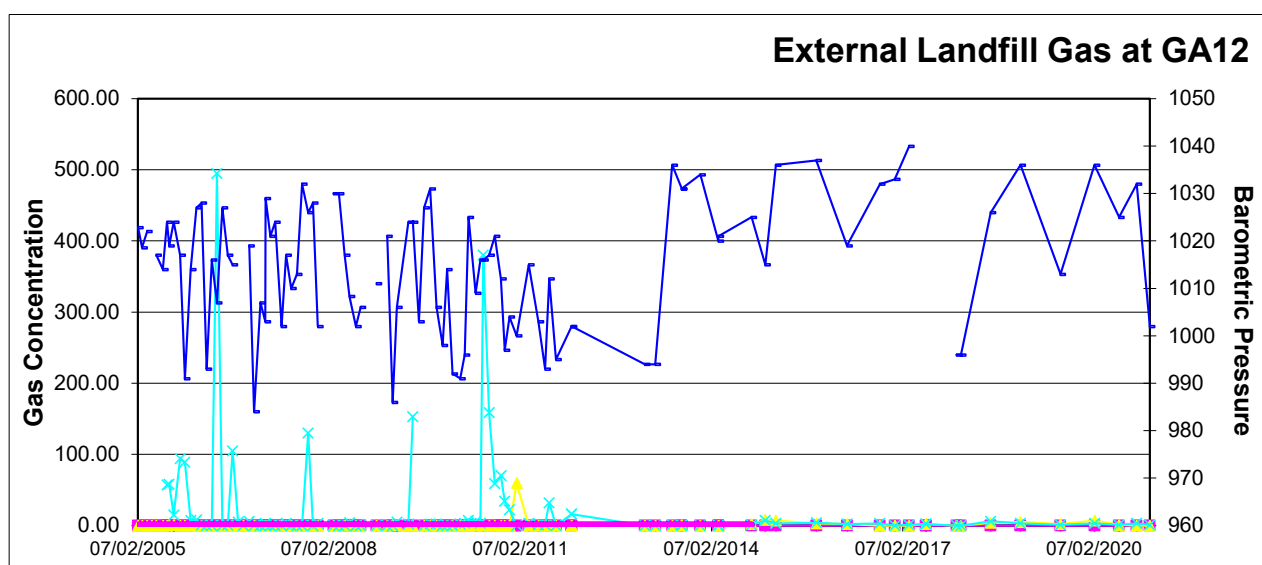
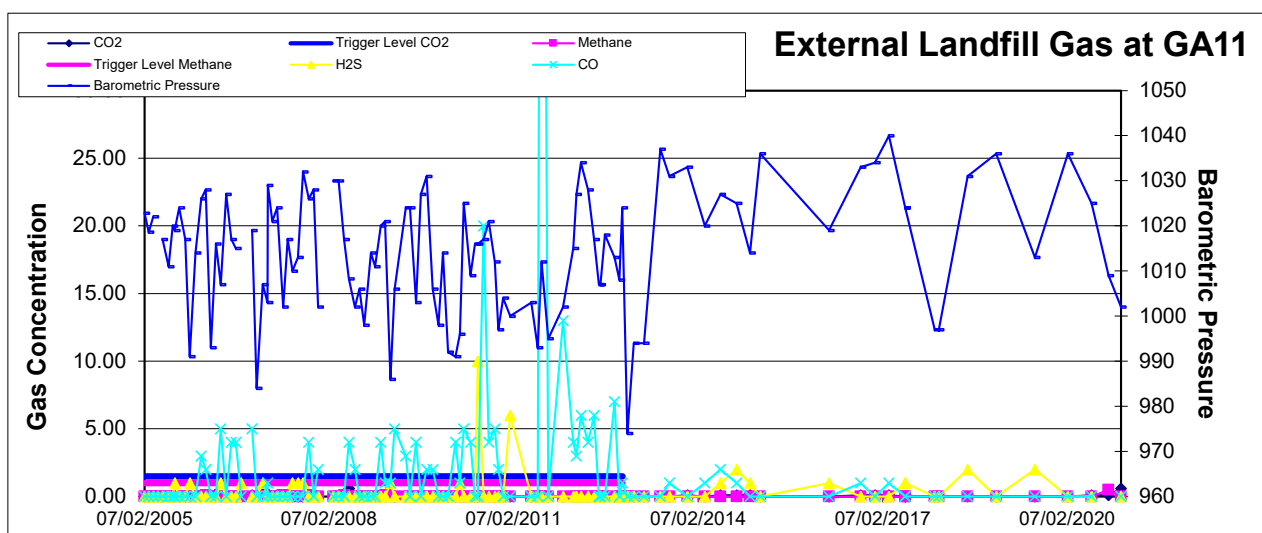
**2020 Annual Review of
Environmental
Monitoring**

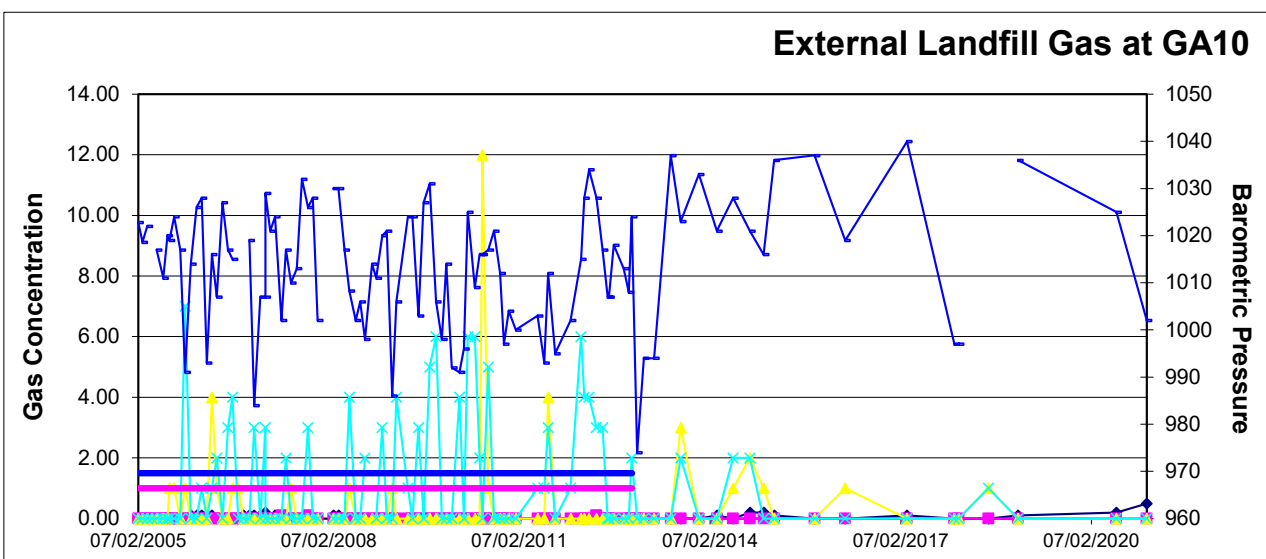
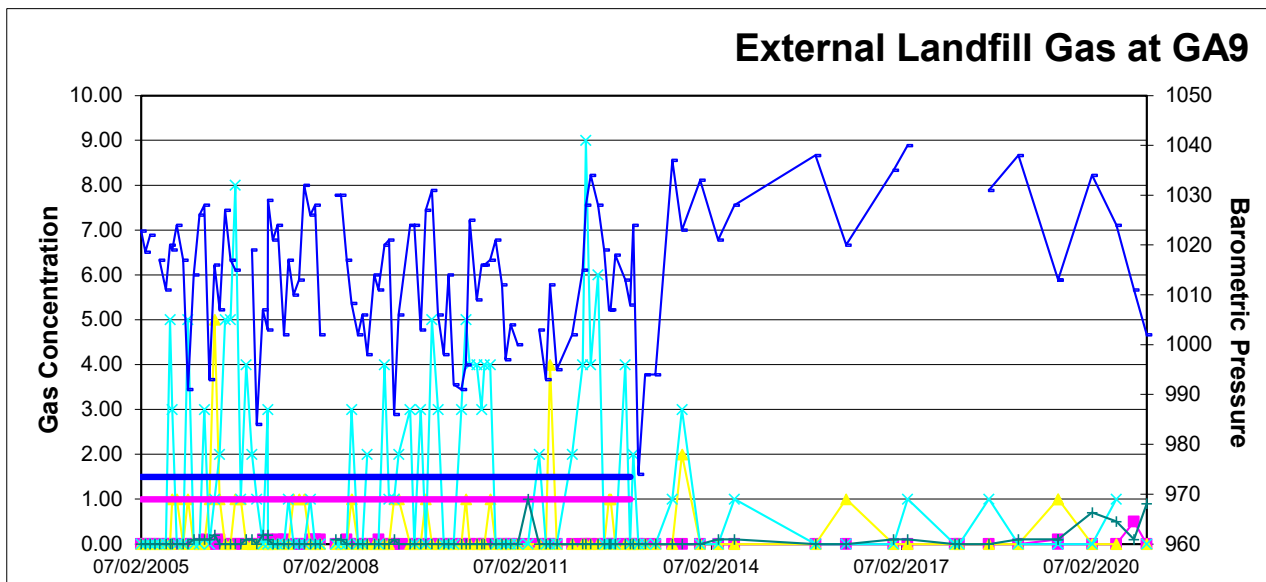
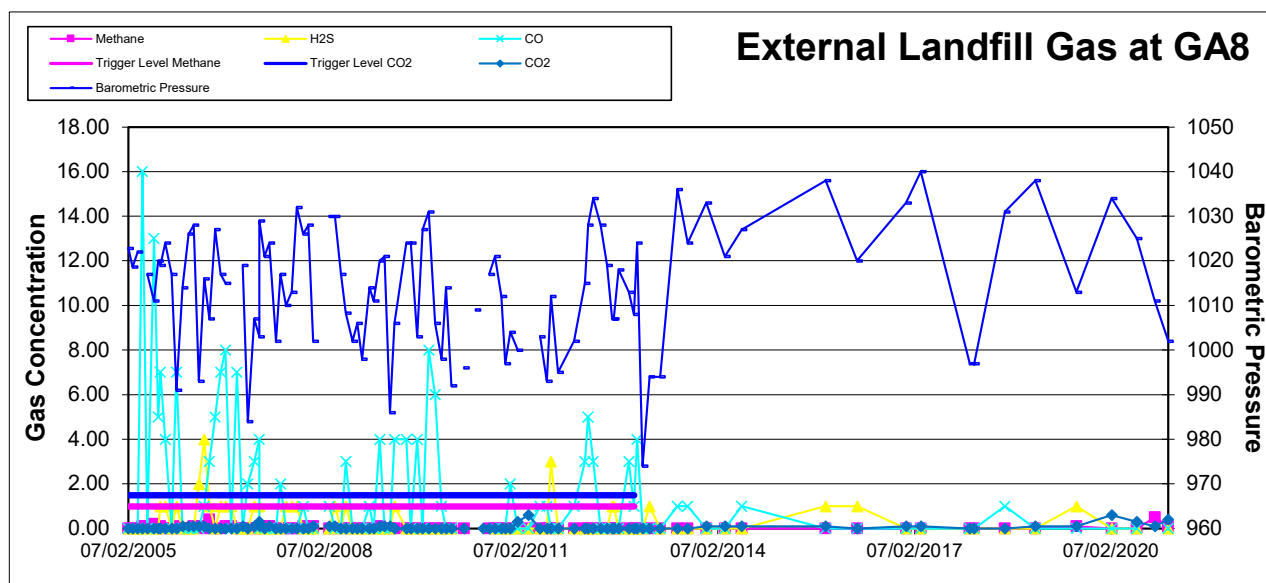
**Appendix 9
Temporal Variation of
Landfill Gas Chemistry**

Report Number 2092r1v1d0221









**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

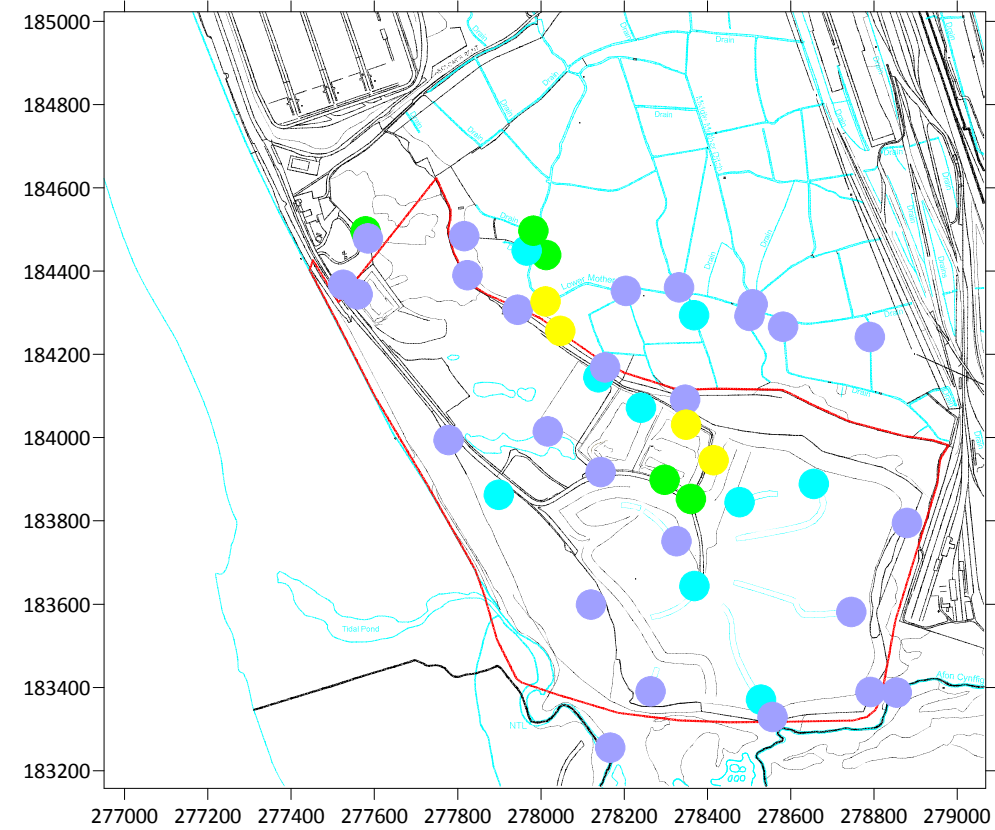
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Environmental
Monitoring**

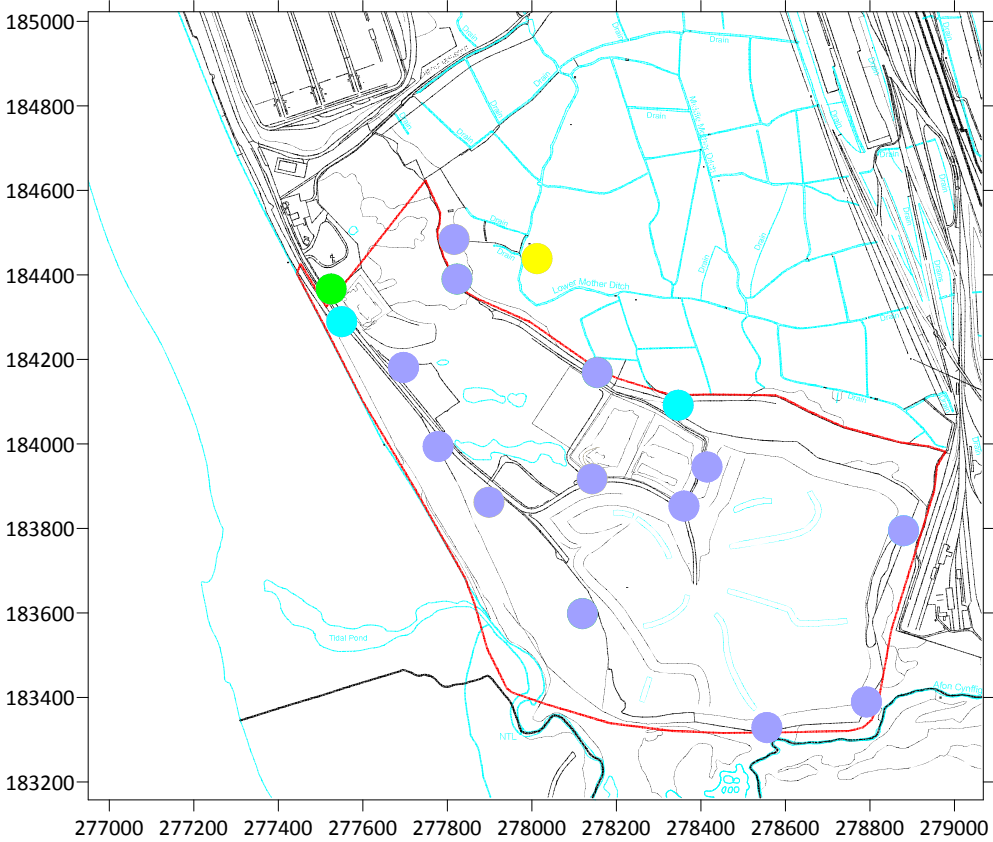
**Appendix 10
Spatial Variation of
Key Parameters**

Report Number 2092r1v1d0221

Copper in Groundwater, Leachate and Surface Water (microg/l)

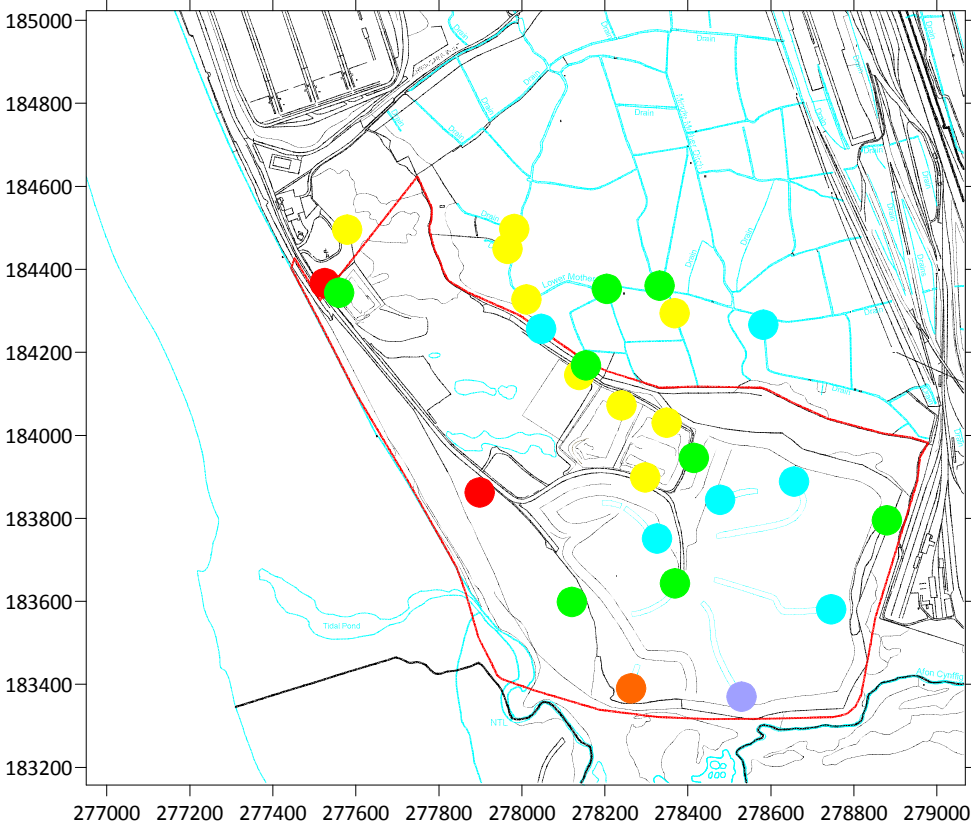


Q4, 2020 - Shallow GW, Leachate, Ponds and Surface Water

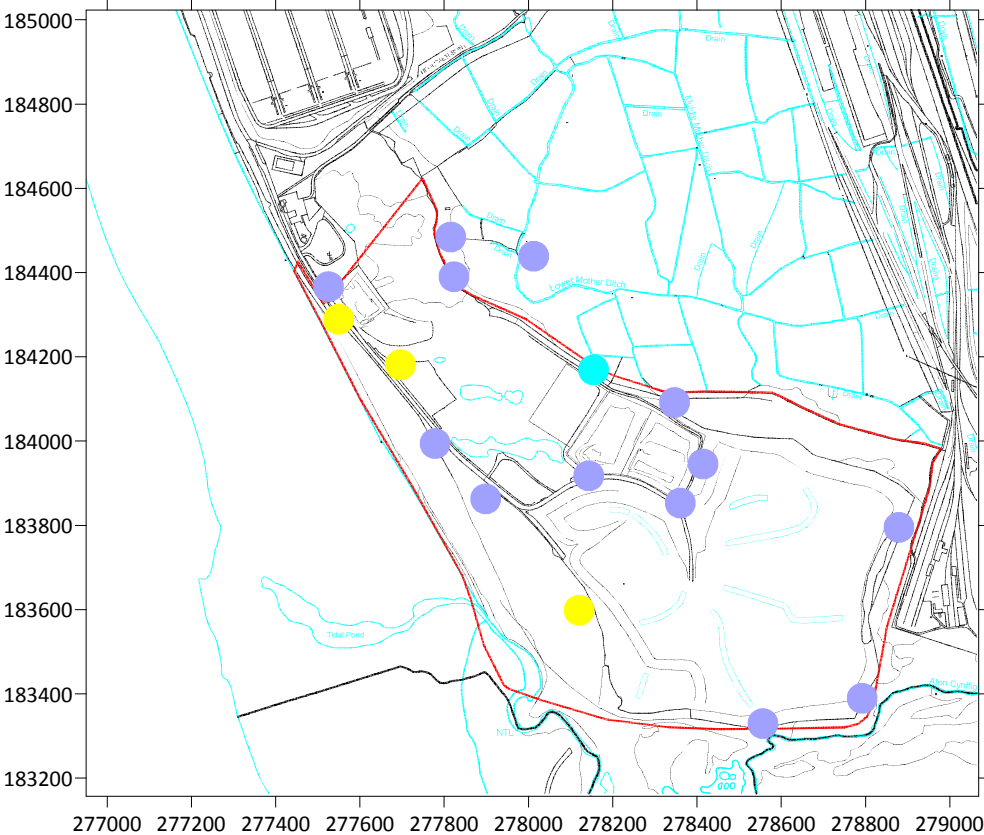


Q4, 2020 - Deep Groundwater

Zinc in Groundwater, Leachate and Surface Water (microg/l)

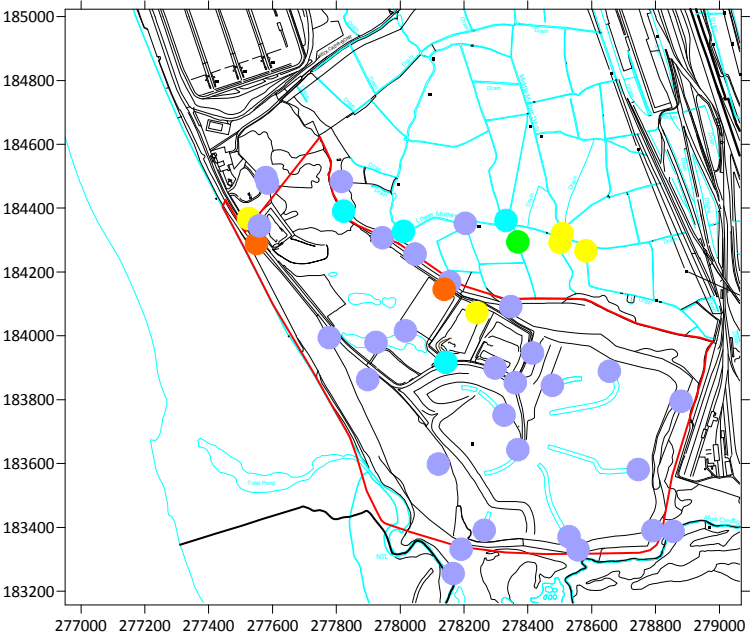


Q4, 2020 - Shallow GW, Leachate, Ponds and Surface Water

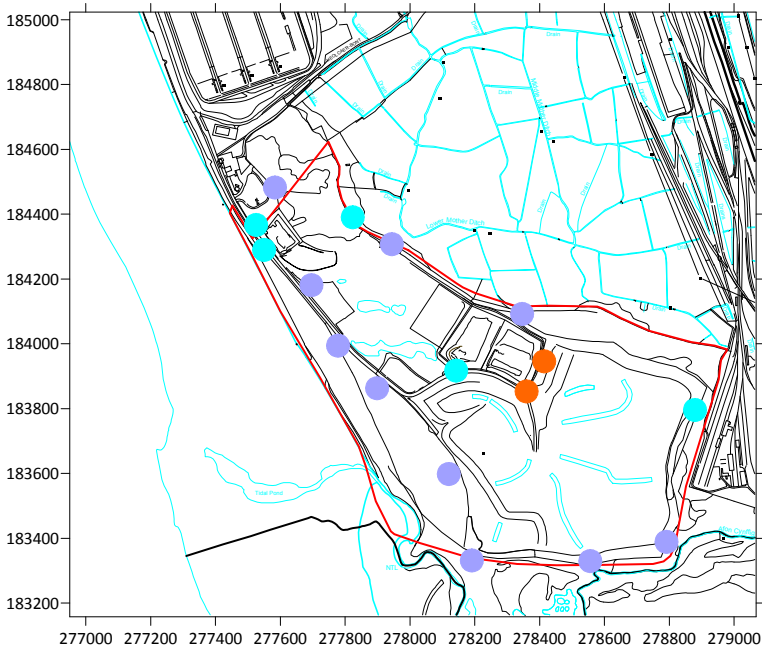


Q4, 2020 - Deep Groundwater

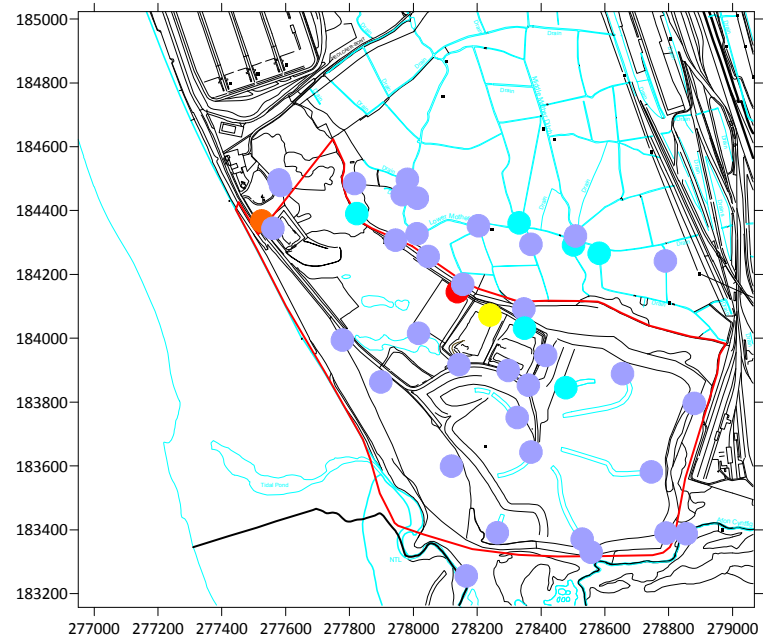
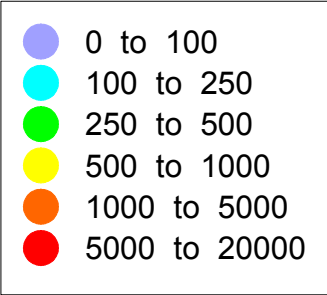
Chloride in Groundwater, Leachate and Surface Water (mg/l)



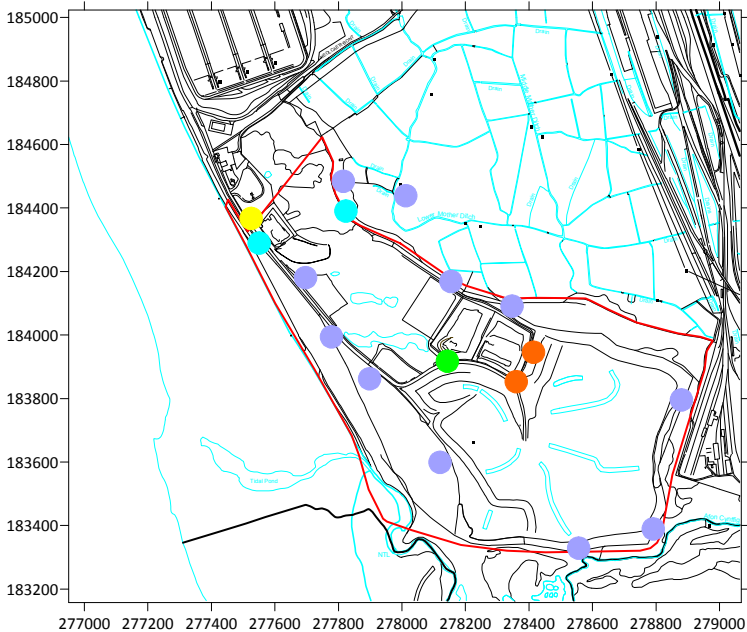
June 2019 - Shallow GW, Leachate, Ponds and Surface Water



June 2019 - Deep Groundwater

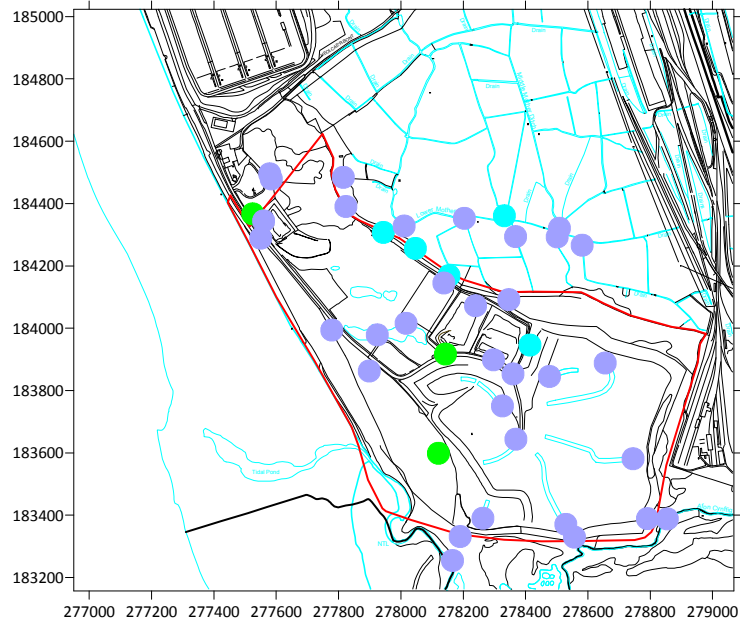


Q4, 2020 - Shallow GW, Leachate, Ponds and Surface Water

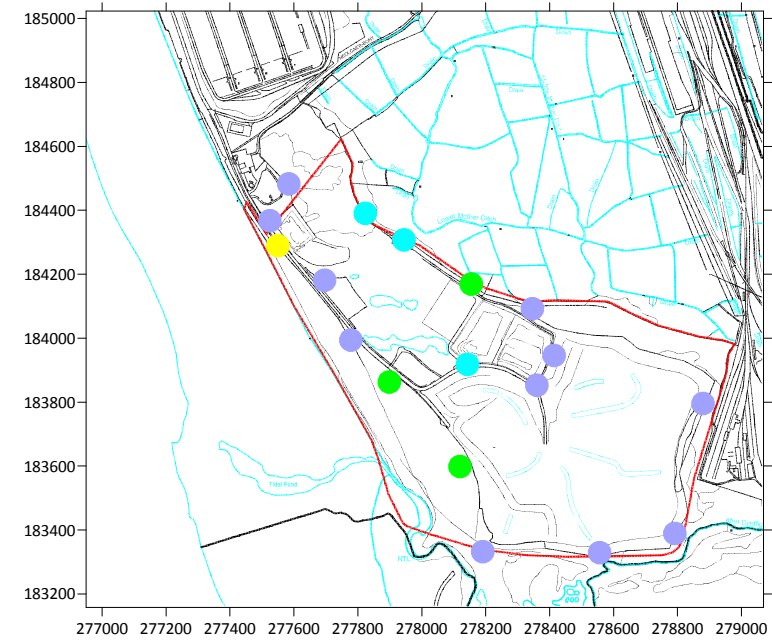


Q4 2020 - Deep Groundwater

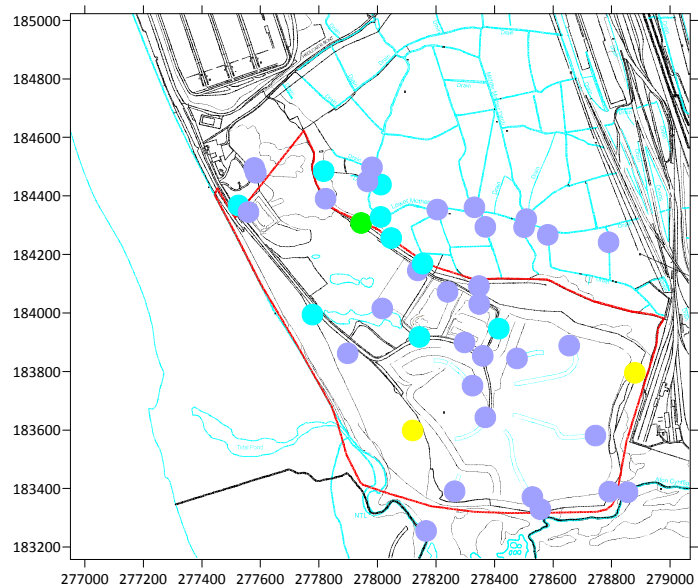
Arsenic in Groundwater, Leachate and Surface Water (microg/l)



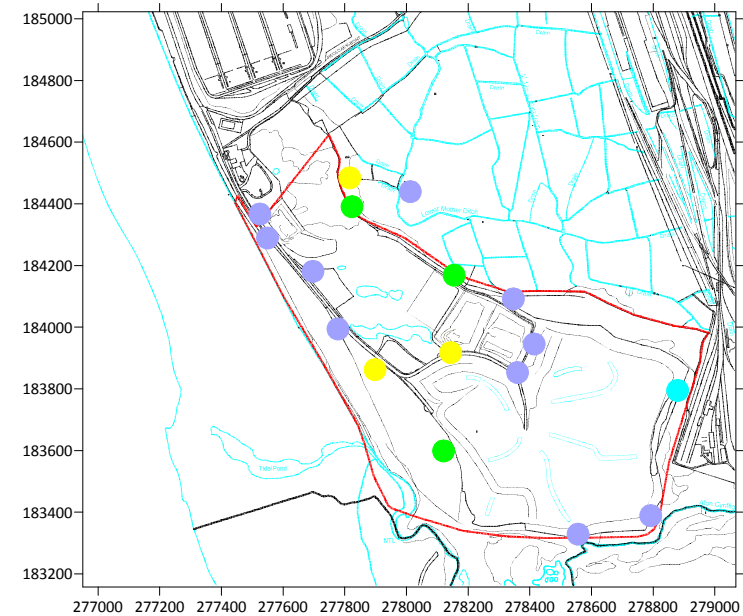
June 2019 - Shallow GW, Leachate, Ponds and Surface Water



June 2019 - Deep Groundwater



Q4, 2020 - Shallow GW, Leachate, Ponds and Surface Water



Q4, 2020 - Deep Groundwater

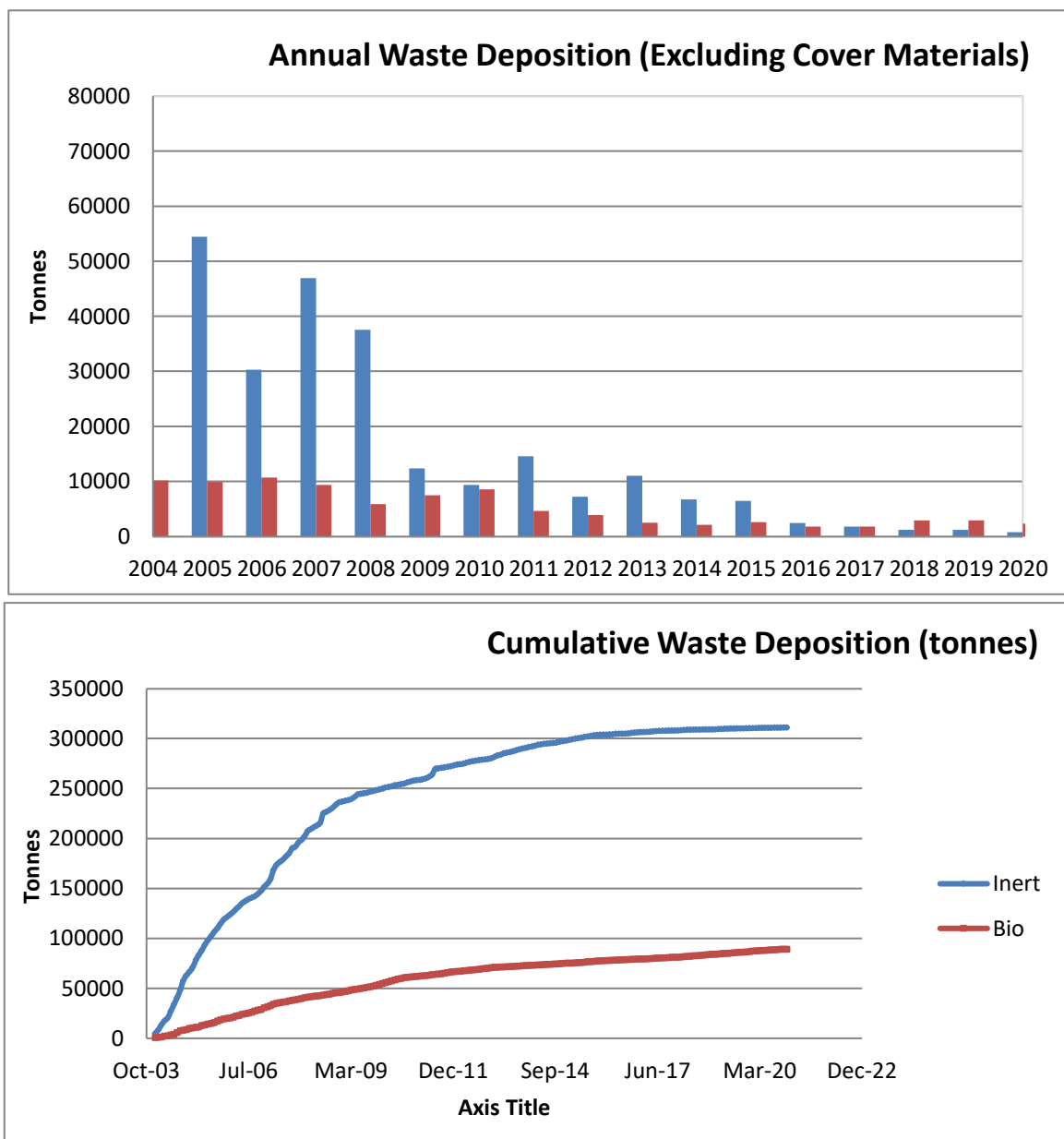
**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

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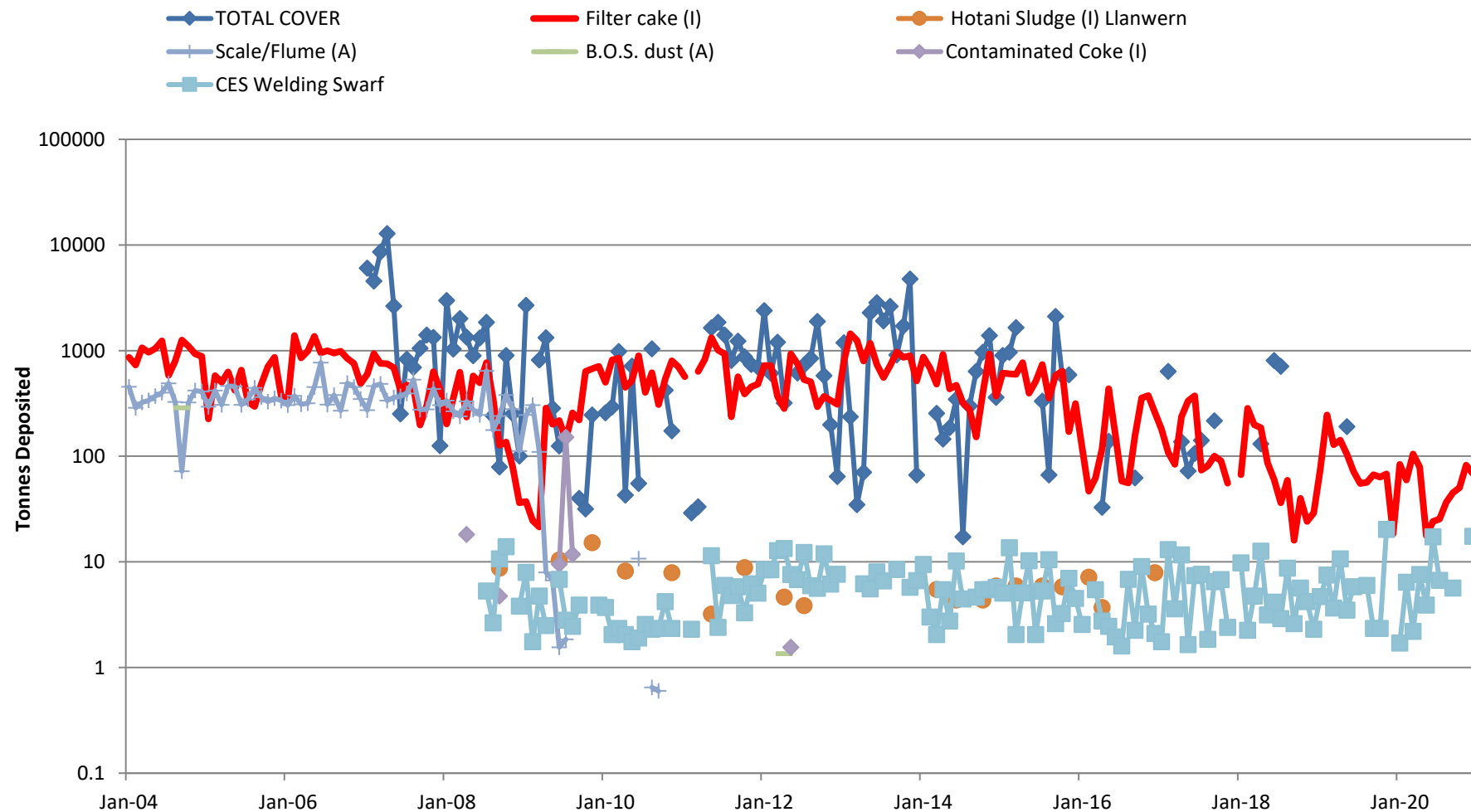
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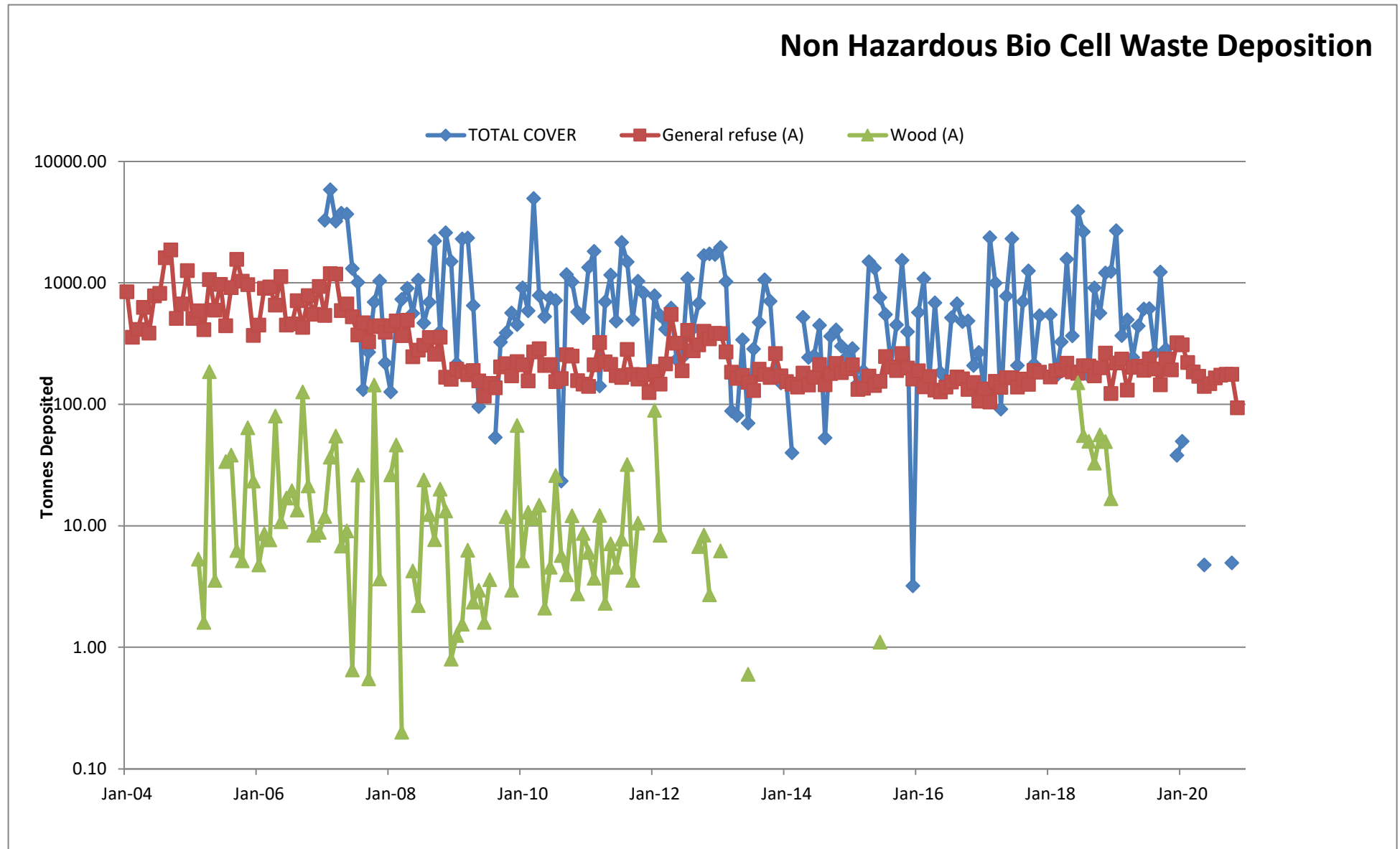
**Appendix 11
Record of Landfilled
Waste**

Report Number 2092r1v1d0221



Non Hazardous Waste Deposition





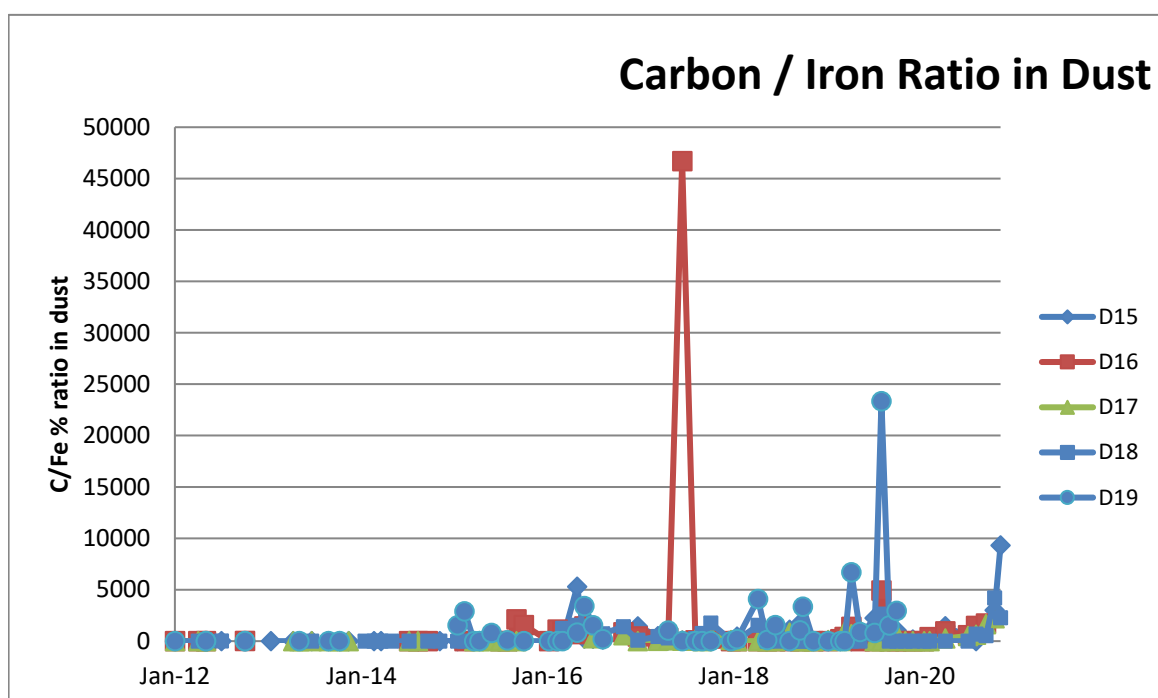
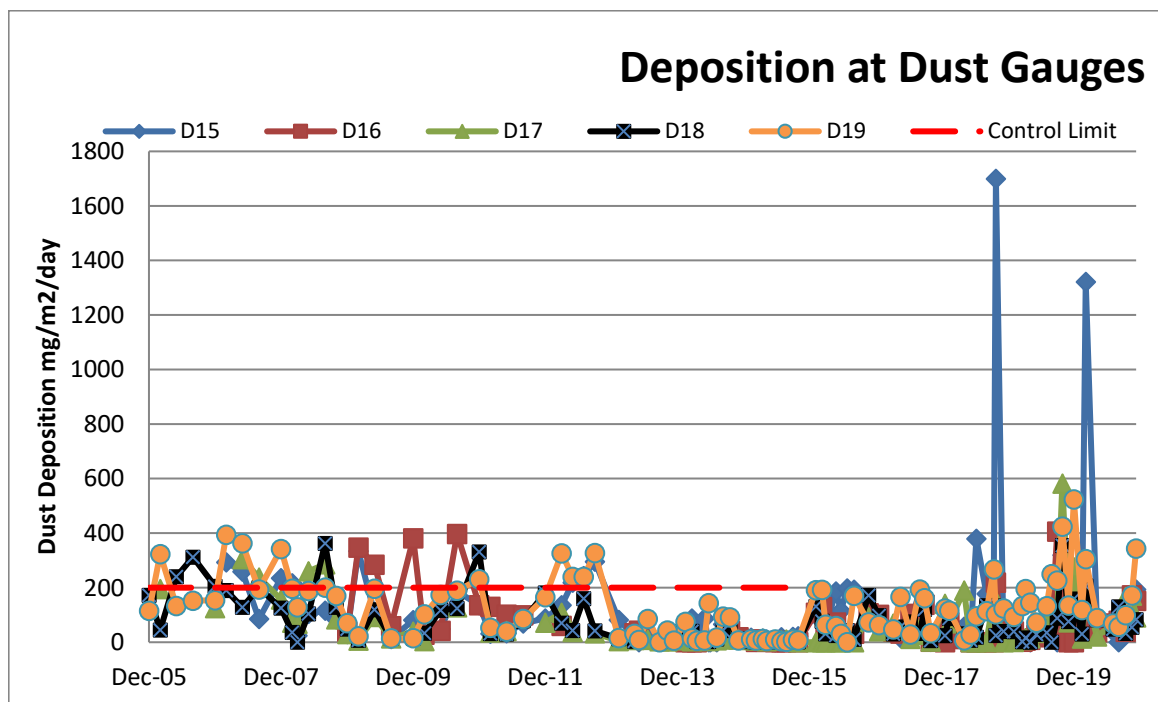
**MORFA NON-
HAZARDOUS
LANDFILL, PORT
TALBOT**

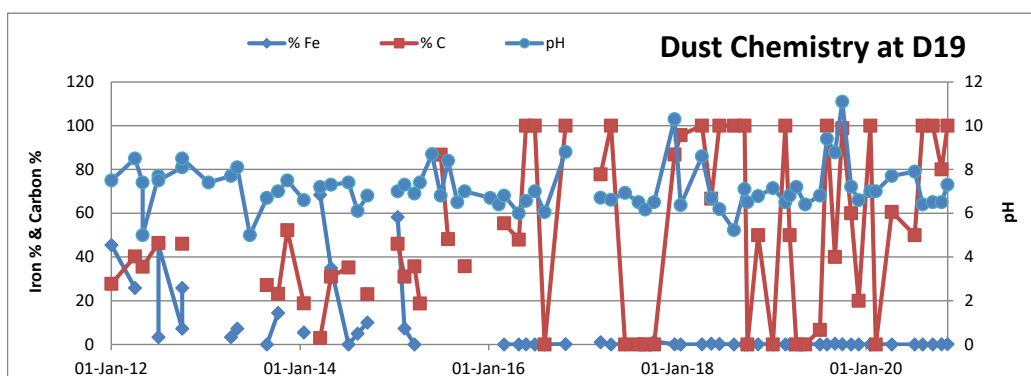
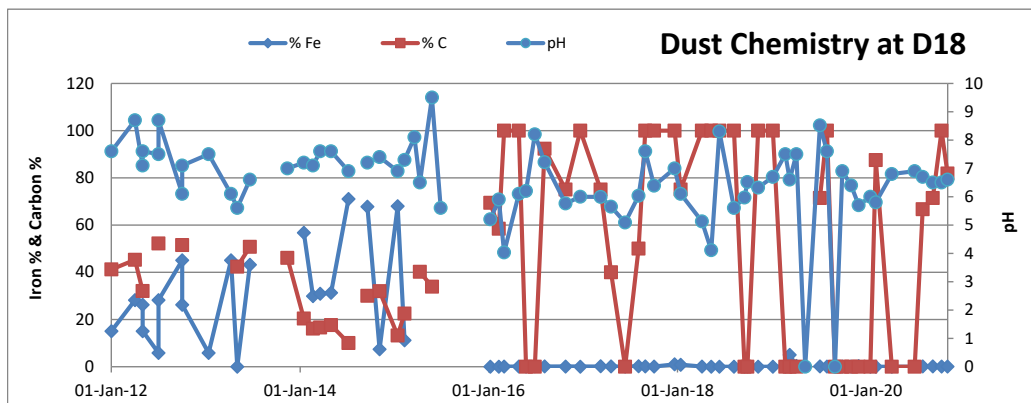
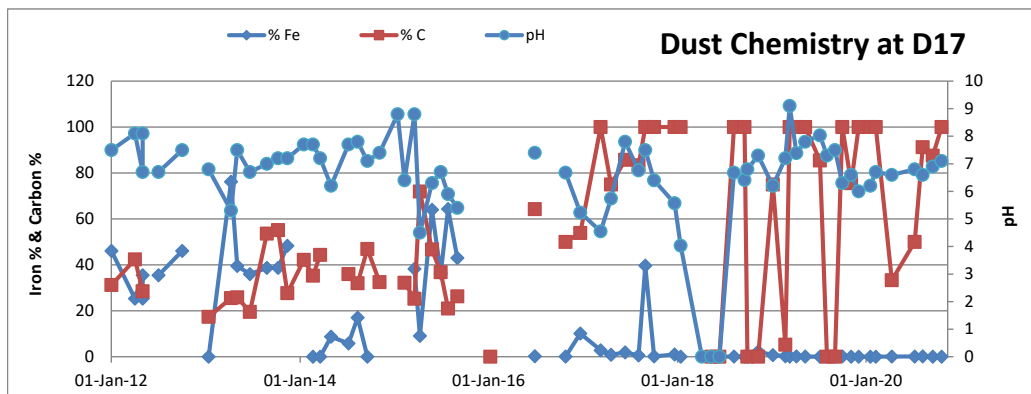
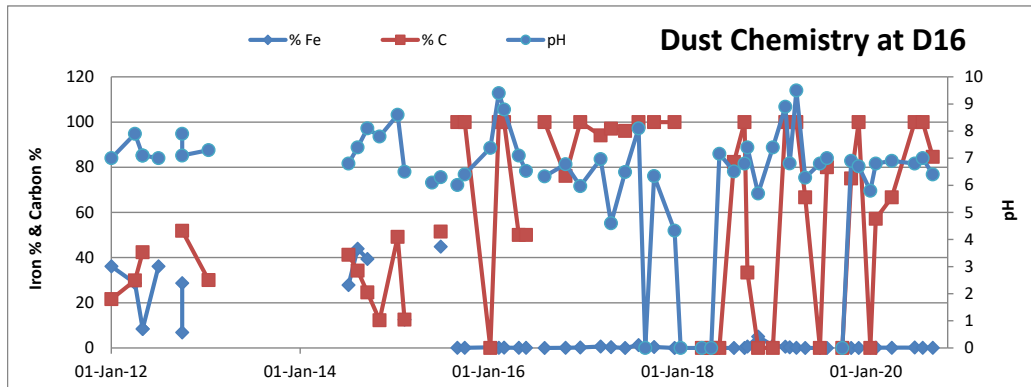
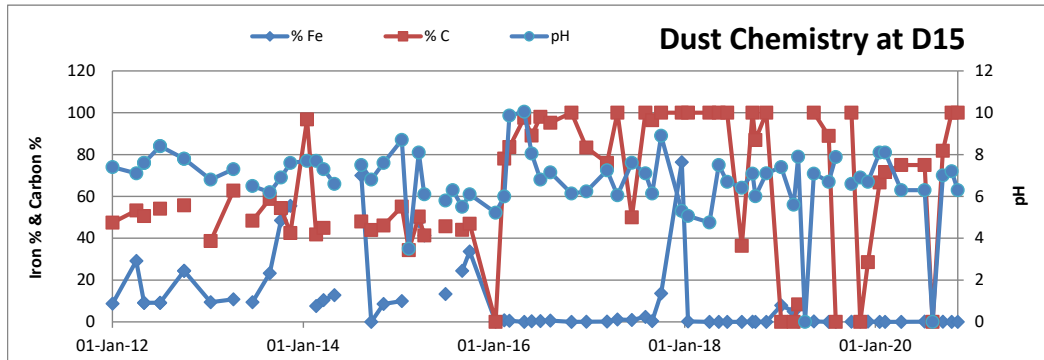
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**2020 Annual Review of
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Monitoring**

**Appendix 12
Results from Dust
Monitoring Gauges**

Report Number 2092r1v1d0221







GEO
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