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The Royal Mint

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THE ROYAL MINT,
LLANTRISANT
SITE PROTECTION AND
MONITORING
PROGRAMME (SPMP)
GROUNDWATER
MONITORING ROUND
XV

THE ROYAL MINT, LLANTRISANT
SITE PROTECTION AND MONITORING PROGRAMME
(SPMP) GROUNDWATER MONITORING ROUND XV

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1. INTRODUCTION

Ramboll Environment and Health UK Limited (Ramboll) was commissioned by The Royal Mint (the Client), to design a Site Protection and Monitoring Programme (SPMP) in order to collect reference data for an IPPC Permit No. VP3539SL (the "permit").

The first phase report of the SPMP was submitted to the Environment Agency (EA) in April 2006 following an intrusive ground investigation carried out in March 2006. The objectives of the environmental monitoring programme are to monitor the effectiveness of infrastructure and management procedures and provide a warning of loss of containment. The results of the monitoring programme will assist during the permit surrender process by determining the movement of pollutants both within and on/off the site; and will provide information on long term trends.

In accordance with the Design SPMP (Ref: 63C8777, October 2005) groundwater monitoring is to be carried out annually; however, an increased frequency of monitoring may be necessary to facilitate identifying the source and extent of any pollution.

The first round of monitoring was carried out subsequent to the intrusive investigation (initial sampling) in March 2006 and the laboratory results ('Reference Data') are tabulated within the first phase report. Groundwater monitoring has been carried out annually thereafter and this report details the results of the fifteenth round of monitoring carried out on 3rd September 2019. The results have been compared with the Reference Data and are presented graphically in order to identify trends in groundwater contaminant concentrations over the monitoring period to date.

This report has been written by Ramboll on behalf of The Royal Mint and is to be submitted to Natural Resources Wales (NRW) in pursuance of Condition 4.1.7 of the Permit.

2. SCOPE OF WORK

During the 2019 SPMP Groundwater Monitoring (Round XV) samples were recovered from eight monitoring wells: BH001, BH002, BH003, BH201, BH801, BH901R (replacement to BH901), BHNP2 and CBH6. BH26 was also intended to be included; however, it was not possible to obtain a sample due to the presence of a cathode/ electrode which has been installed in the well as part of Celtic's ongoing electrokinetic remediation of persistent elevated metals in groundwater at this location. Each well was purged prior to the groundwater sample being obtained. The monitoring well locations are shown on Figure 1 in Appendix 1.

The groundwater samples were analysed for metals (As, Cd, Cr, Cu, Pb, Ni, Hg, Se, Zn, B), pH, total cyanide, sulphate, sulphide, alkalinity, volatile organic compounds (VOC) and Total Petroleum Hydrocarbons (TPH).

For screening purposes, reference has been made to appropriate UK water quality guidelines. Environmental Quality Standards (EQS) were used on the basis that the principal Controlled Waters receptor for the site is the Nant Mychydd River, for which the freshwater EQS is most applicable.

In the absence of an EQS under the Water Framework Directive (WFD), we have referred to the former EQS under the Dangerous Substances Directive and where EQS are not available, the UK Drinking Water Standards (UK DWS).

From 2013 to 2017, SPMP groundwater sampling comprised monitoring eleven SPMP boreholes in accordance with the Design SPMP that was updated by Ramboll in August 2013. In 2017, Ramboll recommended that two of the monitoring wells (BHE5 and BHE6) be removed from future rounds of SPMP groundwater monitoring. The overall approach was agreed with Natural Resources Wales (NRW) in a November 2017 Compliance Assessment Report (Ref: CAR_NRW0032431).

3. GROUNDWATER ANALYSIS RESULTS

A full set of laboratory certificates and a summary table of the ongoing groundwater monitoring results are presented in Appendix 2 and Appendix 3 respectively, and the main findings are summarised below. Graphs are presented showing concentrations recorded over time for selected determinands that have been detected above the laboratory limit of detection.

Ramboll has only discussed the results of analysis where the concentrations were detected above the laboratory limit of detection.

The site has been divided into zones according to their potential for pollution as described in the Design SPMP (Ref. 63C8777).

3.1 ZONE 0: Non-Target Zone

3.1.1 Perimeter Boreholes

Three boreholes (BH001, BH002 and BH003) are located outside the target zones. Both BH001 and BH002 are located in an up-hydraulic gradient location on site (i.e. to the north); and BH003 is located down-hydraulic gradient (to the south).

pH Values

The pH values of groundwater from boreholes BH001, BH002 and BH003 were within the EQS range (pH 6 to pH 9) during the most recent round of monitoring.



Metals

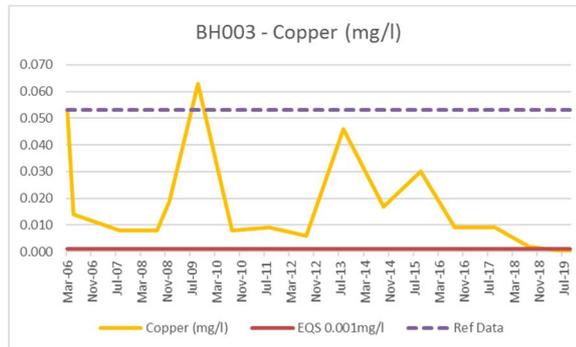
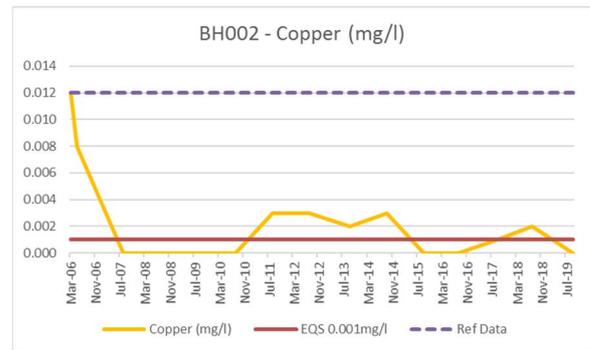
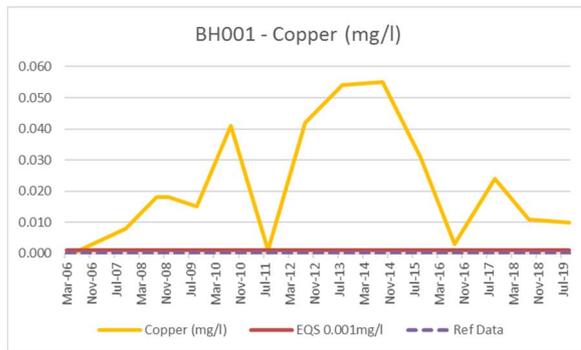
Boron was detected in BH003 only, at a concentration of 0.033mg/l; which is similar to, and slightly above, the reference data of 0.019mg/l; however, the concentration does not exceed the EQS of 2mg/l.

Cadmium was detected in BH003 at a concentration of 0.0011mg/l; for the purpose of screening, any recorded concentration above the laboratory LOD is considered to exceed the EQS of 0.00008mg/l. Cadmium was not detected in any of the perimeter boreholes during reference data

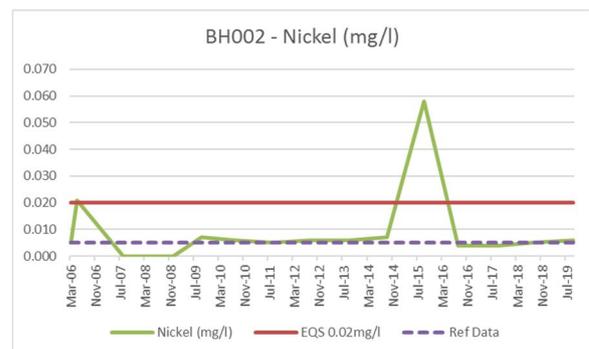
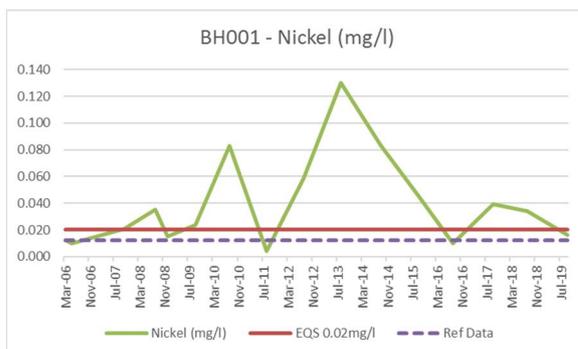
collection; however, it has been detected in low concentrations in BH003 for the last ten rounds of annual monitoring.

Chromium was not detected above the laboratory LOD of 0.015mg/l in any of the perimeter boreholes.

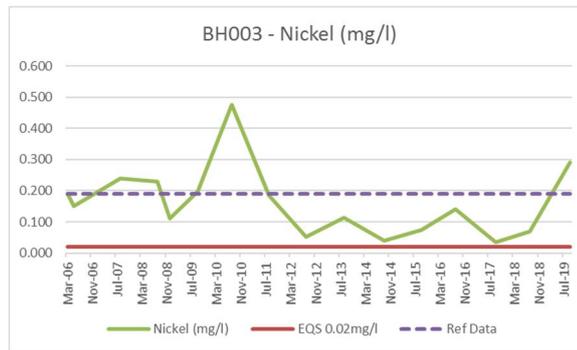
Copper was only detected above the laboratory LOD in perimeter borehole BH001 (0.010mg/l). Recorded concentrations have remained similar to, or slightly decreased since the previous monitoring round; however, they continue to exceed the EQS values of 0.006mg/l. The reference data concentration in borehole BH001 was below the laboratory LOD; therefore, the most recent recorded concentration is slightly greater than the reference data. Recent recorded concentrations in boreholes BH002 and BH003 are slightly less than their respective reference data.



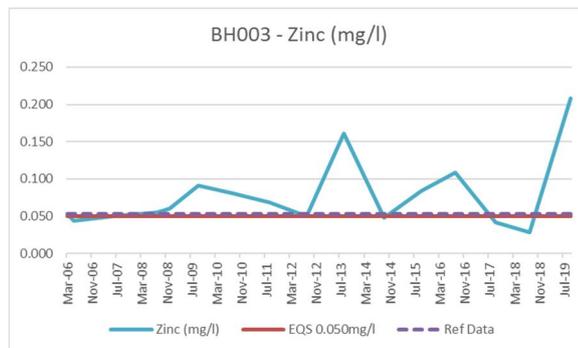
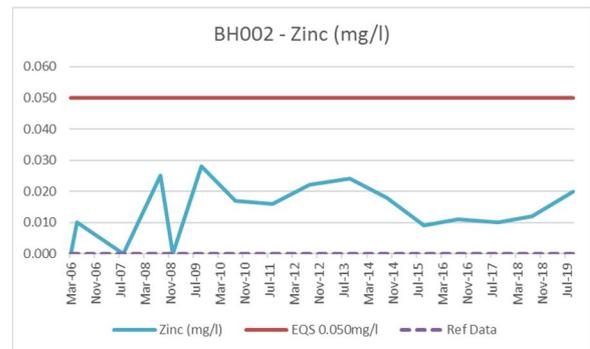
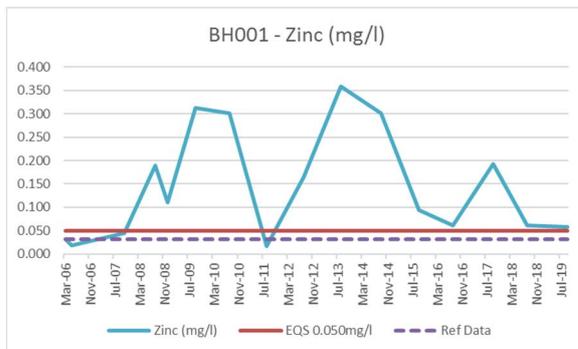
Historically, the concentration of nickel in borehole BH001 has regularly exceeded the EQS; the most recent recorded concentration (0.016mg/l) exceeds reference data, but not the EQS of 0.02mg/l. Nickel was recorded at a concentration slightly exceeding the reference data, and below the EQS in borehole BH002 (0.006mg/l). Nickel was recorded at a concentration above the EQS value of 0.02mg/l in down-hydraulic gradient borehole BH003 (0.292mg/l), which is typical of previous recorded concentrations at this location.



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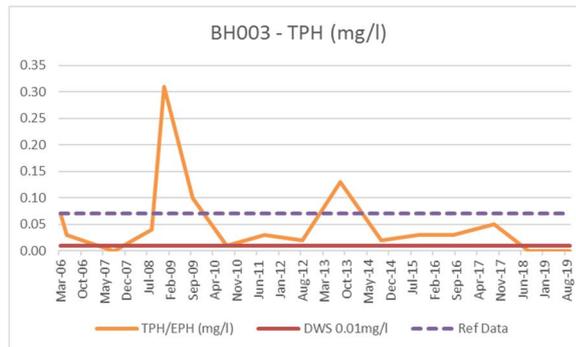
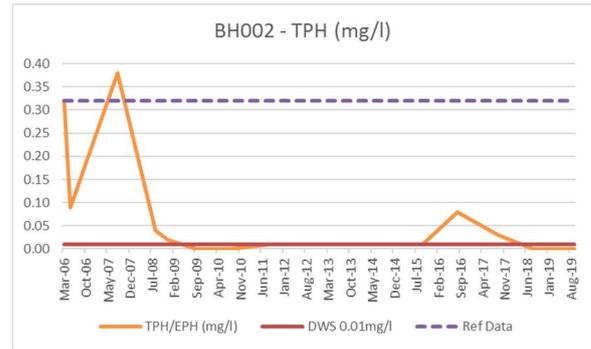
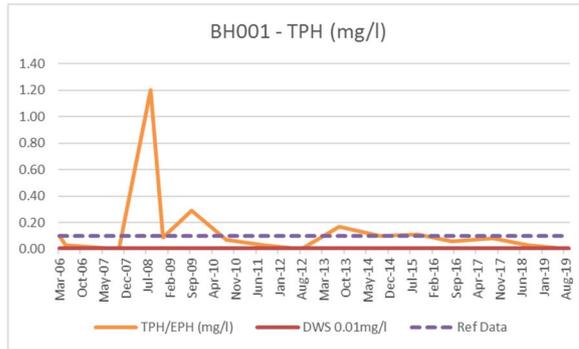
Zinc was detected in BH001 (0.058mg/l), BH002 (0.020mg/l) and BH003 (0.208mg/l); the concentration in BH002 exceeds the EQS value of 0.008mg/l. The concentrations of zinc in BH001 and BH003 also exceed the greater EQS of 0.05mg/l, due to a higher value for water hardness. The concentration of zinc detected in BH003 is the highest recorded at this location since SPMP groundwater monitoring began.



Hydrocarbons

Total Petroleum Hydrocarbons (TPH) was not detected above the laboratory LOD in any of the perimeter boreholes; and therefore, are below the screening value of 0.01mg/l. In each case, the most recent recorded values are below the reference data and within the range of previously recorded values at each location.

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VOCs

A Trace concentration of the VOC 1,1,1-Trichloroethane (TCA) ($5\mu\text{g/l}$) was detected in groundwater from borehole BH003 only, which is consistent with previous rounds of monitoring. The EQS value for 1,1,1-trichloroethane is $100\mu\text{g/l}$. Trichloroethene (TCE) has also previously been detected in this monitoring well; however, on this occasion TCE was below the laboratory LOD ($<5\mu\text{g/l}$).

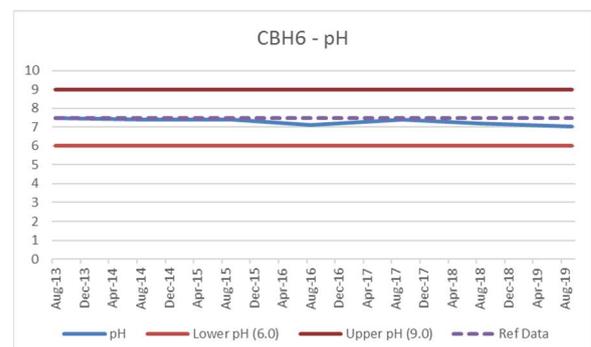
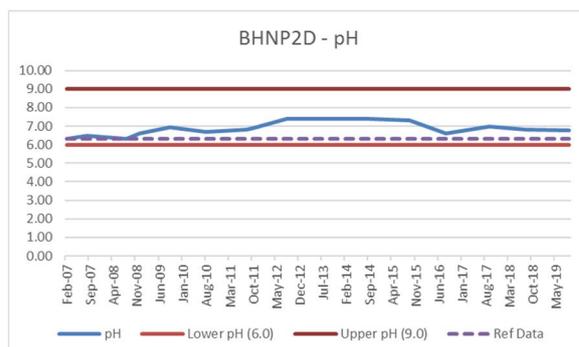
3.1.2 Additional Perimeter Monitoring Wells

Two additional perimeter monitoring wells have been included in the SPMP in order to monitor the effectiveness of groundwater remediation (for VOCs) carried out in the south-east of the site by Celtic Technologies Limited ('Celtic') between 2011 and 2013 (Celtic Report Ref: R1430/12/4003).

The additional wells (BHNP2 and CBH6) are positioned between Zone 8 and the River Nant Mychydd. BHNP2 comprises dual monitoring wells, shallow and deep; this monitoring location has been included in the SPMP since its installation in 2007. It should be noted that only the deep well is monitored under the SPMP (BHNP2D). Borehole CBH6 was installed by Celtic and has been included in the SPMP since 2013.

pH Values

The pH values in this area were within the EQS range (pH 6 to pH 9) during the most recent round of monitoring and are broadly consistent with previous rounds of monitoring.

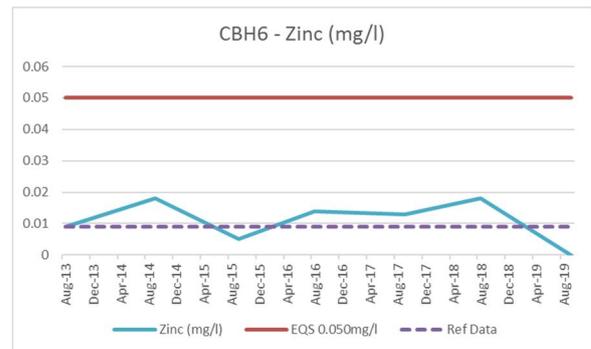
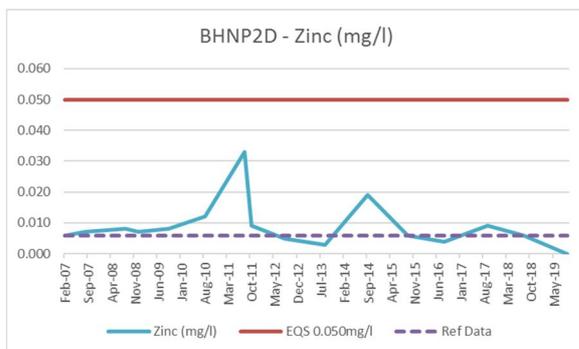
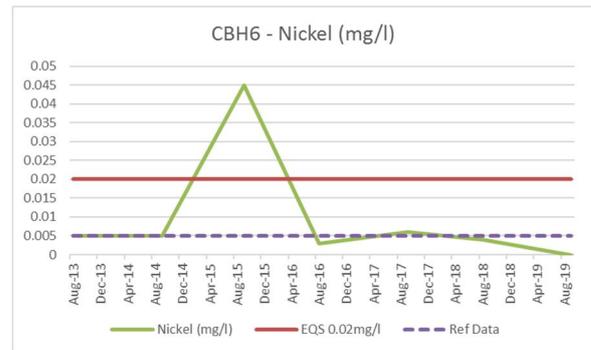
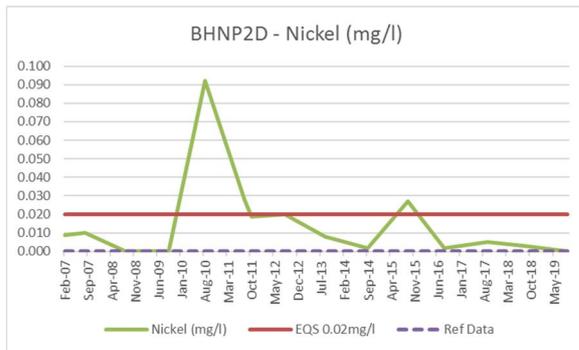
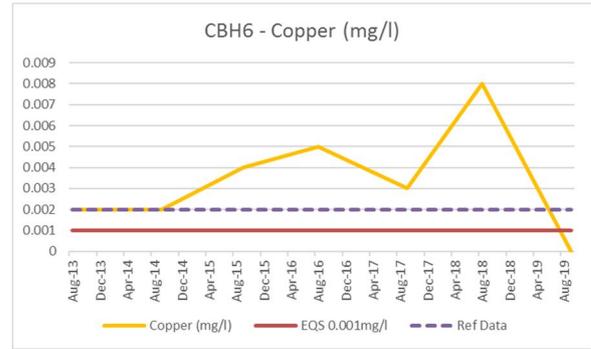
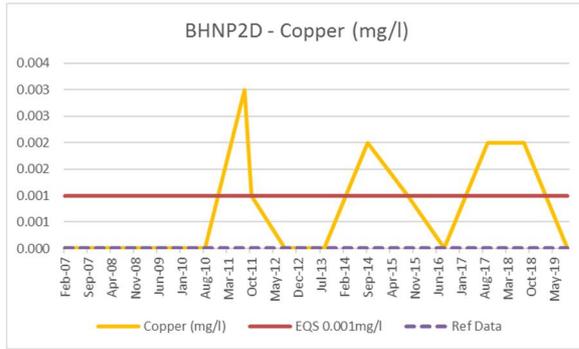


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Metals

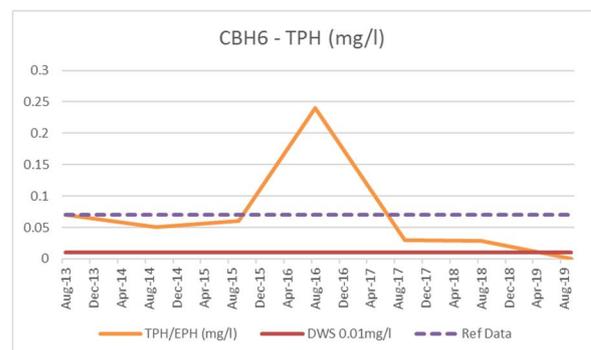
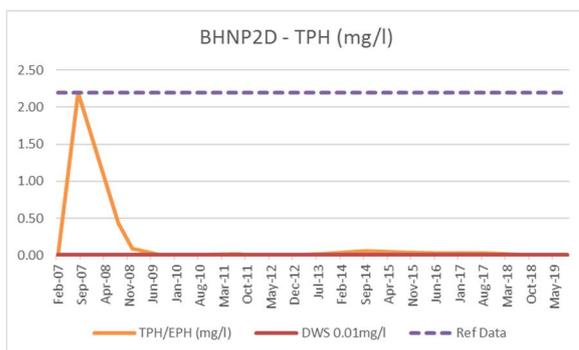
Boron was detected in both BHNP2D (0.023mg/l) and CBH6 (0.019mg/l); which is below reference data for borehole BHNP2D (0.072mg/l), and greater than the reference data for CBH6 (<0.005mg/l). Concentrations do not exceed the EQS of 2mg/l.

Copper, nickel and zinc were not detected above the laboratory LOD in the two boreholes in this area.



Hydrocarbons

Total Petroleum Hydrocarbons (TPH) was not detected above the laboratory LOD in either of the two boreholes in this area; and therefore, remains below the screening value of 0.01mg/l.



VOCs

Remediation was carried out in this area by Celtic between 2011 and 2013 and boreholes BHNP2D, CBH6, BHE5 and BHE6 were added to the SPMP between 2013 and 2017 as a requirement of NRW to verify the success of the remediation scheme. Only BHNP2D and CBH6 have been monitored since 2018.

The following compounds were detected in BHNP2D: vinyl chloride (1.1µg/l); 1,1 dichloroethane (9µg/l); 1,1,1-trichloroethane (12µg/l); and trichloroethene (4µg/l).

The following VOCs were detected in CBH6: vinyl chloride (1.4µg/l); 1,1-Dichloroethane (4µg/l); cis 1,2-dichloroethene (6µg/l); 1,1,1-trichloroethane (24µg/l); trichloroethene (16µg/l); and tetrachloroethene (8µg/l).

Overall, the VOC concentrations in borehole BHNP2D have decreased compared to the previous round of monitoring. The concentrations in borehole CBH6 have slightly increased; however, are all below the respective Controlled Waters screening criteria, where available.

Site specific remedial targets were developed by Celtic for the following VOC compounds as follows:

- 1,1,1-trichloroethane: 341µg/l;
- 1,1-dichloroethene: 10.1µg/l;
- trichloroethene: 34.4µg/l; and
- tetrachloroethene: 38.5µg/l.

None of the most recent recorded concentrations exceed the remedial targets.

3.2 ZONE 1: Non-Ferrous Melting and Casting Activities

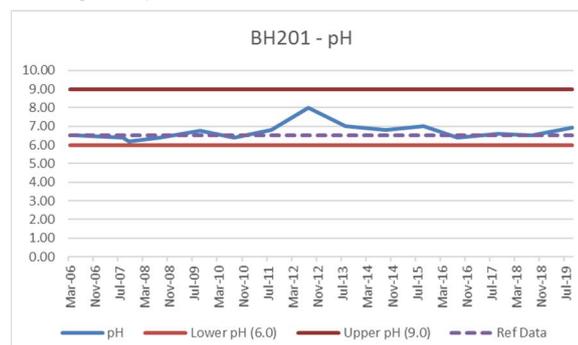
Zone 1 is located in the north-west section of the site and includes the MRB (Melting, Rolling and Blanking) building. There is one monitoring well in the area, BH101 located up-gradient of the MRB (i.e. to the north). Based on the previous stable or decreasing concentrations of determinands in this monitoring well, BH101 has not been included in the SPMP monitoring programme since August 2012. This decision was made following a review of the SPMP monitoring programme undertaken to address Action 1 of the Compliance Assessment Report (CAR) (Ref: KP3135KV/0184470) issued by NRW.

3.3 ZONE 2: Effluent and Cooling Sumps

Zone 2 is located in the centre of the site between the MRB building (to the north) and the Ancillary Services building (to the south). There is one monitoring well in this area, BH201 located immediately south east of the underground soluble oil chamber (Chamber 19C).

pH Value

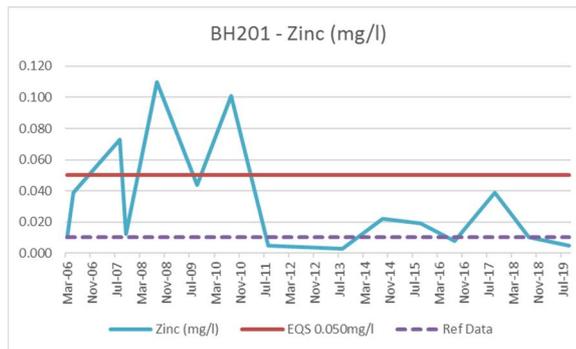
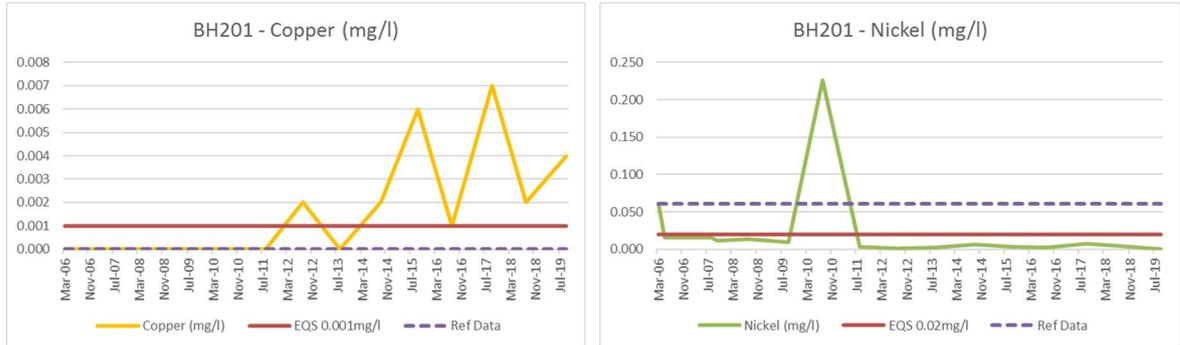
The pH value recorded in BH201 was pH 6.91, slightly greater than the reference data at this location and within the EQS range of pH values.



Metals

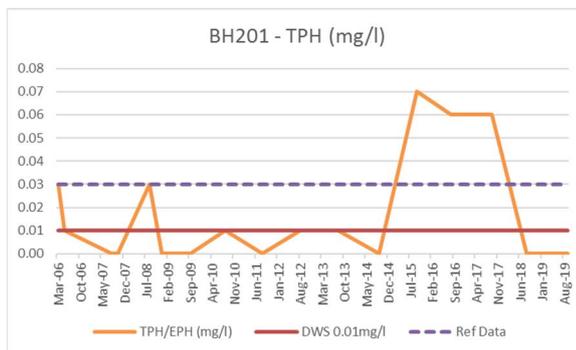
Copper was recorded at a concentration of 0.004mg/l, which is a slight increase in concentration compared to the previous round of monitoring (0.002mg/l) and does not exceed the EQS of 0.006mg/l. However, the recorded concentration slightly exceeds the reference data, which was below the laboratory LOD.

The concentration of zinc was recorded at 0.005mg/l, which has decreased since the previous round of monitoring; this remains below the EQS value of 0.05mg/l for total alkalinity as CaCO₃ of 50mg/l to 100mg/l. The most recent recorded concentration is less than the reference data (0.010mg/l).



Hydrocarbons

TPH was not detected above the laboratory LOD on this occasion.



VOCs

The VOC 1,1,1-Trichloroethane was detected at a concentration of 3µg/l on this occasion. 1,1,1-Trichloroethane is regularly detected at low concentrations at this location. The recorded concentration is greater than the reference data, which was below the laboratory LOD, but does not exceed the Controlled Waters screening criteria of 100µg/l.

3.4 ZONE 7: Effluent Treatment Plant

Zone 7 is located in the COMAH area to the west of Zone 8 and comprises the former effluent treatment plant (ETP) that was decommissioned in 2012. The two monitoring wells in this area

(BH701 and WS701) have been removed from the SPMP monitoring programme based on stable or decreasing concentrations of determinands and the decommissioning of the ETP. This decision was made following a review of the SPMP monitoring programme undertaken to address Action 1 of the CAR (Ref: KP3135KV/0184470) issued by NRW.

3.5 ZONE 8: COMAH Area

Zone 8 is located in the north-east section of the site and comprises three copper plating buildings, two nickel plating buildings, a chemical store, a coin store and a services area for acid storage and dilution. There were originally two monitoring wells located in Zone 8 (BH801 and BH802). BH801 is located to the east of Copper Plating 2 (CP2); and BH802 was formerly located immediately south of Nickel Plating 1 (NP1). BH802 was decommissioned in 2010 due to the construction of a new Waste Water Recycling Plant (WWRP).

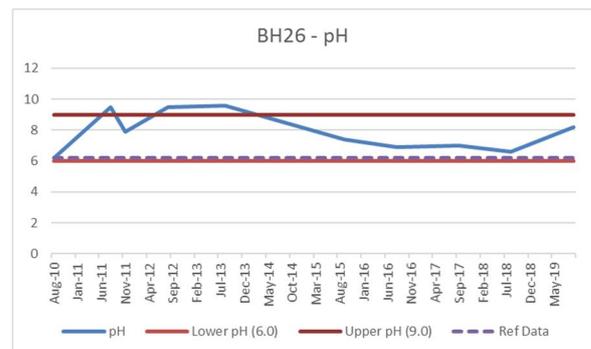
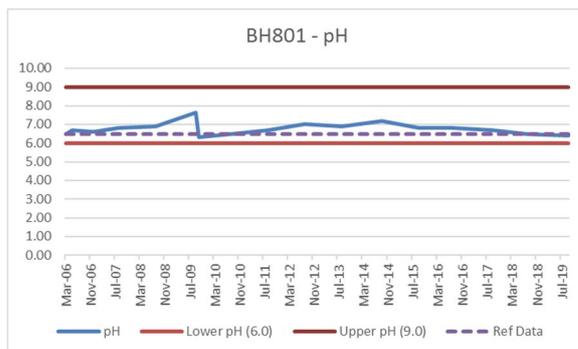
BH26 has replaced BH802 as an SPMP monitoring well which is located approximately 11m distant (to the east). Both BH802 and BH26 have previously recorded significantly elevated concentrations of nickel. The source is considered likely to be a historical spillage that occurred in the east of the NP1 building. The building has been decommissioned but the structure remains in place. Residual contamination may be present beneath the ground slab of the building in soil and groundwater. Nickel contamination in groundwater has been addressed by Celtic in this area by a 'pump and treat' system which commenced in 2012 (Celtic Report Ref: R1430/12/4003).

More recently, Celtic has piloted electrolysis using steel rods to remove the nickel content. Ramboll understands that a significant reduction in concentrations has been achieved; however, the field trial indicated that the method is better suited to open lagoon type features rather than groundwater. The field trial results are reported in Celtic's Electrokinetic Field Trial Report (Ref: R1722/19/4953), dated July 2019. Ramboll understands that the next step in terms of remediation is likely to be source removal from beneath the footprint of the building, assuming that the area is accessible and there is adequate space for the treatment of impacted materials.

Due to the presence of a cathode/electrode that has been installed in borehole BH26 as part of Celtic's ongoing electrokinetic remediation activities in this area of the site, it was not possible to obtain a sample from this well during the most recent round of groundwater monitoring. The pH and concentration of nickel in a sample collected by Celtic on 6th September 2019 has been provided, and is discussed below.

pH Value

The pH of groundwater in borehole BH801 was pH 6.38, which is slightly lower than the reference data and within the EQS range of pH values. The pH in BH26 (as provided by Celtic) was pH 8.20, which is slightly greater than the reference data, but within the EQS range of pH values.

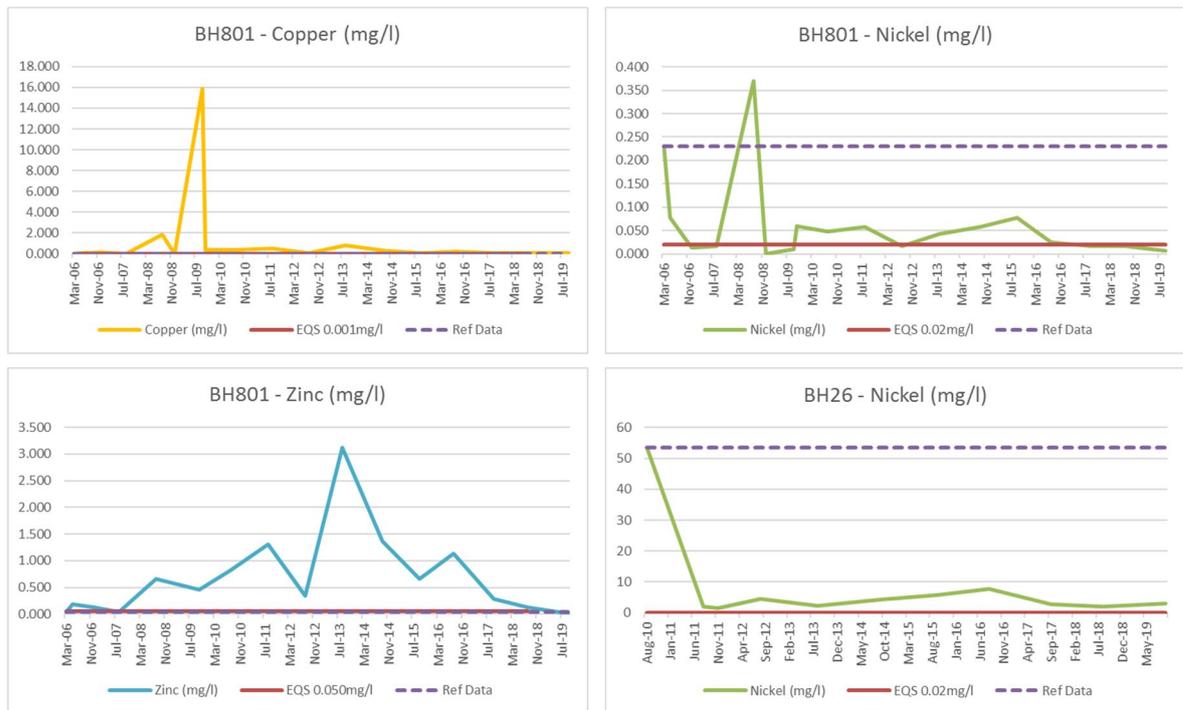


Metals

Copper was recorded at a concentration of 0.021mg/l in borehole BH801, which is within the range of previous concentrations recorded at this location. However, the concentration in borehole BH801 exceeds the relevant EQS value of 0.001mg/l.

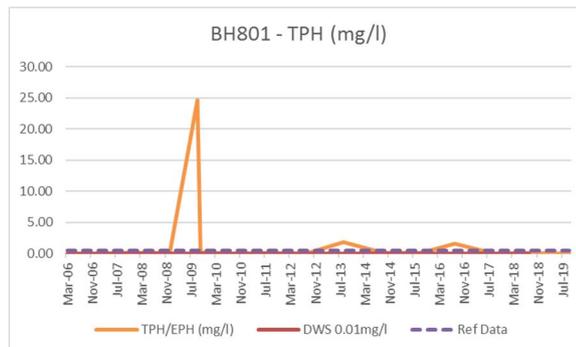
Nickel was recorded at a concentration of 0.006mg/l in borehole BH801, and a concentration of 3.000mg/l in borehole BH26 (as provided by Celtic). Both recorded concentrations are within the range of previous concentrations recorded at these locations, and below the reference data. The graph showing nickel concentrations in BH26 demonstrates an overall decreasing concentration; however, the latest concentration detected remains significantly elevated compared with the relevant EQS value of 0.02mg/l.

Zinc was recorded in borehole BH801 at a concentration of 0.016mg/l, which is the lowest recorded concentration at this location; however, it still exceeds the relevant EQS value of 0.008mg/l.



Hydrocarbons

TPH was below the laboratory LOD in borehole BH801.



3.6 ZONE 9: Pickling, Duplex Plating Line, Annealing and Burnishing

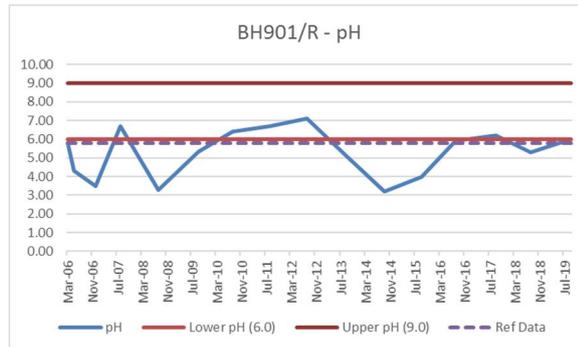
Zone 9 is located south of the COMAH area and includes the annealing, pickling and plating (AP&P) building. Historically, there has been one monitoring well in this area, BH901, located between the AP&P and the CPR (Coin Press Room). In 2015, BH901 was decommissioned and

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removed as part of engineering works to the adjacent embankment. During the engineering works, a borehole was installed in the vicinity of the former BH901; for the purposes of the ongoing groundwater monitoring at the site, this borehole is acting as a replacement for BH901 and is referred to as BH901R (BH901 Replacement).

pH Value

The pH value of the groundwater sample from borehole BH901R was pH 6.01, which is greater than the reference data and within the EQS range of pH values. Slightly reduced pH values have regularly been recorded in Zone 9 throughout the SPMP groundwater monitoring rounds.



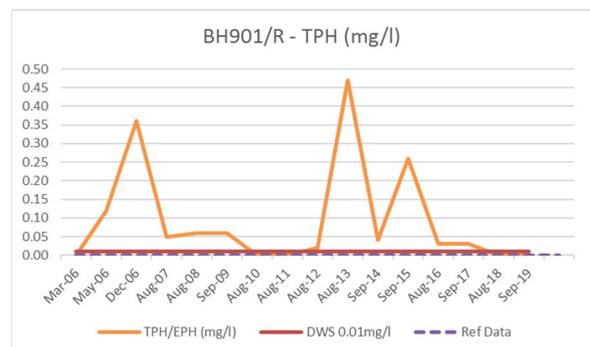
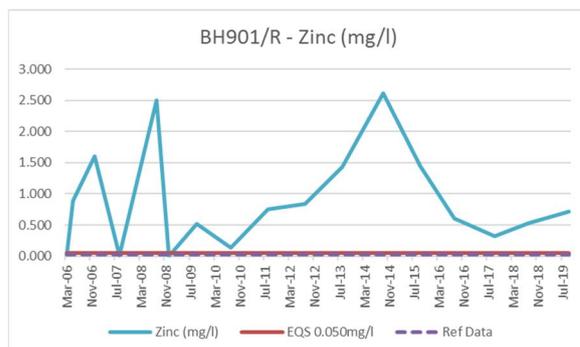
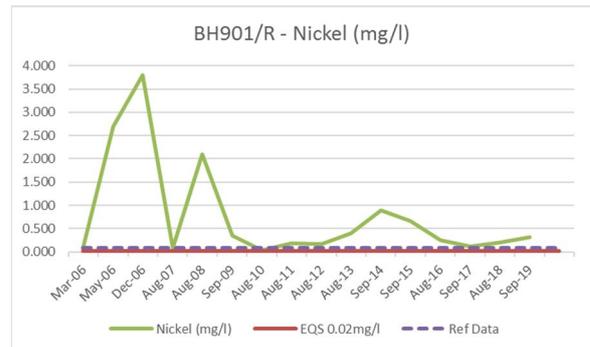
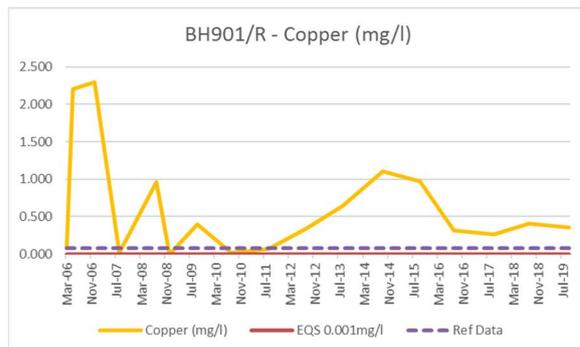
Metals

Boron was detected at a concentration of 0.091mg/l in borehole BH901R, which is typical for the range of concentrations recorded in BH901 and is below the EQS value of 2mg/l.

The concentration of copper was recorded at 0.357mg/l in BH901R, which exceeds the relevant EQS of 0.006mg/l, and is greater than the 2006 reference data collected from BH901.

Nickel was detected at a concentration of 0.315mg/l in BH901R, which exceeds the EQS value of 0.02mg/l and is typical for the range of concentrations previously recorded in BH901.

Zinc was detected at a concentration of 0.719mg/l in BH901R, which exceeds the relevant EQS value of 0.05mg/l and is typical for the range of concentrations previously recorded in BH901.



Hydrocarbons

TPH was not detected above the laboratory LOD on this occasion.

4. STATISTICAL ANALYSIS

Data from previous rounds of monitoring have been further assessed using the Mann Kendall Test, a non-parametric statistical test to detect trends in data. Mann Kendall analysis has been performed using available data from monitoring rounds undertaken from 2006 to 2019. Selected determinands that have regularly exceeded the screening values during the monitoring period have been assessed using this approach. Where sufficient data is available, the results of the statistical analysis for the main contaminants of concern are shown in Tables 4.1 and 4.2 below and are also presented for each sampling location on Figure 2.

4.1 Statistical Analysis for Metals and TPH

Table 4.1: Results of Trend Analysis for Metals and TPH in Groundwater

Borehole Location	TPH	Copper	Nickel	Zinc
BH001	No trend	Probably Increasing	No trend	No trend
BH002	Decreasing	No Trend	No Trend	No trend
BH003	No trend	Probably Decreasing	Decreasing	No trend
BHNP2D	Probably Decreasing	Probably Increasing	No Trend	Stable
BH201	No trend	Increasing	Decreasing	Probably Decreasing
BH801	No trend	No Trend	Decreasing	No trend
BH26	No trend	No Trend	No trend	No trend
BH901/BH901R	No trend	No Trend	No trend	No trend

In general, the majority of monitoring wells have demonstrated 'no trend' for the concentrations of determinands of concern, with the following exceptions:

- BH001 (Zone 0, up-hydraulic gradient) has identified a 'probably increasing' trend for concentrations of copper. Concentrations of copper, nickel and zinc have all decreased slightly during the most recent monitoring round, albeit slightly greater than the reference data. The increasing trend identified for copper in BH001 is considered likely have been influenced by elevated concentrations observed in 2013 and 2014, which were the highest recorded values at this location. Graphs show that the recent concentrations are significantly lower than the most elevated concentrations detected in 2013/ 2014.
- A 'decreasing' trend has been identified for TPH concentrations in BH002. TPH was not detected above the laboratory LOD during the most recent round of monitoring.
- BH003 showed a 'probably decreasing' trend for copper and a 'decreasing' trend for nickel. Copper was not detected during the most recent round of monitoring; however, both determinands have historically exceeded the screening values at this location.
- BHNP2D showed a 'probably decreasing' trend for TPH, a 'probably increasing' trend for copper, and a 'stable' trend for zinc. Low level fluctuations in the concentration of the metal determinands have been recorded throughout the monitoring period that remain well below the relevant EQS value. TPH was not detected above the laboratory LOD during the most recent round of monitoring.
- BH201 showed a 'decreasing' trend for nickel, a 'probably decreasing' trend for zinc, and an 'increasing' trend for copper. Metal concentrations are considered to be relatively low at this

location, with occasional marginal exceedances of the screening values. The ‘increasing’ trend identified for copper is likely to be reflective of a very slight increase in concentration over the entire monitoring period. Copper was not detected in BH201 until 2012; and, from 2012 onwards, copper was detected at low concentrations in the majority of monitoring rounds. Overall, metal concentrations are considered to be relatively low and rarely exceed the screening criteria at this location.

- A ‘decreasing’ trend was identified for nickel in BH801; the concentration of nickel in borehole BH801 has not exceeded the assessment criteria since 2016.
- Statistical analysis has not identified any trends for metal concentrations in borehole BH901/BH901R; however, concentrations of the metals copper, nickel, and zinc consistently exceed the relevant EQS values in borehole BH901 and its replacement borehole BH901R. Concentrations recorded since 2016 (in borehole BH901R) have not matched the maximum values previously recorded in borehole BH901; however, are within the range of previously recorded concentrations. The current statistical analysis ‘no trend’ is likely to have been influenced by the move from monitoring borehole BH901 to monitoring borehole BH901R; and fluctuating concentrations in recent years including elevated concentrations recorded in borehole BH901 in 2014.
- Statistical analysis has not identified any trends for metal concentrations in borehole BH26. Concentrations of nickel have been well below the reference data throughout the monitoring programme; however, recorded concentrations have fluctuated over time and continuously significantly exceed the relevant EQS values at this location. Remediation of nickel-impacted groundwater at this location is ongoing.

4.2 Statistical Analysis for VOCs

Throughout the monitoring period, VOCs have been recorded above the relevant EQS value or at trace concentrations in some locations. Mann Kendall analysis was carried out on the relevant VOC data at these locations, results of the statistical analysis for VOCs are presented in Table 4.2 below.

Table 4.2: Results of Trend Analysis for VOCs in Groundwater

Borehole Location	1,1,1-Trichloroethane	Trichloroethene	Tetrachloroethene
BH001	Not Detected	No Trend	Not Detected
BH002	Not Detected	Stable	Not Detected
BH003	No Trend	Decreasing	Not Detected
BHNP2D	No Trend	Stable	Decreasing
BH201	No Trend	Decreasing	Not Detected
BH801	Not Detected	Not Detected	Not Detected
BH26	Not Detected	Not Detected	Not Detected
BH901/BH901R	No Trend	Not Detected	Not Detected
CBH6	No Trend	No Trend	No Trend

Where VOCs have been detected above the laboratory LOD, the following trends have been identified:

- ‘Decreasing’ trends have been identified for trichloroethene in boreholes BH201 and BH003; concentrations of trichloroethene have not been recorded above the laboratory LOD at these locations since August 2007 (BH201) and December 2008 (BH003).

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- A 'decreasing' trend was identified for tetrachloroethene in borehole BHNP2D; this has remained below the laboratory LOD since 2011 at this location.
- Statistical analysis has indicated 'no trend' for the concentrations of:
 - 1,1,1-trichloroethane in BH003, BHNP2D, BH201, BH901/BH901R, and CBH6;
 - Trichloroethene in BH001, and CBH6; and
 - Tetrachloroethene in CBH6.

Concentrations of 1,1,1-trichloroethane, trichloroethene, and tetrachloroethene have fluctuated over the monitoring period; however, recent recorded concentrations are below screening criteria and specific remedial targets.

5. CONCLUSIONS

5.1 ZONE 0: Non-Target Zone

The concentrations of the metals copper and zinc in BH001 remain consistently elevated above the respective EQS values and reference data; however, for each metal, the concentrations are lower than the maximum detected over the SPMP monitoring period.

The concentrations of nickel and zinc have increased in BH003; recent recorded concentrations are among the highest recorded at this location.

The majority of metals in the perimeter boreholes in the south-east of the site (BHNP2D and CBH6) were below the laboratory LOD; and therefore, relevant EQS values.

A historical source of VOC contamination in groundwater was previously identified in the south-east of the site. The area was investigated by Ramboll, followed by remediation by Celtic. A period of post-remediation groundwater monitoring (by Celtic) indicated that one single borehole had concentrations of VOCs fluctuating around the remedial target. Accordingly, the affected borehole (BHNP2D) was added to the SPMP as recommended by NRW. Overall, concentrations of VOCs have decreased in this borehole during the most recent round of monitoring and there were no recorded exceedances of screening criteria or site specific remedial targets.

5.2 ZONE 2: Effluent and Cooling Sumps

Statistical analysis identified an 'increasing' trend for copper in borehole BH201. However, metal concentrations are relatively low and have not exceeded the relevant EQS value. Concentrations have remained relatively consistent with previous monitoring rounds at this location.

5.3 ZONE 8: COMAH Area

The concentration of nickel remains elevated in BH26. Remediation using 'pump and treat' has been ongoing at this location; however, Celtic have been conducting an electrokinetic field trial using steel electrodes to remove dissolved phase metals (primarily nickel) from groundwater since 2017. Celtic Electrokinetic Field Trial Report (Ref: R1722/17/4822), dated November 2017, concluded that the technique is potentially viable in this application as significantly reduced concentrations on nickel were recorded at the cathode monitoring well. Field trials are ongoing in the vicinity of BH26, with the latest findings reported in Celtic Electrokinetic Field Trial Report (Ref: R1722/19/4953), dated July 2019. The electrokinetic extended field trials were considered by Celtic to have been successful to date and were due to continue until September 2019. Concluding remarks in the latest available report indicate that the next step would be to increase mass removal of nickel by abstracting groundwater from monitoring wells and anode wells.

5.4 ZONE 9: Pickling, Duplex Plating Line, Annealing and Burnishing

No trends were identified for contaminant concentrations in BH901 and BH901R. Metal concentrations recorded in BH901R appear to be generally slightly lower than those previously recorded in BH901; however, concentrations of copper, nickel and zinc all exceed the relevant screening values coinciding with low pH values.

The groundwater analysis results have consistently identified elevated metal concentrations in Zone 9 (Building 9A, Annealing and Pickling). An investigation into the bund integrity within the building was recommended in 2018. A survey of the bunds was subsequently commissioned by The Royal Mint and all were found to be in good condition. NRW has received a copy of the survey report and the results were accepted according to the Compliance Assessment Report (Ref: CAR_NRW0034536), issued in January 2019.

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In a later Compliance Assessment Report (REF: CAR_NRW0034780), issued in March 2019, NRW stated that the inspected bunds were reported to be in good condition; and therefore, the source of contamination is likely to elsewhere. NRW agreed with the Royal Mint that boreholes to the north of BH8 and BH9 should be tested in the next round of monitoring to try to identify the source.

Upgradient boreholes BH16 and BH701 were added to a February 2019 monitoring round (separate to SPMP groundwater monitoring) to consider whether the upgradient boreholes are also affected; however, low pH values (<pH 6) were not recorded either of these locations. Furthermore, concentrations of the metals copper, nickel and zinc were significantly lower in the upgradient boreholes, when compared to BH8 and BH9.

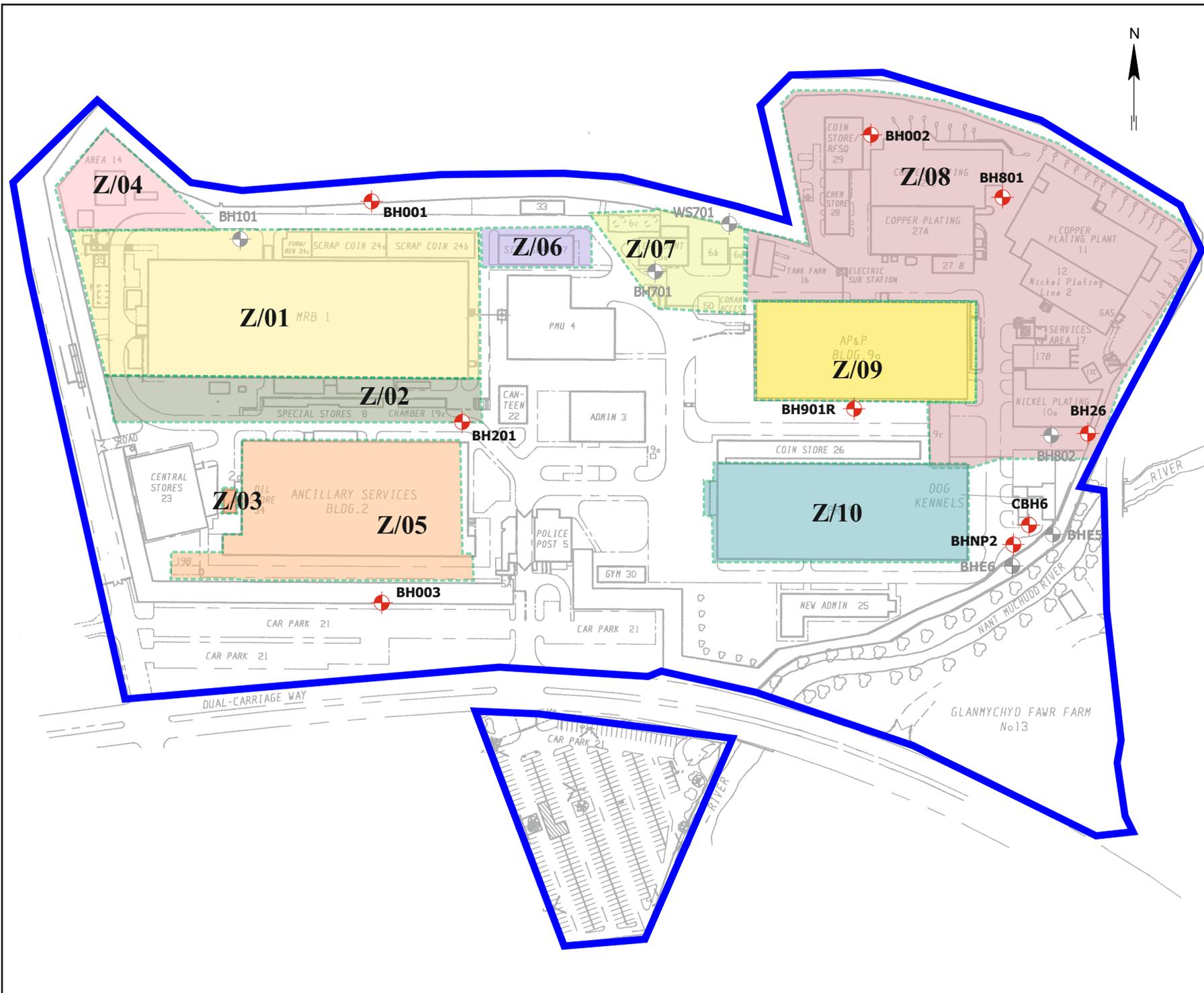
6. RECOMMENDATIONS

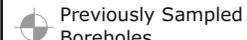
On the basis of this round of groundwater monitoring the following recommendations are made:

- Recent improvements to the drainage system and housekeeping in the north of the site have likely resulted in an overall decrease in concentrations of metals detected in up-gradient borehole, BH001. However, recent results and statistical analysis suggest that there has been a recent slight increase in concentrations of metals in this location. Mitigation measures to prevent the pathway for contaminants to groundwater and drainage systems should continue.
- The down-gradient borehole, BH003 has recorded the most elevated concentrations of nickel and zinc to date at this location. Ramboll recommends that a repeat sample is collected from this location during the November monitoring round.
- The programme of drain cleaning appears to be having a positive effect on metals detected in groundwater across the wider site and it is recommended that this programme is continued. Furthermore, below ground process pipes are progressively being diverted above-ground which should also continue. Ramboll recommends that the drainage network immediately down-gradient of the AP&P is revisited in terms of drain cleaning, and/ or diverting above ground in response to persistent elevated concentrations in BH901R (discussed further below).
- Ramboll understands that an electrokinetic remediation technique has been underway to address nickel contamination in groundwater within Zone 8 (specifically in the area of BH26). The trial ended in September 2019, and although successful, it has been concluded by Celtic that the next step would be to undertake source removal. Ramboll agrees, that if feasible for The Royal Mint, source removal would be the most effective solution to persistent elevated concentrations at this location.
- It is recommended that boreholes BHNP2D and CBH6 remain within the SPMP groundwater monitoring programme.
- As recommended in a Compliance Assessment Report (REF: CAR_NRW0034780), issued in March 2019, upgradient boreholes BH16 and BH701 were added to a February 2019 monitoring round (separate to SPMP groundwater monitoring) to further investigate the source of low pH and elevated metals in BH8 and BH9. Low pH values (<pH 6) were not recorded in either of these locations; and concentrations of the metals copper, nickel and zinc were significantly lower in the upgradient boreholes, when compared to BH8 and BH9. Given that an ongoing source has not been identified in the building (i.e. from bunds) and that up gradient boreholes are not impacted, the elevated concentrations are localised, immediately down gradient of the AP&P. Ramboll recommends that a review of the drainage network in this area is undertaken to establish whether there are any process water drains that may be leaking. If there are no potential sources from the drainage network, the elevated concentrations may be attributed to an historical source.
- Further rounds of groundwater monitoring should be carried out on an annual basis, in accordance with the Design SPMP.

The results of this SPMP groundwater monitoring occasion should be provided to the NRW in accordance with the Permit.

APPENDIX 1 FIGURES



- Key
-  Site Boundary
 -  Sampled Boreholes
 -  Previously Sampled Boreholes

Title Figure 1: Borehole Location Plan

Project No. 1620006655

Site The Royal Mint Llantrisant Pontyclun, CF72 8YT

Client The Royal Mint

Date October 2019

Scale NTS

Issue 1 Drawn by RH



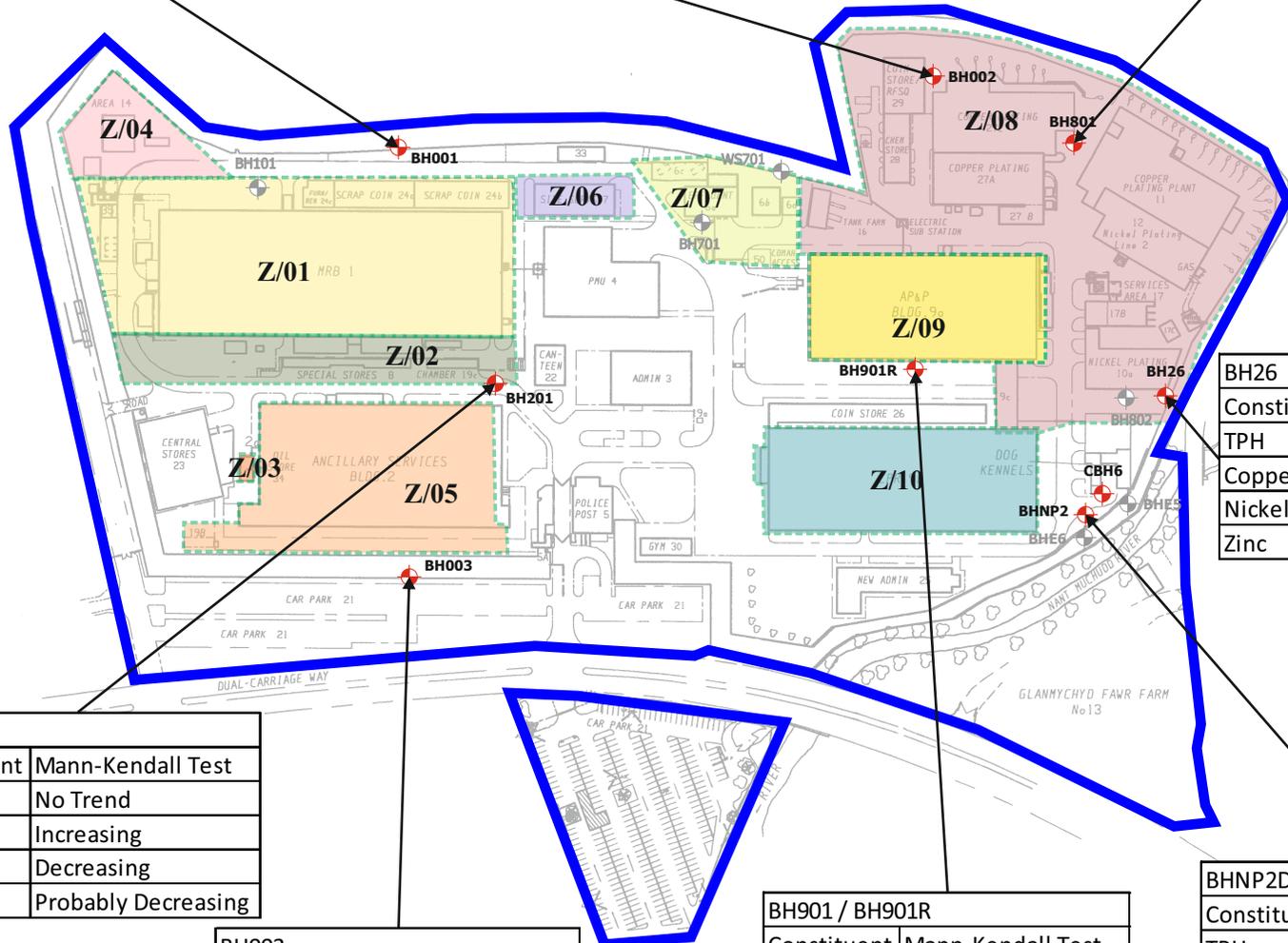
BH001	
Constituent	Mann-Kendall Test
TPH	No Trend
Copper	Probably Increasing
Nickel	No Trend
Zinc	No Trend

BH002	
Constituent	Mann-Kendall Test
TPH	Decreasing
Copper	No trend
Nickel	No trend
Zinc	No trend

BH801	
Constituent	Mann-Kendall Test
TPH	No Trend
Copper	No Trend
Nickel	Decreasing
Zinc	No Trend



- Key
- Site Boundary
 - Sampled Boreholes
 - Previously Sampled Boreholes



BH201	
Constituent	Mann-Kendall Test
TPH	No Trend
Copper	Increasing
Nickel	Decreasing
Zinc	Probably Decreasing

BH003	
Constituent	Mann-Kendall Test
TPH	No Trend
Copper	Probably Decreasing
Nickel	Decreasing
Zinc	No Trend

BH901 / BH901R	
Constituent	Mann-Kendall Test
TPH	No Trend
Copper	No Trend
Nickel	No Trend
Zinc	No Trend

BHN2D	
Constituent	Mann-Kendall Test
TPH	Probably Decreasing
Copper	Probably Increasing
Nickel	No Trend
Zinc	Stable

BH26	
Constituent	Mann-Kendall Test
TPH	No Trend
Copper	No Trend
Nickel	No Trend
Zinc	No Trend

Title Figure 2: Mann Kendall Analysis

Project No. 1620006655

Site The Royal Mint, Llantrisant, Pontyclun, CF72 8YT

Client The Royal Mint

Date October 2019

Scale NTS

Issue 1 Drawn by RH



APPENDIX 2 LABORATORY CERTIFICATES

Ramboll Environment and Health UK Ltd
8 Village Way
Green Meadow Springs
Cardiff
CF15 7NE



Attention : Rob Hodgson
Date : 24th September, 2019
Your reference : 162000665
Our reference : Test Report 19/14300 Batch 1
Location : Royal Mint SPMP 2019
Date samples received : 5th September, 2019
Status : Final report
Issue : 2

Eight samples were received for analysis on 5th September, 2019 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Simon Gomery BSc
Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Ramboll Environment and Health UK Ltd
Reference: 162000665
Location: Royal Mint SPMP 2019
Contact: Rob Hodgson
EMT Job No: 19/14300

VOC Report : Liquid

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	36-42	43-49	50-56				
Sample ID	BH001	BH002	BH003	BH201	BH801	BH901R	CBH6	BHNP2D				
Depth												
COC No / misc												
Containers	V HN N Z P G											
Sample Date	03/09/2019 10:30	03/09/2019 16:00	03/09/2019 13:00	03/09/2019 14:30	03/09/2019 15:30	03/09/2019 11:00	03/09/2019 12:00	03/09/2019 12:30				
Sample Type	Ground Water											
Batch Number	1	1	1	1	1	1	1	1				
Date of Receipt	05/09/2019	05/09/2019	05/09/2019	05/09/2019	05/09/2019	05/09/2019	05/09/2019	05/09/2019				
										LOD/LOR	Units	Method No.
VOC MS												
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.4	1.1		<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Chloroethane #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Dichloromethane (DCM) #	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	4	9		<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	6	<3		<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Bromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Chloroform #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2	5	3	<2	<2	24	12		<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	16	4		<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	8	<3		<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Bromoform #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/l	TM15/PM10
Bromobenzene #	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	95	103	87	89	94	93	93		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	104	106	107	93	96	99	100	98		<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/14300

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

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REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/14300

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes			
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060, APHA Standard Methods for Examination of Water and Wastewater 5310B, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			

EMT Job No: 19/14300

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM107	Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser	PM0	No preparation is required.				

APPENDIX 3 SUMMARY OF RESULTS

		Analysis																			
Borehole Location	Date	TPH/EPH (mg/l)	Arsenic (mg/l)	Boron (mg/l)	Cadmium (mg/l)	Chromium (mg/l)	Chromium (Hexavalent) (mg/l)	Copper (mg/l)	Lead (mg/l)	Mercury (mg/l)	Nickel (mg/l)	Potassium (mg/l)	Selenium (mg/l)	Zinc (mg/l)	Total Cyanide (mg/l)	Total Alkalinity as CaCo3 (mg/l)	Chloride (mg/l)	pH	Sulphide (mg/l)	Sulphate as SO4 (mg/l)	
ZONE 0																					
BH001	Mar-06	0.10	<0.005	<0.005	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.012	<1	<0.005	0.031	<0.03	50	21	6.50	<0.05	14	
	May-06	0.03	<0.005	0.012	<0.001	<0.005	0.010	<0.005	<0.005	<0.00005	0.010	1.7	<0.005	0.018	<0.03	<20	14	5.50	<0.05	22	
	Aug-07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
	Oct-07	<0.01	<0.005	<0.005	<0.001	<0.005	<0.010	0.008	<0.005	<0.00005	0.021	1.3	<0.005	0.045	<0.02	140	11	6.50	<0.05	18	
	Aug-08	1.20	<0.005	0.040	<0.001	<0.005	<0.010	0.018	<0.005	<0.00005	0.035	3.2	<0.005	0.190	<0.02	65	<10	6.20	<0.05	<10	
	Dec-08	0.09	<0.005	0.031	<0.001	<0.005	<0.010	0.018	<0.005	<0.00005	0.015	NA	<0.005	0.110	<0.02	88	<10	6.70	<0.05	10	
	Sep-09	0.29	<0.005	<0.018	<0.001	<0.005	<0.010	0.015	<0.005	<0.00005	0.024	NA	<0.005	0.312	<0.02	90	9	7.04	<0.05	9	
	Aug-10	0.07	0.001	0.020	<0.001	0.002	<0.010	0.041	<0.001	<0.00005	0.083	NA	<0.001	0.301	<0.02	75	6	6.80	<0.05	8	
	Aug-11	0.03	0.004	0.030	<0.001	0.002	NA	0.001	<0.001	<0.00001	0.004	NA	<0.001	0.016	<0.02	98	NA	7.10	<0.05	10	
	Aug-12	<0.01	0.003	0.010	<0.0001	<0.001	NA	0.042	<0.001	0.0001	0.059	NA	<0.001	0.165	<0.02	85	NA	7.10	<0.05	6	
	Aug-13	0.17	<0.001	<0.01	0.0002	0.001	NA	0.054	<0.001	<0.0001	0.130	NA	<0.001	0.358	0.03	88	NA	7.00	<0.05	7	
	Sep-14	0.10	<0.001	0.010	0.0002	<0.001	<0.01	0.055	<0.001	<0.0001	0.083	NA	<0.001	0.302	<0.02	72	NA	6.80	<0.05	6	
	Sep-15	0.11	0.001	0.150	<0.0001	<0.001	NA	0.031	<0.001	<0.0001	0.045	NA	<0.001	0.094	<0.02	94	NA	7.30	<0.05	7	
	Aug-16	0.06	0.008	<0.01	<0.0001	0.002	NA	0.003	<0.001	<0.0001	0.010	NA	<0.001	0.061	<0.02	101	NA	6.70	<0.02	8	
	Sep-17	0.08	0.004	<0.01	<0.0001	<0.001	<0.003	0.024	<0.001	<0.0001	0.039	NA	<0.001	0.193	<0.02	98	NA	6.90	<0.02	8	
	Aug-18	0.03	<0.001	<0.01	<0.0001	<0.001	<0.003	0.011	<0.001	<0.0001	0.034	NA	<0.001	0.062	<0.02	64	NA	6.80	<0.02	10	
	Sep-19	<0.01	<0.0025	<0.012	<0.005	<0.0015	<0.006	0.010	<0.005	<0.001	0.016	NA	<0.003	0.058	<0.01	73	NA	6.89	<0.01	7.8	
	BH002	Mar-06	0.32	<0.005	0.008	<0.001	0.005	<0.010	0.012	<0.005	<0.00005	0.005	2.2	0.013	<0.005	<0.03	250	11	7.80	<0.05	39
May-06		0.09	<0.005	0.034	<0.001	<0.005	0.010	0.008	<0.005	<0.00005	0.021	2.1	<0.005	0.010	<0.03	320	17	8.20	<0.05	42	
Aug-07		0.38	<0.005	0.015	<0.001	<0.005	<0.010	<0.005	0.015	<0.00005	<0.005	1.3	<0.005	<0.005	<0.02	92	14	6.50	<0.05	25	
Aug-08		0.04	<0.005	0.030	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	<0.005	1.6	<0.005	0.025	<0.02	63	14	6.10	<0.05	16	
Dec-08		0.02	<0.005	0.008	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	<0.005	NA	<0.005	<0.005	<0.02	<20	12	5.50	<0.05	14	
Sep-09		<0.01	<0.005	<0.018	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.007	NA	<0.005	0.028	<0.02	18	12.3	6.15	<0.05	14.9	
Aug-10		<0.01	<0.001	0.030	<0.001	0.001	<0.010	<0.001	<0.001	<0.00005	0.006	NA	<0.001	0.017	NA	18	12	6.30	<0.05	13	
Aug-11		0.01	<0.001	0.070	<0.001	0.002	NA	0.003	<0.001	<0.0001	0.005	NA	<0.001	0.016	<0.02	19	NA	5.90	<0.05	13	
Aug-12		0.01	<0.001	0.020	<0.0001	0.002	NA	0.003	0.001	<0.0001	0.006	NA	<0.001	0.022	<0.02	36		7.70	<0.05	13	
Sep-13		0.01	<0.001	<0.01	0.0001	<0.001	NA	0.002	<0.001	<0.0001	0.006	NA	<0.001	0.024	<0.02	53	NA	7.10	<0.05	15	
Sep-14		0.01	<0.001	0.010	<0.0001	<0.001	<0.01	0.003	<0.001	<0.0001	0.007	NA	<0.001	0.018	<0.02	32	NA	6.30	<0.05	12	
Sep-15		0.01	<0.001	<0.01	0.0002	0.013	NA	<0.001	<0.001	<0.0001	0.058	NA	<0.001	0.009	<0.02	30	NA	6.30	<0.05	12	
Aug-16		0.08	<0.001	<0.01	<0.0001	<0.001	NA	<0.001	<0.001	<0.0001	0.004	NA	<0.001	0.011	<0.02	43	NA	6.00	<0.02	12.2	
Sep-17		0.03	<0.001	<0.01	<0.0001	<0.001	<0.003	0.001	<0.001	<0.0001	0.004	NA	<0.001	0.010	<0.02	49	NA	6.20	<0.02	13	
Aug-18		<0.01	<0.001	<0.01	<0.0001	<0.001	<0.003	0.002	<0.001	<0.0001	0.005	NA	<0.001	0.012	<0.02	22	NA	5.90	<0.02	12	
Sep-19		<0.01	<0.0025	<0.012	<0.005	<0.0015	<0.006	<0.003	<0.005	<0.001	0.006	NA	<0.003	0.020	<0.01	45	NA	6.57	<0.01	12.2	
BH003		Mar-06	0.07	<0.005	0.019	<0.001	0.009	<0.010	0.053	<0.005	<0.00005	0.190	5.2	<0.005	0.053	<0.03	30	19	6.00	<0.05	55
		May-06	0.03	<0.005	0.026	<0.001	<0.005	0.010	0.014	<0.005	<0.00005	0.150	5.1	<0.005	0.044	<0.03	25	21	6.10	<0.05	57
	Aug-07	<0.01	<0.005	0.032	<0.001	<0.005	<0.010	0.008	<0.005	<0.00005	0.240	6.1	<0.005	0.051	<0.02	38	29	6.00	<0.05	140	
	Aug-08	0.04	<0.005	0.029	<0.001	<0.005	<0.010	0.008	<0.005	<0.00005	0.230	6.1	<0.005	0.055	0.02	50	19	6.00	<0.05	81	
	Dec-08	0.31	<0.005	0.019	<0.001	<0.005	<0.010	0.019	<0.005	<0.00005	0.110	NA	<0.005	0.060	<0.02	32	12	6.00	<0.05	49	
	Sep-09	0.10	<0.005	<0.018	<0.001	<0.005	<0.010	0.063	<0.005	<0.00005	0.198	NA	<0.005	0.091	<0.02	32	21	6.47	<0.05	88.2	
	Aug-10	0.01	<0.001	0.040	0.0008	0.002	<0.010	0.008	<0.001	<0.00005	0.477	NA	<0.001	0.081	<0.02	22	35	5.90	<0.05	219	
	Aug-11	0.03	<0.001	0.020	0.0004	0.003	NA	0.009	<0.001	<0.0001	0.184	NA	<0.001	0.069	<0.02	37	NA	6.20	<0.05	171	
	Aug-12	0.02	<0.001	0.040	0.0001	0.002	NA	0.006	<0.001	<0.0001	0.051	NA	<0.001	0.050	<0.02	99	NA	8.00	<0.05	35	
	Aug-13	0.13	<0.001	<0.01	0.0004	0.002	NA	0.046	<0.001	<0.0001	0.113	NA	<0.001	0.161	<0.02	64	NA	6.50	<0.05	46	
	Sep-14	0.02	<0.001	0.030	0.0001	0.002	<0.01	0.017	<0.001	<0.0001	0.040	NA	<0.001	0.048	<0.02	35	NA	6.80	<0.05	46	
	Sep-15	0.03	<0.001	0.020	0.0002	0.001	NA	0.030	<0.001	<0.0001	0.073	NA	<0.001	0.084	<0.02	33	NA	6.20	<0.05	39	
	Aug-16	0.03	<0.001	<0.01	0.0004	0.002	NA	0.009	<0.001	<0.0001	0.141	NA	<0.001	0.109	<0.02	88	NA	5.80	<0.02	37.6	
	Sep-17	0.05	<0.001	<0.01	0.0001	0.002	<0.003	0.009	<0.001	<0.0001	0.035	NA	<0.001	0.042	<0.02	71	NA	6.30	<0.02	26	
	Aug-18	<0.01	<0.001	0.020	0.0002	0.002	<0.003	0.002	<0.001	<0.0001	0.070	NA	<0.001	0.028	<0.02	27	NA	6.10	<0.02	56	
	Sep-19	<0.01	<0.0025	0.033	0.0011	<0.0015	<0.006	<0.003	<0.005	<0.001	0.292	NA	<0.003	0.208	<0.01	78	NA	6.49	<0.01	51.5	
	Screening Value		0.01(2)	0.05(1)	2 (1)	0.00008(1)	0.0047(1)	0.0034 (1)	0.001-0.028* (1)	0.0072 (1)	0.00005(1)	0.02 (1)	NG	0.01(2)	0.008 - 0.125* (1)	0.05(2)	NG	250(3)	6-9 (1)	NG	400(2)

		Analysis																			
Borehole Location	Date	TPH/EPH (mg/l)	Arsenic (mg/l)	Boron (mg/l)	Cadmium (mg/l)	Chromium (mg/l)	Chromium (Hexavalent) (mg/l)	Copper (mg/l)	Lead (mg/l)	Mercury (mg/l)	Nickel (mg/l)	Potassium (mg/l)	Selenium (mg/l)	Zinc (mg/l)	Total Cyanide (mg/l)	Total Alkalinity as CaCo3 (mg/l)	Chloride (mg/l)	pH	Sulphide (mg/l)	Sulphate as SO4 (mg/l)	
BHP2D	Feb-07	NA	<0.005	0.072	<0.001	<0.005	<0.005	<0.005	<0.005	<0.00005	0.009	NA	<0.005	0.006	NA	NA	NA	6.30	NA	NA	39
	Aug-07	2.20	<0.005	0.066	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.010	2.6	<0.005	0.007	<0.02	68	19	6.50	<0.05	46	
	Aug-08	0.43	<0.005	0.036	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	<0.005	2.6	<0.005	0.008	<0.02	66	12	6.30	<0.05	21	
	Dec-08	0.09	<0.005	0.049	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	<0.005	NA	NA	0.007	<0.02	71	<10	6.60	<0.05	19	
	Sep-09	<0.01	<0.005	<0.018	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	<0.005	NA	<0.005	0.008	<0.02	70	13.3	6.92	<0.05	17.7	
	Aug-10	0.01	<0.001	0.11	<0.001	0.002	<0.010	<0.001	<0.001	<0.00005	0.092	NA	<0.001	0.012	<0.02	66	15	6.7	<0.05	28	
	Aug-11	0.02	<0.001	0.09	0.0002	0.002	NA	0.003	<0.001	<0.0001	0.028	NA	<0.001	0.033	<0.02	77	NA	6.8	<0.05	37	
	Oct-11	NA	<0.001	NA	0.0002	0.002	NA	0.001	<0.001	0.0001	0.019	NA	<0.001	0.009	NA	67	NA	6.9	NA	NA	
	Aug-12	<0.01	<0.001	0.08	<0.0001	<0.001	NA	<0.001	<0.001	<0.0001	0.02	NA	<0.001	0.005	<0.02	73	NA	7.4	<0.05	14	
	Aug-13	0.02	<0.001	<0.01	<0.0001	0.001	NA	<0.001	<0.001	<0.0001	0.008	NA	<0.001	0.003	0.02	82	NA	7.4	<0.05	13	
	Sep-14	0.06	<0.001	<0.01	0.0002	0.001	<0.01	0.002	<0.001	<0.0001	0.002	NA	<0.001	0.019	<0.02	68	NA	7.4	<0.05	15	
	Sep-15	0.04	<0.001	<0.01	0.0003	0.006	NA	0.001	<0.001	0.0002	0.027	NA	0.001	0.006	<0.02	75	NA	7.3	<0.05	11	
	Aug-16	0.03	<0.001	0.05	<0.0001	<0.001	NA	<0.001	<0.001	<0.0001	0.002	NA	<0.001	0.004	<0.02	80	NA	6.6	<0.02	13	
	Sep-17	0.03	<0.001	<0.01	<0.0001	<0.001	<0.003	0.002	<0.001	<0.0001	0.005	NA	<0.001	0.009	<0.02	70	NA	7	<0.02	11	
	Aug-18	0.01	<0.001	0.02	<0.0001	<0.001	<0.003	0.002	<0.001	<0.0001	0.003	NA	<0.001	0.006	<0.02	50	NA	6.8	<0.02	18	
	Sep-19	<0.01	<0.0025	0.023	<0.005	<0.0015	<0.006	<0.003	<0.005	<0.001	<0.002	NA	<0.003	<0.003	<0.01	72	NA	6.79	<0.01	12.5	
	BHE5	Aug-13	0.32	<0.001	<0.01	<0.0001	0.001	NA	0.001	<0.001	<0.0001	0.001	NA	<0.001	<0.002	<0.02	110	NA	7.5	<0.05	14
		Sep-14	0.32	<0.001	<0.01	0.0001	<0.001	<0.01	<0.001	<0.001	<0.0001	<0.001	NA	<0.001	0.003	<0.02	78	NA	7.4	<0.05	14
		Sep-15	0.16	<0.001	<0.01	0.0002	0.018	NA	0.001	<0.001	<0.0001	0.075	NA	<0.001	0.003	<0.02	88	NA	7.4	<0.05	10
Aug-16		0.07	<0.001	<0.01	<0.0001	<0.001	NA	<0.001	<0.001	<0.0001	<0.001	NA	<0.001	0.002	<0.02	86	NA	7	<0.02	12	
Sep-17		0.18	0.001	<0.01	<0.0001	<0.001	<0.003	0.002	<0.001	<0.0001	0.002	NA	<0.001	0.004	<0.02	93	NA	7	<0.02	10	
BHE6	Aug-13	0.02	<0.001	<0.01	0.0001	<0.001	NA	0.001	<0.001	<0.0001	0.004	NA	<0.001	0.006	<0.02	105	NA	7.1	<0.05	14	
	Sep-14	0.13	<0.001	<0.01	<0.0001	<0.001	<0.01	<0.001	<0.001	<0.0001	0.002	NA	<0.001	0.005	<0.02	72	NA	7.3	0.08	15	
	Sep-15	0.22	<0.001	<0.01	0.0003	0.012	NA	<0.001	<0.001	<0.0001	0.052	NA	<0.001	0.006	<0.02	94	NA	7.1	<0.05	10	
	Aug-16	0.05	<0.001	<0.01	<0.0001	<0.001	NA	<0.001	<0.001	<0.0001	0.001	NA	<0.001	0.007	<0.02	78	NA	6.7	<0.02	9.7	
	Sep-17	0.04	0.001	<0.01	<0.0001	<0.001	<0.003	<0.001	<0.001	<0.0001	0.004	NA	<0.001	0.008	<0.02	83	NA	6.9	<0.02	10	
CBH6	Aug-13	0.07	<0.001	<0.01	<0.0001	0.001	NA	0.002	<0.001	<0.0001	0.005	NA	<0.001	0.009	<0.02	82	NA	7.5	<0.05	13	
	Sep-14	0.05	<0.001	<0.01	<0.0001	<0.001	<0.01	0.002	<0.001	<0.0001	0.005	NA	<0.001	0.018	<0.02	80	NA	7.4	<0.05	11	
	Sep-15	0.06	<0.001	<0.01	0.0002	0.011	NA	0.004	<0.001	0.0001	0.045	NA	<0.001	0.005	<0.02	66	NA	7.4	0.15	8	
	Aug-16	0.24	<0.001	<0.01	<0.0001	<0.001	NA	0.005	<0.001	<0.0001	0.003	NA	<0.001	0.014	<0.02	77	NA	7.1	<0.02	10.5	
	Sep-17	0.03	<0.001	<0.01	0.0002	<0.001	<0.003	0.003	<0.001	<0.0001	0.006	NA	<0.001	0.013	<0.02	78	NA	7.4	<0.02	10	
	Aug-18	0.028	<0.001	0.02	<0.0001	<0.001	<0.003	0.008	<0.001	<0.0001	0.004	NA	<0.001	0.018	<0.02	66	NA	7.2	0.06	17	
Sep-19	<0.01	<0.0025	0.019	<0.005	<0.0015	<0.006	<0.003	<0.005	<0.001	<0.002	NA	<0.003	<0.003	<0.01	70	NA	7.04	<0.01	11.7		
ZONE 2																					
BH201	Mar-06	0.03	<0.005	<0.005	<0.001	0.008	<0.010	<0.005	<0.005	<0.00005	0.061	5.9	<0.005	0.010	<0.03	75	15	6.50	<0.05	41	
	May-06	0.01	<0.005	0.011	<0.001	<0.005	0.010	<0.005	<0.005	<0.00005	0.016	4.1	<0.005	0.039	<0.03	70	14	6.50	<0.05	24	
	Aug-07	<0.01	0.056	0.016	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.016	6.3	<0.005	0.073	<0.02	59	21	6.40	<0.05	38	
	Oct-07	NA	<0.005	0.006	<0.001	<0.005	NA	<0.005	<0.005	<0.00005	0.011	NA	NA	0.012	NA	NA	NA	6.20	NA	20	
	Aug-08	0.03	<0.005	0.014	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.014	4.2	<0.005	0.110	<0.02	85	15	6.40	<0.05	15	
	Dec-08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Sep-09	<0.01	<0.005	<0.018	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.009	NA	<0.005	0.044	<0.02	110	12	6.75	<0.05	13.3	
	Aug-10	0.01	<0.001	0.03	0.0006	<0.005	<0.010	<0.005	<0.001	<0.00005	0.226	NA	<0.001	0.101	<0.02	50	33	6.4	<0.05	238	
	Aug-11	<0.01	<0.001	0.03	<0.0001	0.002	NA	<0.001	<0.001	<0.0001	0.003	NA	<0.001	0.005	<0.02	62	NA	6.8	<0.05	10	
	Aug-12	0.01	0.017	0.03	<0.0001	<0.001	NA	0.002	<0.001	<0.0001	0.001	NA	<0.001	0.004	<0.02	46	NA	8	<0.05	17	
	Aug-13	0.01	<0.001	<0.01	<0.0001	0.001	NA	<0.001	<0.001	<0.0001	0.002	NA	<0.001	0.003	<0.02	110	NA	7	<0.05	6	
	Sep-14	<0.01	<0.001	0.02	<0.0001	<0.001	<0.01	0.002	<0.001	<0.0001	0.006	NA	<0.001	0.022	<0.02	68	NA	6.8	<0.05	8	
	Sep-15	0.07	<0.001	<0.01	<0.0001	<0.001	NA	0.006	<0.001	<0.0001	0.003	NA	<0.001	0.019	<0.02	51	NA	7	<0.05	10	
	Aug-16	0.06	0.001	<0.01	<0.0001	<0.001	NA	0.001	<0.001	<0.0001	0.002	NA	<0.001	0.008	<0.02	65	NA	6.4	<0.02	7.7	
	Sep-17	0.06	0.001	<0.01	<0.0001	<0.001	<0.003	0.007	<0.001	<0.0001	0.007	NA	<0.001	0.039	<0.02	73	NA	6.6	<0.02	8	
Aug-18	< 0.010	<0.001	0.01	<0.0001	<0.001	<0.003	0.002	<0.001	<0.0001	0.004	NA	<0.001	0.010	<0.02	76	NA	6.5	<0.02	6		
Sep-19	<0.01	<0.0025	<0.012	<0.005	<0.0015	<0.006	0.004	<0.005	<0.001	<0.002	NA	<0.003	0.005	<0.01	68	NA	6.91	<0.01	6.1		
Screening Value		0.01(2)	0.05(1)	2 (1)	0.00008(1)	0.0047(1)	0.0034 (1)	0.001-0.028* (1)	0.0072 (1)	0.00005(1)	0.02 (1)	NG	0.01(2)	0.008 - 0.125* (1)	0.001(1)	NG	250(3)	6-9 (1)	NG	400(2)	

Analysis																					
Borehole Location	Date	TPH/EPH (mg/l)	Arsenic (mg/l)	Boron (mg/l)	Cadmium (mg/l)	Chromium (mg/l)	Chromium (Hexavalent) (mg/l)	Copper (mg/l)	Lead (mg/l)	Mercury (mg/l)	Nickel (mg/l)	Potassium (mg/l)	Selenium (mg/l)	Zinc (mg/l)	Total Cyanide (mg/l)	Total Alkalinity as CaCo3 (mg/l)	Chloride (mg/l)	pH	Sulphide (mg/l)	Sulphate as SO4 (mg/l)	
ZONE 8																					
BH801	Mar-06	0.47	<0.005	<0.005	<0.001	<0.005	<0.010	<0.005	<0.005	<0.00005	0.230	4.5	<0.005	0.042	<0.03	120	22	6.50	<0.05	21	
	May-06	0.04	<0.005	0.050	<0.001	<0.005	0.010	0.017	<0.005	<0.00005	0.077	5.8	<0.005	0.180	<0.03	85	33	6.70	<0.05	17	
	Dec-06	<0.01	<0.005	0.006	<0.001	<0.005	<0.010	0.140	<0.005	<0.00005	0.014	3.5	<0.005	0.130	0.05	76	<10	6.60	<0.05	<10	
	Aug-07	0.07	<0.005	0.006	<0.001	<0.005	<0.010	<0.005	<0.00005	0.017	2.5	<0.005	0.047	<0.02	59	15	6.80	<0.05	<10		
	Aug-08	0.09	<0.005	0.021	<0.001	<0.005	<0.010	1.800	<0.005	<0.00005	0.370	9.6	<0.005	0.660	1.9	120	24	6.90	<0.05	15	
	Dec-08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Sep-09	24.70	<0.005	<0.018	<0.001	0.005	<0.010	15.900	<0.005	<0.00005	0.010	NA	<0.005	0.467	6.49	235	36	7.63	<0.05	33.7	
	Oct-09	0.28	<0.001	0.030	<0.001	0.002	NA	0.362	<0.001	0.0002	0.060	NA	<0.001	0.464	0.75	88	NA	6.30	NA	<3	
	Aug-10	0.03	<0.001	0.030	<0.001	0.001	<0.010	0.369	<0.001	<0.00005	0.048	NA	<0.001	0.819	0.16	68	12	6.50	<0.05	6	
	Aug-11	0.12	<0.001	0.020	0.0002	0.002	NA	0.482	<0.001	<0.0001	0.058	NA	<0.001	1.312	0.58	80	NA	6.70	<0.05	6	
	Aug-12	0.01	<0.001	0.010	<0.0001	<0.001	NA	0.066	<0.001	<0.0001	0.017	NA	<0.001	0.347	0.85	72	NA	7.00	<0.05	4	
	Aug-13	1.87	<0.001	<0.01	0.0002	0.002	NA	0.767	<0.001	<0.0001	0.043	NA	<0.001	3.119	0.5	100	NA	6.90	<0.05	5	
	Sep-14	0.10	<0.001	0.040	0.0002	<0.001	0.030	0.302	<0.001	<0.0001	0.057	NA	<0.001	1.370	0.4	79	NA	7.20	<0.05	4	
	Sep-15	0.11	<0.001	<0.01	0.0002	0.014	NA	0.086	<0.001	<0.0001	0.078	NA	<0.001	0.659	<0.02	67	NA	6.80	<0.05	<3	
	Aug-16	1.64	<0.001	<0.01	0.0002	<0.001	NA	0.163	<0.001	<0.0001	0.025	NA	<0.001	1.137	0.19	46	NA	6.80	<0.02	3.4	
	Sep-17	0.05	<0.001	<0.01	0.0002	<0.001	<0.003	0.027	<0.001	<0.0001	0.016	NA	<0.001	0.286	<0.02	54	NA	6.70	<0.02	5	
	Aug-18	0.14	<0.001	<0.01	<0.0001	<0.001	<0.003	0.024	<0.001	<0.0001	0.017	NA	<0.001	0.125	0.03	48	NA	6.50	<0.02	4	
	Sep-19	<0.01	<0.0025	<0.012	<0.005	<0.0015	<0.006	0.021	<0.005	<0.001	0.006	NA	<0.003	0.016	<0.01	44	NA	6.38	<0.01	3.2	
	BH26	Aug-10	0.3	0.006	4.71	0.0009	0.003	NA	<0.001	<0.001	<0.0001	53.59	NA	0.002	0.014	NA	NA	NA	6.2	NA	698
Aug-11		0.15	0.081	3.38	<0.001	0.013	NA	0.051	<0.01	<0.001	1.923	NA	<0.01	0.022	<0.02	49	NA	9.5	<0.05	722	
Nov-11		NA	0.053	NA	<0.0001	0.008	NA	0.002	<0.001	<0.0001	1.503	NA	0.007	<0.002	NA	485	NA	7.9	NA	NA	
Aug-12		1.16	0.076	3	0.0007	0.001	NA	0.021	0.001	<0.0001	4.622	NA	0.008	0.019	<0.02	768	NA	9.5	<0.05	444	
Aug-13		0.02	0.084	3.54	0.0008	0.002	NA	0.036	0.005	<0.0001	2.348	NA	0.004	0.031	<0.02	1490	NA	9.6	<0.05	450	
Sep-14		0.06	0.016	1.88	0.0001	0.002	<0.01	0.002	<0.001	<0.0001	4.207	NA	0.002	0.005	<0.02	590	NA	7.5	<0.05	183	
Sep-15		0.28	0.019	1.95	0.0002	0.02	NA	0.001	<0.001	<0.0001	5.741	NA	0.001	0.003	<0.02	291	NA	7.4	<0.05	335	
Aug-16		0.29	0.01	1.3	0.0003	<0.001	NA	<0.001	<0.001	<0.0001	7.878	NA	<0.001	0.009	<0.02	102	NA	6.9	<0.02	223	
Sep-17		0.08	<0.001	1.03	0.0012	<0.001	<0.003	<0.001	<0.001	<0.0001	2.75	NA	<0.001	0.005	<0.02	71	NA	7	<0.02	73	
Aug-18		0.786	<0.001	0.43	0.0174	<0.001	<0.003	0.003	<0.001	<0.0001	2.146	NA	<0.001	0.053	<0.02	93	NA	6.6	0.02	30	
Sep-19	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	NA	NA	NA	NA	NA	NA	NA	8.2	NA	NA	
ZONE 9																					
BH901	Mar-06	<0.01	<0.005	<0.005	<0.001	0.008	<0.010	0.074	<0.005	<0.00005	0.076	4.4	<0.005	0.031	<0.03	<20	460	5.80	<0.05	110	
	May-06	0.12	<0.005	0.032	0.002	<0.005	0.010	2.200	<0.005	<0.00005	2.700	16.0	<0.005	0.890	0.03	<20	13	4.30	<0.05	18	
	Dec-06	0.36	<0.005	0.140	0.005	0.006	<0.010	2.300	<0.005	<0.00005	3.800	25.0	<0.005	1.600	<0.02	<20	63	3.50	<0.05	950	
	Aug-07	0.05	<0.005	0.031	<0.001	<0.005	<0.010	0.013	<0.005	<0.00005	0.090	6.1	<0.005	0.018	<0.02	62	33	6.70	<0.05	210	
	Aug-08	0.06	<0.005	0.060	0.003	<0.005	<0.010	0.960	<0.005	<0.00005	2.100	17.0	<0.005	2.500	<0.02	<20	25	3.30	<0.05	490	
	Dec-08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Sep-09	0.06	<0.005	<0.018	<0.001	<0.005	<0.010	0.401	<0.005	<0.00005	0.342	NA	<0.005	0.522	<0.02	6.5	22	5.36	<0.05	128	
	Aug-10	<0.01	<0.001	0.030	<0.001	0.001	<0.010	0.019	<0.001	<0.00005	0.035	NA	<0.005	0.142	<0.02	41	21	6.40	<0.05	47	
	Aug-11	<0.01	<0.001	0.030	0.0003	<0.001	NA	0.067	<0.001	<0.0001	0.185	NA	<0.001	0.749	<0.02	11	NA	6.70	<0.05	73	
	Aug-12	0.02	<0.001	0.030	0.0006	<0.001	NA	0.330	0.001	<0.0001	0.171	NA	<0.001	0.838	<0.02	3	NA	7.10	<0.05	70	
	Aug-13	0.47	<0.001	0.030	0.0014	<0.001	NA	0.642	0.001	<0.0001	0.390	NA	<0.001	1.427	<0.02	0	NA	5.20	<0.05	143	
	Sep-14	0.04	<0.001	0.020	0.0037	0.001	<0.01	1.102	0.002	<0.0001	0.886	NA	<0.001	2.609	<0.02	<2	NA	3.20	<0.05	180	
	Sep-15	0.26	<0.001	0.160	0.001	<0.001	NA	0.970	<0.001	<0.0001	0.656	NA	<0.001	1.438	<0.02	<2	NA	4.00	<0.05	138	
	BH901R	Aug-16	0.03	<0.001	0.040	0.0006	<0.001	NA	0.313	<0.001	<0.0001	0.249	NA	<0.001	0.600	<0.02	89	NA	5.90	<0.02	104
		Sep-17	0.03	<0.001	0.010	0.0003	<0.001	<0.003	0.262	<0.001	<0.0001	0.121	NA	<0.001	0.317	<0.02	64	NA	6.20	<0.02	51
Aug-18		<0.010	<0.001	0.060	0.0005	<0.001	<0.003	0.408	<0.001	<0.0001	0.199	NA	<0.001	0.532	<0.02	13	NA	5.30	0.06	71	
Sep-19		<0.01	<0.0025	0.091	<0.005	<0.0015	<0.006	0.357	<0.005	<0.001	0.315	NA	<0.003	0.719	<0.01	125	NA	6.01	<0.01	100.7	
Screening Value		0.01(2)	0.05(1)	2 (1)	0.00008(1)	0.0047(1)	0.0034 (1)	0.001-0.028* (1)	0.0072 (1)	0.00005(1)	0.02 (1)	NG	0.01(2)	0.008 - 0.125* (1)	0.001(1)	NG	250(3)	6-9 (1)	NG	400(2)	

The red cells indicate elevated concentrations compared with the screening values

NA= Not Analysed

NS= Not Sampled

NG= No Guidance

MI = Matrix Interference

(1) = European Environmental Quality Standard (EQS): The River Basin Districts Typology, Standards and Groundwater threshold Values (Water Framework Directive (England and Wales) Directions 2010

(2) = Water Supply (Water Quality) (England and Wales) Regulations 2000 (SI 2000/3184) (as amended); Water Supply (Water Quality) (Wales) Regulations 2001 (SI 3911 W.323) (as amended)

* = Range determined by alkalinity

(3) = Environment Agency Non-Statutory Operational EQS