Site Protection and Monitoring Programme

2017 Groundwater Monitoring Report

Cabot Carbon Ltd

Project number: 60560304

15 March 2018

Quality information

Prepared by	Checked by	Approved by
		
Joshua Lewis Environmental Consultant	James Cochrane Project Manager	Geoff Jones Technical Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:

Cabot Carbon Ltd

Prepared by:

Joshua Lewis
Environmental Consultant
T: 02920 674 715
E: joshua.lewis02@aecom.com

AECOM Infrastructure & Environment UK Limited
1 Callaghan Square
Cardiff CF10 5BT
United Kingdom

T: +44 29 2067 4600
aecom.com

Table of Contents

1. Introduction

Cabot Carbon Ltd (Cabot) holds a Pollution Prevention Control (PPC) Permit (reference BU21101S) for its Barry, South Wales facility. There is a requirement within this permit to collect groundwater data on an annual basis. The requirements are specified by the Design Site Protection and Monitoring Programme (SPMP) document (reference R0862/44382657rev2). The permit is administered by the Natural Resources Wales (NRW).

AECOM Infrastructure & Environment UK Limited (AECOM) understands that during 2009 Cabot negotiated with the NRW to reduce the monitoring requirements to a full suite of analysis once every two years with no analysis required in intervening years. However, following correspondence with the NRW (forwarded to URS (now AECOM)), a reduced scope (comprising BH110 and BH108 only) was completed in 2009 and a full monitoring round was completed in 2010.

During the 2009 monitoring, elevated concentrations of chloride, alkalinity and certain metals were observed in BH110. Further monitoring was completed and reduced concentrations were observed during sampling completed in 2010. A full SPMP round was not required in 2011 and the works completed during 2011 were therefore concentrated on those wells located in the vicinity of BH110. A full SPMP monitoring round was required for 2012 and was reported in March 2013.

The next round of sampling was due in quarter four of 2014 but was delayed pending review of the SPMP in light of the new Industrial Emissions Directive (IED) requirements. This review had been completed by AECOM (formerly URS) on behalf of Cabot and identified the potential to reduce the frequency of groundwater sampling as follows:

- Reduction of the frequency of groundwater sampling from every 2 to every 5 years. It was proposed that the following rounds are scheduled:
  - A full round to be undertaken in late 2017 of all wells and analytes.
  - To introduce the 5 year programme for all wells and analytes following the 2017 round.

The changes under IED include:

- The requirement for periodic monitoring of groundwater and soil is determined based on a systematic appraisal of the risk of contamination of soil or groundwater from relevant hazardous substances arising during the lifetime of the installation. Should no significant risk exist, then periodic monitoring is not required;
- A revised list of “relevant hazardous substances” (RHS);
- Specific minimum frequencies for soil (10 years) and groundwater sampling (5 years) where potential contamination risk exists.
- An assumption of a ‘zero contamination’ baseline for the site where baseline site condition data on specific substances has not been provided.

More detail is included in the SPMP review – AECOM report reference 47072112 dated 15th January 2015.

A full groundwater monitoring round was undertaken by AECOM on behalf of Cabot Carbon on the 14th and 15th of December 2017. This report represents completion of the scope of works as outlined in AECOM’s proposal OPP-492734, dated November 2017.

1.1 Background

Results obtained during the November 2009 SPMP monitoring detected elevated concentrations of chloride, alkalinity and certain metals in the sample collected from BH110. Further monitoring was completed in January 2010 with samples taken from BH110, the surrounding wells (BH6, BH8, BH105, and BH108) and the Katalco effluent pipe. Similarities in the field results for temperature and conductivity from BH110 and the Katalco effluent were observed. The similarities observed in the field measurements were corroborated by the laboratory analytical results where elevated pH, chloride, alkalinity and certain metals were detected in both samples. Metals results were observed to be significantly lower in the January 2010 samples than the November 2009 samples; the reason for this reduction has not been identified.

The similarities in results from BH110 and the Katalco effluent pipe appeared to confirm the suspicion of a leak from the pipe that outfalls from the Katalco into the acid pit. It is understood that Cabot completed excavation

works around that pipe, with repair undertaken of a minor leak at joint between an overflow pipe and the Katalco waste water pipe. The process line was later re-routed to above ground and within a bunded area.

URS completed further monitoring of BH110 in August 2010 with the laboratory results indicating a decreasing trend for alkalinity, chloride and chromium since the initial elevated concentrations were detected in November 2009. URS letter reports detailing the monitoring completed in relation to BH110[1] [2] [3] have been provided to Cabot who is understood to have passed them to the NRW.

A full SPMP monitoring round was completed in November 2010 with results reported to Cabot in March 2011[4]. Following review of the SPMP report by NRW, Cabot was asked to review the possibility of residual contamination associated with Katalco leak, and review the need for remediation. URS compiled a letter report[5] which Cabot are understood to have incorporated into their response letter to the NRW.

The 2011 monitoring was concentrated on those wells in the vicinity of BH110. Concentrations of chloride, alkalinity, chromium and pH were observed to be following a decreasing trend in the samples from BH110 since the leak was identified in 2009[6].

The 2012 groundwater monitoring round was carried out alongside intrusive works to replace SPMP boreholes BH5 and BH11. BH5 was covered by a new plant process since the 2010 SPMP. BH11 could not be located during the November 2010 sampling round. The area had been regraded with gravel and it is thought that the well has been buried. BH5a was installed to the north-west as close as practicably possible to the original location. BH11A was installed in close proximity to the original well to provide a monitoring location to the east of the 'swimming pool'.

The 2012 monitoring observed a continuation of alkalinity, chromium and chloride decreasing in in samples collected from BH110. The results of the investigation were reported to Cabot in March 2013[7].

1.2 Objectives

Discussion of the selection, justification and design for each sample location with respect to individual zones of the site is provided in the first phase monitoring report (URS report reference 44358976/R896/Rev1/LS/PT dated 29 September 2006).

1.3 Site Location

The site is located approximately 2 kilometres east of the town of Barry within the predominantly industrial setting of the Barry Chemical Complex. The centre of the site is at National Grid Reference ST 145 687 and the site covers an area of approximately 9.7 hectares. A Site Location Plan is presented in **Appendix A - Figure 1**. A site zoning plan is presented as **Figure 2**.

The site is bordered:

- To the east and south by the former Ineos ChlorVinyls Ltd (Ineos) site which closed in late 2010, beyond which to the east is Trailer Services, the B4267 and a garage. To the south are further chemical plants;
- To the west by the River Cadoxton, beyond which is the Dow Corning Limited (DCL) chemical manufacturing facility;
- To the north by the River Cadoxton, beyond which is a vegetated area and AB Car Sales and then the A4055. Industrial units and a petrol station are then located some 30m beyond the boundary.

The nearest residential housing is located approximately 50m north west of the site.

The site is located on a former coastal marsh and is essentially flat lying at an approximate elevation of 6-7 metres Above Ordnance Datum (mAOD). The elevation of the site is reported to have been raised some 1-2m

[1] URS Letter, Additional Groundwater Sampling, 49310807/CRLT0002/MJS, 28/01/10.
[2] URS Letter, BH110 Sampling, 49310807/CRLT0001/MS, 24/06/10.
[3] URS Letter, BH110 Groundwater Sampling, 49310807/CRLT0004/MJS, 16/08/10.
[4] Site Protection and Monitoring Programme, 2010 Groundwater Sampling Report, 49311521/CRRP0001, March 2011, Final
[5] URS Letter, URS Support Work, 49311521/CTLR0002, 07/04/11
[6] URS, Site Protection and Monitoring Programme, 2011 Groundwater Sampling Report, 46353025/CRRP0001, March 2012, Final
[7] URS, Site Protection and Monitoring Programme, 2012 Groundwater Sampling Report, 47065726/CRRP001, March 2013, Final

above its original level during site construction. The land to the north and northwest of the site rises to an elevation of between 30m and 50mAOD. Land to the south of the Barry Chemical Complex rises to an approximate elevation of 15mAOD at Windmill Hill.

2. Sampling Strategy

Discussion of the selection, justification and design for each sample location with respect to individual zones of the site is provided in the first phase monitoring report (URS report reference 44358976/R896/Rev1/LS/PT dated 29 September 2006). URS undertook an SPMP review in 2015[8] which presented a revised analytical suite based on an assessment of the existing time-series results (Table 5.1 of that report, and below).

The December 2017 monitoring round comprised the re-sampling of 10 of the original groundwater monitoring wells (BH1, BH3, BH7 to BH10, BH105, BH108, BH110 and BH113) as well as the two 2012 replacement wells (BH5A and BH11A). Groundwater monitoring well BH6 could not be located during the site works. All groundwater samples were scheduled for the following analytical suite:

- Chemical Oxygen Demand (COD),
- Biological Oxygen Demand (BOD),
- Anions and cations (sulphide, chloride, nitrate, nitrite, bromide, phosphate, sulphate, pH and alkalinity)
- Metals (arsenic, boron, cadmium, chromium suite, copper, lead, nickel, selenium and zinc),
- Acidity as HCL
- Formaldehyde - all locations with the exception of locations BH108 and BH113.

2.1 Sampling Techniques

All wells were purged and sampled using a method consistent with the previous SPMP monitoring rounds.

Groundwater sampling was undertaken in general accordance with AECOM Field Procedure FP11: Groundwater Sampling.

Prior to sampling, the elevation of the water level in each well was measured to allow calculation of the purge volume required.

At least three well volumes of groundwater were then purged from each well using a portable peristaltic pump with disposable tubing. Groundwater samples were obtained once purging was complete. BH108, BH110 and BH113 ran dry before three volumes could be removed. BH108 and BH113 were left to recharge overnight and sampled the following day. BH110 was left to recharge throughout the day and sampled prior to the completion of the work. Full sample suites were obtained at all monitored locations. Borehole locations are presented on **Figure 2**.

During purging groundwater quality measurements of pH, electrical conductivity, redox potential, dissolved oxygen and temperature were recorded using a calibrated YSI multiparameter probe with flow through cell. Field readings are presented in **Appendix B.**

Dedicated sampling equipment and disposable nitrile gloves were used for each well to reduce the potential for cross-contamination. Samples were stored on site in a cool box prior to dispatch to the laboratory.

In addition to the locations identified above, field quality assurance samples were collected including a duplicate groundwater sample (BH10) and an equipment blank (EB). The equipment blank was obtained during the groundwater sampling event by pumping laboratory supplied de-ionised water through clean groundwater sampling equipment into laboratory supplied sample jars. The duplicate sample was scheduled for the full suite of analysis. The EB sample was scheduled for the analysis suite with the exception of Boron, BOD and Formaldehyde.

Samples were dispatched to ALS Laboratories under temperature controlled chain of custody conditions. Formaldehyde analysis was undertaken by i2 Laboratories. It is noted that the i2 analysis for formaldehyde as

[8] URS, Cabot Carbon Limited - Site Protection Monitoring Programme Review, 47072112, 15th January 2015.

part of the aldehyde suite is an in-house method (based on EPA 8315) in order to achieve a lower Method Detection Limit of 0.05mg/L than is commercially available as standard (0.5mg/L). Both ALS and i2 are UKAS accredited laboratories and approved suppliers under AECOM's Quality Management System (ISO9001). Full laboratory certificates are presented as **Appendix D.**

2.2 Constraints of Investigation

Groundwater monitoring well BH6 could not be located during the monitoring round. The area in which the well is located is covered with gravel. A search of the area was undertaken by AECOM field staff but the well could not located.

3. Analytical strategy and results

3.1 Justification of Analytical Suites

The analytical suite agreed in the Design SPMP and revised in the 2015 SPMP review was used for the analysis of samples collected during the December 2017 monitoring round as discussed in Section 2.

3.2 Quality Control

The sampling and analytical quality assurance and quality control plan was generally followed as stated in the Design SPMP. Results obtained from the quality control plan are summarised below, whilst analytical quality control data are presented in **Appendix C.**

3.2.1 Groundwater Duplicate:

A field duplicate groundwater sample was taken from monitoring well BH10 at the time of sampling (sample ID: DUP1). The duplicate sample was analysed for all parameters in the analytical suite. A Relative Percentage Difference (RPD) calculation was carried out to compare sample and duplicate data and assess the discrepancies between the two results, presented in **Table 3.1** below.

Table 3.1 Duplicate Sample: Relative Percentage Difference

Analyte	Units	BH10	DUP01	RPD (%)
Acidity	mg/l	11	16.4	39
BOD	mg/l	<1	<1	0
Bromide	µg/l	978	1080	10
Chloride	mg/l	37.7	47.5	23
Nitrate (as NO3-)	mg/l	<0.3	<0.3	0
Nitrite (as NO2-)	mg/l	<0.05	<0.05	0
Sulphide	mg/l	<0.01	<0.01	0
Phosphate	**µg/l**	**1030**	**1700**	**49**
Alkalinity (total) as CaCO3	mg/l	450	505	12
Sulphate	mg/l	75.7	78.7	4
COD	mg/l	23.1	25.7	11
pH	pH	7.68	7.78	1
Arsenic	µg/l	3.17	3.47	9
Boron	**µg/l**	**539**	**1070**	**66**
Cadmium	µg/l	<0.08	<0.08	0
Chromium (III+VI)	µg/l	<1	<1	0

Analyte	Units	BH10	DUP01	RPD (%)
Chromium (III)	µg/l	<30	<30	0
Chromium (VI)	µg/l	<30	<30	0
Copper	µg/l	<0.3	<0.3	0
Lead	µg/l	<0.2	<0.2	0
Nickel	µg/l	2.15	1.48	37
Selenium	µg/l	<0.5	<0.5	0
Zinc	µg/l	2.11	<1	71

Bold – RPD exceedance

Where the sample or the duplicate result is less than or equal to 10 times the Method Detection Limit (MDL), RPD is not considered a suitable test and results have not been presented in this table. A full RPD table is presented in **Appendix C.**

Where the sample concentration is between 10 times and 20 times the reporting limit, the RPD should be less than 50%. Where the sample concentration is greater than 20 times the reporting limit, the RPD should be less than 30%. All remaining results except one have an RPD of less than 20% and are therefore considered to be acceptable. The results for phosphate and boron have an RPD exceeding the acceptable limit and concentrations should therefore be used with caution.

The RPD reported for Boron was 66%. The RPD reported for Phosphate was 49%. The results are not considered significant.

3.2.2 Equipment Blank

As part of AECOM's quality control procedure an equipment blank sample was sent for analysis. This involved pumping laboratory-supplied rinsate water through clean, unused, peristaltic pump tubing, into laboratory supplied sample containers. For metals the water was also passed through a 0.45 micron filter. The equipment blank was then analysed for all of the parameters in the analytical suite. The majority of results were below the MDL however; chromium (III + VI) was reported in the equipment blank at a concentration of 4.69µg/l. Chromium was not reported above the MDL of 1µg/l in any of the groundwater samples. A full table of the equipment blank results is presented in **Appendix C.**

3.3 Findings of the December 2017 SPMP Groundwater Monitoring

3.3.1 Hydrogeology

Previous site investigations have indicated two groundwater units are present beneath the site. The monitoring wells sampled as part of this investigation are located within the shallow groundwater unit with observed groundwater elevations ranging between 4.47 metres Above Ordnance Datum (m AOD) and 5.77m AOD

Wells BH108, BH110 and BH113 ran dry during purging with low recharge subsequently observed. This is similar to the results of previous monitoring rounds.

Groundwater flow direction is inferred to be towards the north and west as previously reported and is presented in **Appendix A - Figure 3**.

3.3.2 Revisions to the Conceptual Site Model

No changes to the CSM are proposed on the basis of the data gathered during the December 2017 SPMP monitoring.

3.3.3 Assessment of Zone 4 and Zone 5 and General Groundwater Quality Monitoring

Groundwater wells BH5A – BH11A and BH105, BH108, and BH110 were monitored to assess the hydrogeological conditions beneath the site to and to provide a dataset for comparison between the zones of concern (Zones 4 and 5) and other zones of the site. The findings of the monitoring in this area are summarised below. On-site measurements of the groundwater quality indicator parameters were taken at the wellhead during purging of the monitoring wells and were as follows:

- pH: 7.00 (BH9) to 7.66 (BH11A);
- groundwater temperature: 7.70°C (BH108) to 14.52°C (BH8);
- electrical conductivity: 375 µS/cm (BH11A) to 4,268 µS/cm (BH110);
- dissolved oxygen: 0.04mg/l (BH7) to 6.58mg/l (BH11A); and;
- REDOX potential: -131.8mV (BH7) to 90.6mV (BH108).

Dissolved oxygen readings for BH5A, BH7, BH9 and BH10 are noted to be approaching anoxic conditions (<0.5 mg/l). Field water quality parameters for all wells are presented in **Appendix A**.

Laboratory reported concentrations of chemical parameters (including time series data from previous monitoring rounds) are presented in **Appendix C** and summarised for the December 2017 round in **Table 3.2** below.

Table 3.2 Groundwater Summary for Zones 4 and 5

Analyte	Units	MDL	Minimum	Maximum	Average	Standard Deviation
Arsenic	µg/l	0.5	0.918	47.2	9.2	14
Boron	µg/l	5.0	79.2	3230	813	962
Cadmium	µg/l	0.08	0.0979	0.0979	0.046	0.018
Chromium (III+VI)	µg/l	1.0	ND	ND	ND	-
Chromium (III)	µg/l	30	ND	ND	ND	-
Chromium (VI)	µg/l	30	ND	ND	ND	-
Copper	µg/l	0.3	0.706	5.07	1.4	1.7
Lead	µg/l	0.2	0.233	0.566	0.16	0.15
Nickel	µg/l	0.4	1.39	7.33	2.3	2.6
Selenium	µg/l	0.5	0.501	9.12	2.1	2.9
Zinc	µg/l	1.0	1.37	4.6	2.1	1.4
Acidity	mg/l	4	5.48	16.4	11	4.9
Alkalinity (total) as CaCO3	mg/l	2	155	1470	547	427
BOD	mg/l	1	ND	ND	ND	-
COD	mg/l	7	7	63.9	29	20
Bromide	µg/l	60	171	2530	747	760
Chloride	mg/l	2	16.9	1440	233	451
Nitrate (as NO3-)	mg/l	0.3	0.81	10.4	2.1	3.4

Analyte	Units	MDL	Minimum	Maximum	Average	Standard Deviation
Nitrite (as NO2-)	mg/l	0.05	ND	ND	ND	-
Phosphate	µg/l	50	51	17700	2815	5386
Sulphide	mg/l	0.01	0.0258	0.145	0.035	0.042
Sulphate	mg/l	2	41	459	116	123
pH	pH	1	7.23	8.25	7.8	0.32

MDL: Method Detection Limit

3.3.4 Up and Down-hydraulic Gradient Locations

Peripheral monitoring wells BH1, BH3 (downgradient east and north) and BH113 (upgradient - west) were monitored to assess the hydrogeological conditions up and down-hydraulic gradient of the installation. Field observations and measurements recorded in these wells during the groundwater sampling are summarised below, with full details presented in **Appendix B**.

- On-site measurements of groundwater quality indicator parameters were taken at the wellhead during purging of the monitoring wells and were as follows:
  - pH: 6.90 (BH3) to 7.35 (BH1);
  - groundwater temperature: 7.50°C (BH113) to 12.90°C (BH3);
  - electrical conductivity: 1,256.µS/cm (BH3) to 3,449µS/cm (BH1);
  - dissolved oxygen: 1.02mg/l (BH113) to 7.35mg/l (BH1); and
  - redox potential: 40.50mV (BH113) to 95.10mV (BH3).

Laboratory reported concentrations of chemical parameters are presented in **Appendix C** and summarised in **Table 3.3** below.

Table 3.3 Groundwater Summary for Up and Downgradient locations

Analyte	Units	MDL	Minimum	Maximum	Average	Standard Deviation
Arsenic	µg/l	0.5	0.82	17.5	7.7	8.7
Boron	µg/l	5.0	554	2230	1175	918
Cadmium	µg/l	0.08	ND	ND	ND	-
Chromium (III+VI)	µg/l	1.0	ND	ND	ND	-
Chromium (III)	µg/l	30	ND	ND	ND	-
Chromium (VI)	µg/l	30	ND	ND	ND	-
Copper	µg/l	0.3	1.46	12.8	5.3	6.5
Lead	µg/l	0.2	ND	ND	ND	-
Nickel	µg/l	0.4	0.493	1.59	1	0.55
Selenium	µg/l	0.5	1.19	1.19	0.56	0.54

Analyte	Units	MDL	Minimum	Maximum	Average	Standard Deviation
Zinc	µg/l	1.0	1.4	11.4	4.4	6.1
Acidity	mg/l	4	16.4	36.5	23	12
Alkalinity (total) as CaCO3	mg/l	2	575	900	688	183
BOD	mg/l	1	ND	ND	ND	-
COD	mg/l	7	7.14	51.4	35	24
Bromide	µg/l	60	832	832	297	463
Chloride	mg/l	2	106	970	472	447
Nitrate (as NO3-)	mg/l	0.3	0.99	4.8	2	2.5
Nitrite (as NO2-)	mg/l	0.05	ND	ND	ND	-
Phosphate	µg/l	50	161	2300	1297	1076
Sulphide	mg/l	0.01	0.0449	0.0658	0.039	0.031
Sulphate	mg/l	2	91.9	222	156	65
pH	pH	1	7.39	7.93	7.7	0.27

3.4 Data Interpretation

3.4.1 Statistical Interpretation of Data

As part of the last SPMP monitoring undertaken in 2013 a statistical analysis of the laboratory data was used in line with the now withdrawn Environment Agency (EA) guidance of CLR7[9] (in response to a tendency to misapply the test). The statistical tests were previously used to determine whether sample locations represent outliers of pollution associated with particular source areas or whether the observed contamination is representative of the entire zone area.

Previously, the maximum value test (Grubbs outlier test) was used to determine whether the maximum concentrations for each measured compound should be regarded as a statistical outlier. If the determined Outlier Test Statistic was smaller than a critical value at a given confidence level (in this instance 10% confidence), then the maximum value was considered likely to be consistent with other results within the data population. A failure at the given confidence levels indicated that an outlier might be present.

At the time of writing, the CLR7 guidance has not been replaced. However, an online test was conducted using Dixon's test (appropriate to the number of monitoring locations available at the site) within the ProUCL statistics package for the 2017 metals data to assess the possible presence of outliers,. The test is a non-parametric test, i.e. it makes no assumptions about distribution, for small (n < 25) data sets. .

Given that there is a reasonable possibility for pollution to occur at the site (as identified in Table D2 of the Application Site Report - ASR); the monitoring data have been assessed on a site-wide basis.

3.4.1.1 Metals

The test identified single maximum value outliers for the following metals:

- Arsenic, Boron, Copper, Lead, Nickel, Selenium and Zinc.

[9] DEFRA, R&D PUBLICATION CLR7, Assessment of Risks to Human Health from Land Contamination, March 2002.

- The outlier test does not indicate the magnitude and possible significance on the outlier. In the case of lead, for example, concentrations were <0.1µg/l at all but two locations. As might be expected the test identified the highest value of 0.566µg/l as an outlier although this value remains low (within an order of magnitude of the Limit of Detection of 0.1µg/l) and may reflect random variation and potentially due to sampling error.

- Only the spatially distributed data for a single monitoring round were assessed although the data themselves belong to time series. Therefore variations in concentration between boreholes and the apparent presence of outliers for a single monitoring round may be due more to variability over time within a single borehole that is nevertheless consistent with its usual behaviour than spatial variation. Given the potential for intrawell variability between successive monitoring rounds, outlier testing at a spatial level may not provide a meaningful indication of the long-term behaviour of the wells. A more robust approach would be to assess the concentrations of key analytes in individual wells over time to identify possible seasonality and trends and time dependent outliers if they are present.

3.4.1.2 Formaldehyde

All sample results for formaldehyde were below the MDL and therefore no statistical outlier analysis was conducted.

3.4.2 Recommendation for additional statistical analysis

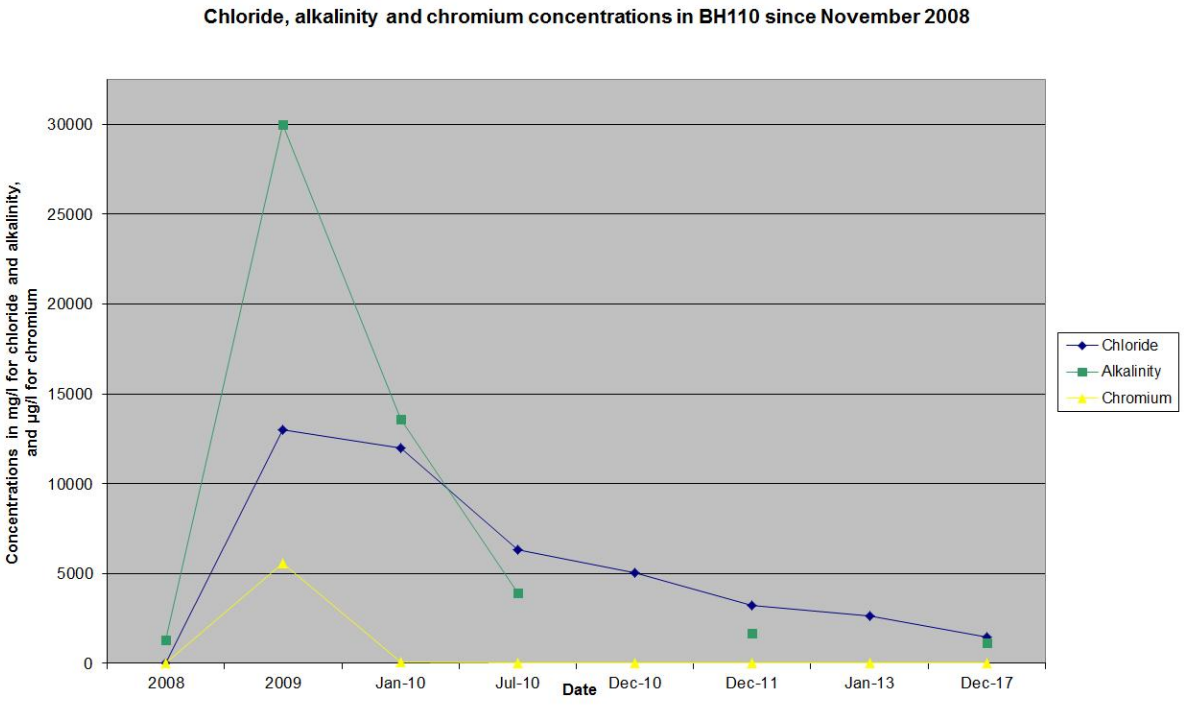
In view of the withdrawal of the CLR7 guidance, it is recommended that future data are analysed using methods more appropriate for time series data. The following additional statistical tests are recommended:

- Time series analysis consisting of distribution and trend analysis for the complete monitoring data set. The objective is to assess whether, over the period monitored, potentially increasing or decreasing trends could be present. These tests will be applied to each analyte in each borehole separately.
- The trend analysis can be used to provide a context for future groundwater monitoring data. In particular, the analysis will help provide control level values against which to compare future groundwater data and provide an indication of whether historical trends are maintained.
- If Cabot chooses to undertake this analysis for the current data set the results could be provided as an addendum to this report.

3.4.3 Review of Confirmed Source of Elevated Levels of Pollutants from 2010

As reported in URS letter 49310807/CRLT0004 dated 16 August 2010, elevated concentrations of alkalinity, chloride and certain metals were detected during the 2009 SPMP monitoring in samples from BH110. The increase in these pollutants was attributed to a leak from the Katalco effluent pipe. Cabot reported to URS that this leak was repaired and the line re-routed to above ground in a bunded area.

The graph below presents the laboratory detected concentrations of chloride, alkalinity and chromium in BH110 since November 2008. A continuing decreasing trend is observed since the peak in November 2009 for all analytes.



3.5 Data Summary

Statistical analysis of groundwater analytical results for metals has been undertaken, as discussed in Section 3.4.

A brief summary of pollutant levels and a comparison to the current Freshwater Environmental Quality Standards (EQS) general assessment criteria (GAC) is presented below. Note that the EQS would only be applicable at a surface water receptor, and is used only to illustrate potential pollutants within groundwater;

Metals

- Copper has demonstrated a very slight increase from the January 2013. Seven locations (BH1, BH3, BH5A, BH9, BH11A, BH105 and BH113) are above the Freshwater EQS of 1µg/l at a maximum concentration of 12.8µg/l in the sample from BH1.
- All other metals have shown a decrease in concentration from the January 2013 data.
- In addition to copper the following metals were reported with one or more sample concentrations in exceedance of the Freshwater EQS:
  - Boron (BH5A and BH113) at a maximum concentration of 3,230µg/l in the sample from BH5A, within the same order of magnitude as the EQS of 2,000µg/l.
  - Cadmium (BH9 only) at a concentration of 0.098µg/l; a marginal exceedance, within the same order of magnitude as the EQS of 0.08µg/l.
  - Nickel (BH9 and BH110) at a maximum concentration of 7.33µg/l in the sample from BH9, within the same order of magnitude as the EQS of 4µg/l.
  - Zinc (BH3 only) at a concentration of 11.4µg/l; a marginal exceedance, within the same order of magnitude as the EQS of 10.9µg/l.

Inorganics

- Average nitrate has increased slightly from 1.62mg/l in January 2013 to 2.32mg/l in December 2017;
- Average concentrations of all remaining inorganic analytes have reduced from January 2013 levels.

- The following inorganic analyte exceeded the Freshwater EQS:
  - Chloride (BH1, BH8, BH110 and BH113) at a maximum concentration of 1,440mg/l in the sample from BH110, one order of magnitude above the EQS of 250µg/l. The remaining three exceedances are within the same order of magnitude at the EQS.

Appendix A - Figures

Based upon an Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office. Crown copyright reserved. Licence No. AL 100017812

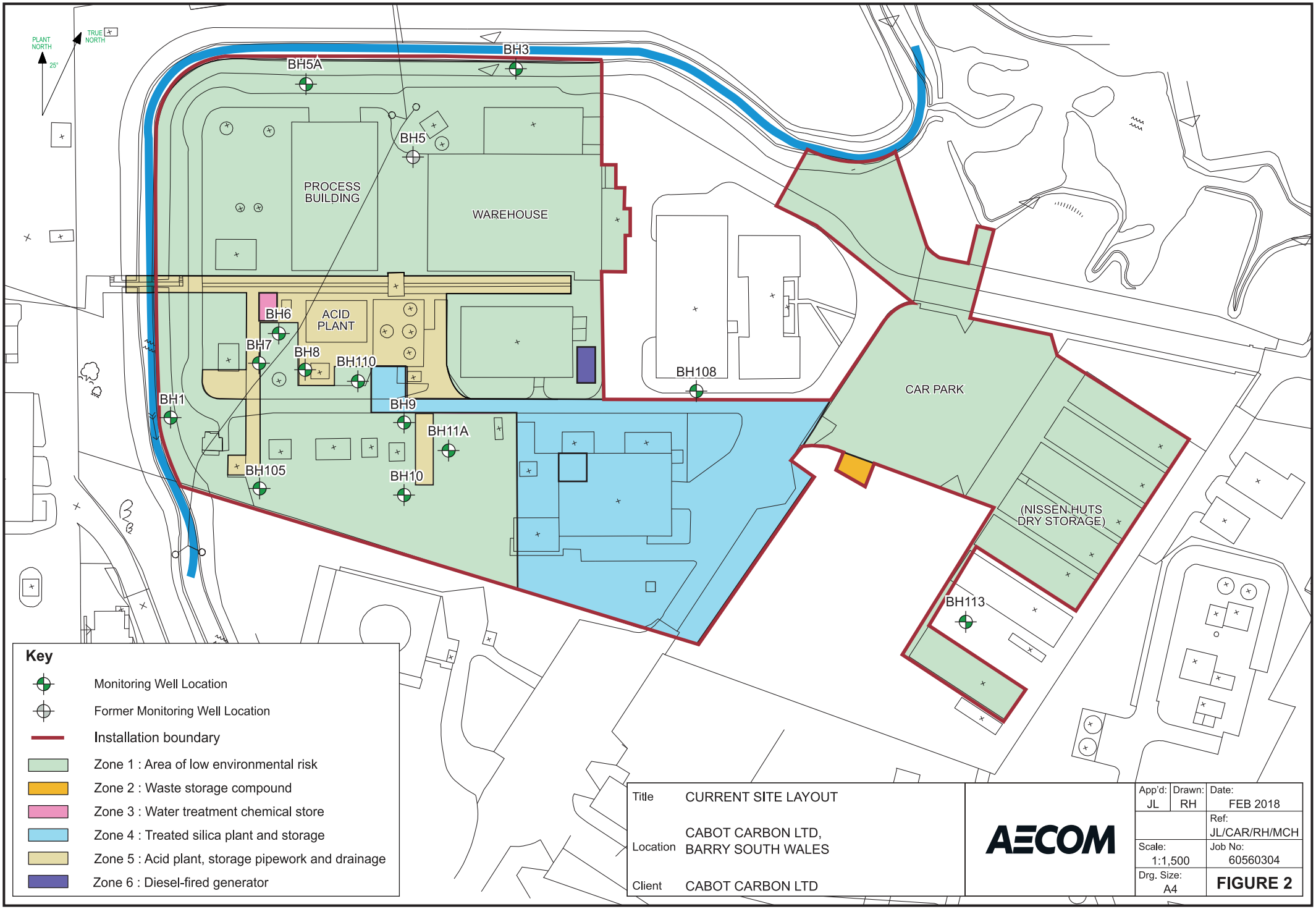
0 1km

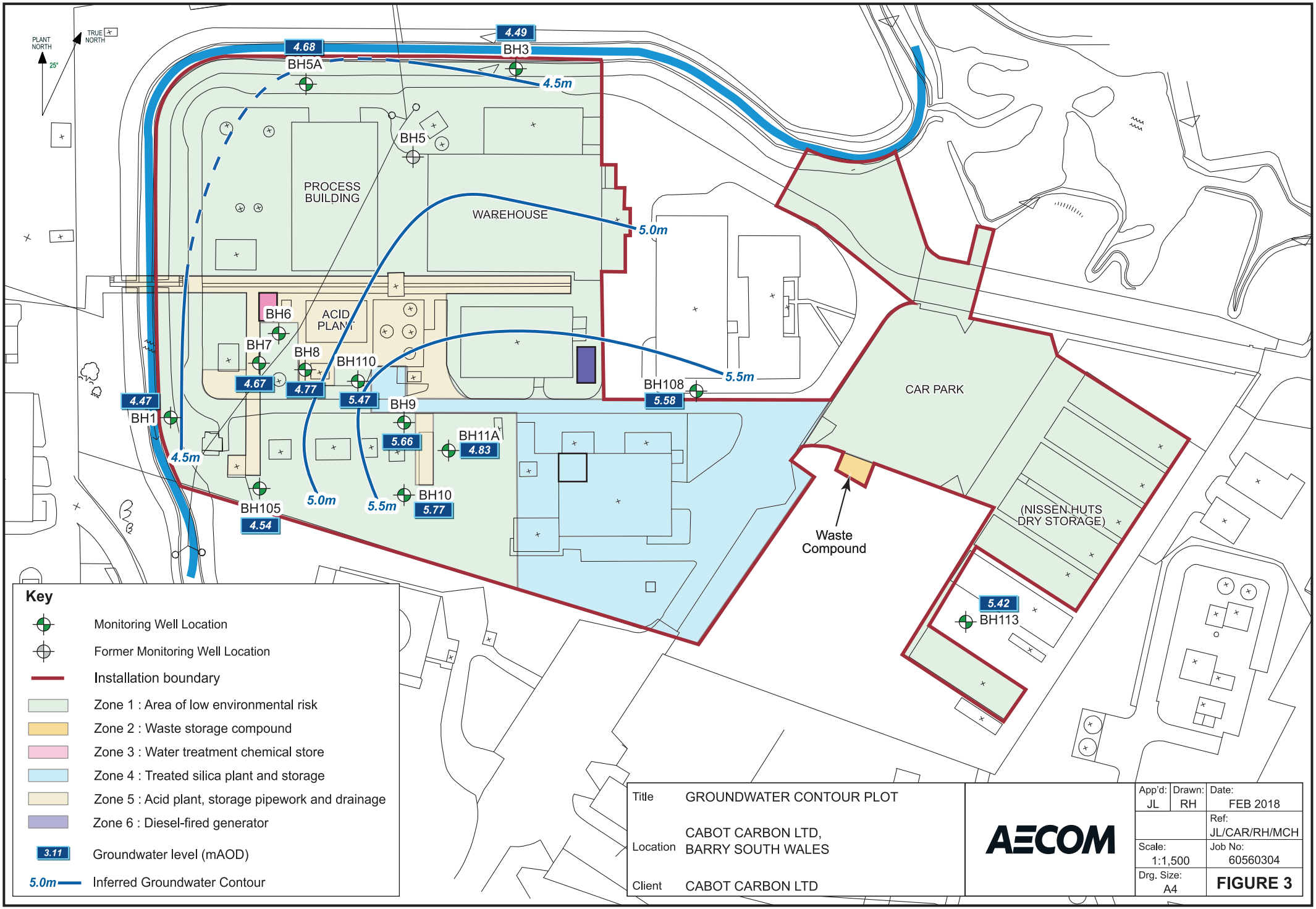
SCALE

Title	SITE LOCATION MAP
Location	CABOT CARBON LTD, BARRY SOUTH WALES
Client	CABOT CARBON LTD

AECOM

App'd:	Drawn:	Date:
JL	RH	FEB 2018
		Ref: JL/CAR/RH/MCH
Scale: 1:25,000		Job No: 60560304
Drg. Size: A4		**FIGURE 1**


PLANT NORTH
TRUE NORTH
25°
BH3
BH5A
BH5
PROCESS BUILDING
WAREHOUSE
ACID PLANT
BH6
BH7
BH8
BH110
BH1
BH9
BH11A
BH105
BH10
BH108
CAR PARK
(NISSEN HUTS DRY STORAGE)
BH113
Key
Monitoring Well Location
Former Monitoring Well Location
Installation boundary
Zone 1 : Area of low environmental risk
Zone 2 : Waste storage compound
Zone 3 : Water treatment chemical store
Zone 4 : Treated silica plant and storage
Zone 5 : Acid plant, storage pipework and drainage
Zone 6 : Diesel-fired generator
Title CURRENT SITE LAYOUT
Location CABOT CARBON LTD, BARRY SOUTH WALES
Client CABOT CARBON LTD
AECOM
App'd: JL
Drawn: RH
Date: FEB 2018
Ref: JL/CAR/RH/MCH
Scale: 1:1,500
Job No: 60560304
Drg. Size: A4
FIGURE 2


PLANT NORTH
TRUE NORTH
25°
4.68
BH5A
4.49
BH3
4.5m
BH5
PROCESS BUILDING
WAREHOUSE
5.0m
BH6
ACID PLANT
BH7
BH8
BH110
4.67
4.77
5.47
5.5m
BH108
5.58
CAR PARK
4.47
BH1
BH9
5.66
BH11A
4.83
4.5m
5.0m
5.5m
BH10
5.77
BH105
4.54
Waste Compound
(NISSEN HUTS DRY STORAGE)
5.42
BH113
Key
Monitoring Well Location
Former Monitoring Well Location
Installation boundary
Zone 1 : Area of low environmental risk
Zone 2 : Waste storage compound
Zone 3 : Water treatment chemical store
Zone 4 : Treated silica plant and storage
Zone 5 : Acid plant, storage pipework and drainage
Zone 6 : Diesel-fired generator
3.11
Groundwater level (mAOD)
5.0m
Inferred Groundwater Contour
Title
GROUNDWATER CONTOUR PLOT
Location
CABOT CARBON LTD, BARRY SOUTH WALES
Client
CABOT CARBON LTD
AECOM
App'd: JL
Drawn: RH
Date: FEB 2018
Ref: JL/CAR/RH/MCH
Scale: 1:1,500
Job No: 60560304
Drg. Size: A4
FIGURE 3

Appendix B – Groundwater Quality Field Data

Table 1 - Groundwater Field Data
Cabot Carbon Ltd

Sample Location	Date	Depth to water (m bTOC)	Depth to base (m bTOC)	Pipe Level (m AOD)	Groundwater Elevation (m AOD)	Field Data					Observations
						PH	Temperature (°C)	Conductivity (us/cm)	Dissolved Oxygen (mg/L)	Redox (mV)	
BH1	14/12/2017	2.62	6.92	7.09	4.47	7.35	12.44	3449.1	7.35	68.9	Clear NVO
BH3	15/12/2017	2.53	6.00	7.02	4.49	6.90	12.90	1256.1	5.24	95.1	Clear NVO
BH5A	15/12/2017	2.55	6.67	7.23	4.68	7.63	13.39	2747.6	0.33	-113.4	Clear NVO
BH7	14/12/2017	2.44	5.93	7.11	4.67	7.35	13.91	751.5	0.04	-131.8	Black, clearing NVO
BH8	14/12/2017	2.45	5.65	7.22	4.77	7.11	14.52	1160.0	0.71	34.0	Clear NVO
BH9	14/12/2017	1.55	6.16	7.21	5.66	7.00	12.40	805.1	0.11	66.8	Clear NVO
BH10	14/12/2017	1.39	6.17	7.15	5.765	7.40	12.54	813.8	0.13	-78.0	Clear NVO
BH11A	15/12/2017	2.26	6.05	7.08	4.825	7.66	13.00	375.8	6.58	71.6	Red Brown sediment NVO
BH105	14/12/2017	2.62	5.75	7.16	4.54	7.36	12.01	454.8	7.21	67.8	Clear NVO
BH108	14/12/2017	1.67	2.52	7.24	5.575	7.62	7.70	415.4	5.84	90.6	Orange sediments clearing NVO
BH110	15/12/2017	1.79	3.93	7.26	5.472	7.52	12.58	4268.5	4.99	-65.9	Clear NVO
BH113	14/12/2017	0.65	2.90	6.06	5.415	7.24	7.50	1987.5	1.02	40.5	Slight sediment clearing NVO

Minimum	6.90	7.50	375.76	0.04	-131.8
Maximum	7.66	14.52	4268.50	7.35	95.1

Appendix C – Groundwater Laboratory Results Summary Tables

Not detects presented as MDL for all analyses
Concentrations highlighted in red exceed the Freshwater EQS (Annual Average).
New EQS 2015

Arsenic results in µg/l EQS: **50** **2010**

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	22	10	20	8	2	15	38		11	3	2	1	22	12.83	50
Nov-07	32	3	33	13	1	12	13	5	9	4	2	3	13	11.00	50
Nov-08	23	1.9	26	20	5.4	4.2	14	7.2	8.2	3.2	1.8	4.2		9.93	50
Nov-09											21	0.75			50
Jan-10				42.5		11				3.89	2.38	**50.7**			50
Nov-10	20.5	1.84	16.6	**104**	21.7	24.9	43.6	9.99		4.59	2.5	40.8	16.7	25.64	50
Dec-11		1.96		**117**	6.55	6.41	13.7				2.11	13.1		22.98	50
Jan-13	43.5	2.03	**85.9**	**89**	10.2	13.7	17.7	5.73	9.49	11.1	2.04	8.22	7.79	23.57	50
Dec-17	17.5	0.82	47.2		14.1	8.73	3.91	3.17	1.5	2.53	0.918	6.16	4.7	9.27	50

Boron results in µg/l EQS: **2000** **2010**

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	849	1571	193	996	169	979	1159		**2662**	211	170	1205	**2246**	1034.17	2000
Nov-07	810	420	10	500	10	1400	**2900**	1800	**2300**	10	10	740	**2300**	1016.15	2000
Nov-08	730	330	20	610	55	610	**3000**	1800	**2100**	97	35	730		843.08	2000
Nov-09											1100	**7100**			2000
Jan-10				404		850				114	102	105		315.00	2000
Dec-11		450		417	140	609	1420				160	536		533.14	2000
Jan-13	750	663	**2820**	528	137	983	1800	1190	1880	923	103	897	**2160**	1141.08	2000
Dec-17	741	554	**3230**		137	793	647	539	150	81.9	79.2	1400	**2230**	881.84	2000

Cadmium results in µg/l EQS: 5 (pre 2010)
0.25 2010
0.08 **2015**

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	0.4	0.4	0.4	0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	0.4	0.40	5
Nov-07	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.40	5
Nov-08	0.22	0.22	0.22	0.22	0.22	0.29	0.22	0.22	0.22	0.22	0.22	0.22		0.23	5
Nov-09											0.3	1.7			5
Jan-10				0.1		0.1				0.1	0.1	0.1			0.25
Nov-10	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.153	0.1	0.10	0.25
Dec-11		0.1		0.1	0.1	0.1	0.1				0.1	0.1		0.10	0.25
Jan-13	0.111	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.389	0.1	0.12	0.25
Dec-17	0.08	0.08	0.08		0.08	0.08	**0.0979**	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

Chromium results in µg/l EQS: 50 2010
3.4 2015

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	1	1	2	1	1	2	7		2	1	1	2	1	1.83	50
Nov-07	1	1	1	1	1	2	3	1	2	1	1	1	1	1.31	50
Nov-08	1	1	1	1	1	1	1	1	1	1	1	2		1.08	50
Nov-09											30	**5600**		**2815.00**	50
Jan-10				18.2		21.6				17	8.66	**76.5**		28.39	50
Nov-10	7.59	11.7	4.38	9.58	7.13	13	25.4	14.4		5.52	4.39	38.6	20	13.47	50
Dec-11		16.2		15.1	8.9	14.9	21.5				7.17	29.2		16.14	50
Jan-13	6.69	5.26	14.1	4.08	2.61	4.6	6.75	4.65	9.03	5.84	1.86	4.57	5.98	5.85	50
Dec-17	1	1	1		1	1	1	1	1	1	1	1	1	1.00	3.4

Copper results in µg/l EQS: 28 2010
1 2015

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	11	5	1	5	2	5	**40**		6	11	3	2	1	7.67	28
Nov-07	6	1	1	1	1	1	1	2	1	1	1	4	3	1.85	28
Nov-08	7.1	4.3	1.7	3.2	2.4	8.1	4.7	5	11	5.3	6.3	9.3		5.70	28
Nov-09											20	**85**			28
Jan-10				1.25		1.52				1.94	1.32	6.14			28
Nov-10	2.38	3.19	2.4	1.3	1.4	1.79	4.47	1.6		3.47	3.68	12	2.03	3.31	28
Dec-11		2.45		1.72	1.02	1.35	3.16				1.96	6.79		2.64	28
Jan-13	7.99	2.34	2.69	0.85	1.06	0.875	2.4	1.71	2.25	1.3	1.37	2.64	3.73	2.40	28
Dec-17	**12.8**	**1.67**	**2.04**		0.3	0.03	**2.86**	0.3	**5.07**	**2.78**	0.706	0.3	**1.46**	2.53	1

Lead results in µg/l EQS: 250 (pre 2010)
7.2 2010
1.2 2015

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00	250
Nov-07	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00	250
Nov-08	1.2	1.1	1.1	1.1	4.4	1.9	0.9	1.3	0.9	7.6	0.9	1.2		1.97	250
Nov-09											1.1	53			250
Jan-10				0.02		0.02				0.02	0.02	1.23			7.2
Nov-10	0.183	0.066	0.163	0.215	0.124	0.136	0.262	0.361		0.432	0.359	0.381	0.074	0.23	7.2
Dec-11		0.055		1.14	0.069	0.068	0.069				0.125	0.201		0.25	7.2
Jan-13	0.273	0.269	1.44	0.302	0.154	0.138	0.156	0.225	2.65	0.454	0.106	0.455	0.415	0.54	7.2
Dec-17	0.2	0.2	0.566		0.2	0.233	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.23	1.2

Nickel results in µg/l EQS: 200 (pre 2010)
4 2015

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	4	9	3	14	5	20	27		11	3	3	7	4	9.17	200
Nov-07	2	5	2	11	7	11	9	2	8	1	2	5	3	5.23	200
Nov-08	4	3.7	2.7	9	3.5	6.1	9.2	4	8	2.6	2.1	5.8		5.06	200
Nov-09											18	94			200
Jan-10				6.03		6.71				3.35	1.52	3.46			20
Nov-10	2.51	4.69	2.49	8.35	2.71	7.98	11.7	2.63		2.69	2.28	5.14	5.76	4.91	20
Dec-11		4.42		7.69	2.79	5.39	9.28				2.38	3.71		5.09	20
Jan-13	3.18	2.25	2.68	5.77	3.9	4.2	7.39	3.13	3.99	2.86	0.999	3.27	2.69	3.56	20
Dec-17	0.493	0.919	1.39		1.39	2.28	**7.33**	2.15	0.4	0.4	0.4	**6.85**	1.59	2.13	4

Selenium results in µg/l EQS: **20 2010**

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	11	2	1	19	6	**153**	**357**		3	4	20	10	9	**49.58**	20
Nov-07	5	6	5	5	6	8	8	4	3	14	16	12	12	8.00	20
Nov-08	8	4	4	6	4	4	7	7	4	7	14	7		6.33	20
Nov-09											**220**	1			20
Jan-10				5.22		5.34				17.2	**21.8**	0.39			20
Nov-10	4.31	5.26	2.97	3.31	1.75	5.08	6.96	4.02		12.8	**23**	**52.2**	9.87	10.96	20
Dec-11		6.09		8.8	1.62	3.56	8.88				**23.8**	13.4		9.45	20
Jan-13	5.25	8.85	5.91	11.6	0.885	7.48	4.63	3.79	4.01	19.7	16.8	9.45	**22.8**	9.32	20
Dec-17	0.5	1.19	0.5		0.5	2.22	0.501	0.5	1.94	4.8	9.12	1.29	0.5	1.96	20

Zinc results in µg/l EQS: 500 (pre 2010)
125 2010
10.9 2015

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average	EQS
Nov-06	13	46	14	11	10	13	32		3	17	50	11	13	19.42	500
Nov-07	27	36	3	20	62	15	23	5	33	13	25	27	9	22.92	500
Nov-08	16	15	13	11	15	15	12	13	**1100**	300	30	23		130.25	500
Nov-09											28	18			500
Jan-10				3.9		2.2				2.48	4.75	2.71			125
Nov-10	2.22	3.58	2.99	2.21	1.99	45.9	4.03	2.53		2.25	5.06	5.1	0.816	6.56	125
Dec-11		4.72		19.4	2.38	5.83	4.43				6.99	6.85		7.23	125
Jan-13	2.55	3.24	14.7	2.7	0.549	0.747	1.13	0.637	8.71	3.74	2.43	6.04	4.03	3.94	125
Dec-17	1.4	**11.4**	4.6		1	3.28	2.72	2.11	1	3.24	1.37	2.49	1	2.97	10.9

New EQS 2015

All non detects presented as the MDL
In December 2012 BH5 and BH11 were replaced. January 2013 onwards results are presented for replacement wells BH5A and BH11A.

pH results in pH units

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	8.67	8.56	8.44	8.52	8	8.74	9.06		8.68	8.41	8.63	8.19	8.87	8.56
Nov-07	8.01	7.61	7.79	7.66	7.75	7.75	7.92	8.04	8.25	7.92	8.02	8.05	7.98	7.90
Nov-08	7.44	7.89	7.71	7.7	7.73	7.57	8	8.3	8.13	7.61	7.94	8.44		7.87
Jan-10				8.6		8.51				8.55	8.48	9.77		
Nov-10	7.59	7.25	7.56	7.44	8.09	7.86	7.92	7.91		7.81	7.59		7.84	7.71
Dec-11		7.6		7.92	8.03	8.03	8.08				7.81	8.6		8.01
Jan-13	7.54	7.32	7.95	7.38	7.56	7.66	7.51	7.74	8.04	7.75	7.78	8.4	8.01	7.74
Dec-17	7.63	7.39	8.11		7.53	7.67	7.23	7.68	8.07	7.73	8.16	8.25	7.93	7.78

Total alkalinity as CaCO3 in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	645	1105	415	770	310	890	1600		1495	390	310	635	1015	798.33
Nov-07	740	550	370	600	520	540	1200	640	1300	270	240	1100	1100	705.38
Nov-08	580	490	270	430	340	440	1300	1000	1100	330	180	1300		646.67
Jan-10				420		465				350	180	13600		
Nov-10	485	495	245	510	650	635	1370	915		435	275		1460	679.55
Dec-11		555		460	255	570	905				175	1680		657.14
Jan-13	625	605	1390	435	294	483	814	657	1090	695	210	-	1040	694.83
Dec-17	590	575	1470		325	485	465	450	215	250	155	1150	900	585.83

BOD in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	2	4	1	1	13	1			1	2	1	2	1	2.64
Nov-07	1	2	6	2	3	1	3	2	3	2	1	3	1	2.31
Nov-08	1	1	1	1	1	1	1	1	1	1	1	1		1.00
Nov-10	1	1	1.64	15.2	1	1	1	1		1.05	1	1	22.1	4.00
Jan-13	2	2	3.75	2	2	2	2	2	6.44	2	2	5	2	2.71
Dec-17	1	1	1		1	1	1	1	1	1	1	1	1	1.00

COD in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	142	42	33	1160	538	47			246	17	25	54	38	212.91
Nov-07	41	11	31	86	49	25	48	27	58	19	20	56	43	39.54
Nov-08	27	15	31	37	16	38	49	27	46	27	7	44		30.33
Nov-10	49.8	10.5	18.6	55.2	39.8	40.6	46.2	22.3		52.8	12	235	1530	176.07
Jan-13	25.6	11	146	20.2	13.1	16.9	25.8	21.4	98.8	26.4	15.4	51.4	78.1	42.32
Dec-17	45.6	7.14	63.9		13.9	29.6	18.1	23.1	50.8	7	7.81	52.6	51.4	30.91

Nitrate in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	0.4	1	1.2	1.4	16.2	2.7	2.2		1.3	0.9	9.9	0.9		3.46
Nov-07	1.6	8.2	0.3	0.3	2.2	0.3	0.3	3.2	0.3	7.9	17	5.4	0.8	3.68
Nov-08	0.8	15	0.3	0.3	0.3	0.3	0.3	3.3	0.3	4.2	4.1	13		3.52
Nov-10	0.3	2.09	0.3	0.3	0.3	0.766	0.3	0.603		7.71	18.2	4.11	0.694	2.97
Jan-13	0.3	2.22	0.3	0.3	0.3	4.18	0.3	0.3	0.3	0.3	10.3	1.69	0.3	1.62
Dec-17	0.3	4.8	0.3		0.3	0.81	0.3	0.3	2.75	5.76	10.4	0.836	0.99	2.32

Nitrite in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	0.05	0.07	0.05	0.06	0.08	0.21	0.36		0.05	0.05	0.05	0.13	0.05	0.10
Nov-07	0.09	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.15	0.68	0.22	0.12
Nov-08	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	4.7	0.38		0.47
Nov-10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.215	0.292	3.21	0.067	0.35
Jan-13	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.22	0.05	0.06
Dec-17	0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Sulphate in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	159	299	78	433	362	713	1012		260	116	83	208	123	320.50
Nov-07	100	210	50	73	270	150	470	150	270	130	76	190	130	174.54
Nov-08	150	250	50	60	130	110	540	180	280	92	160	70		172.67
Nov-10	124	208	49.9	13.4	562	110	556	140		115	78.2	250	116	193.54
Jan-13	163	242	245	63	242	154	211	130	189	227	53.2	217	103	172.25
Dec-17	154	222	459		112	90.6	88.2	75.7	41	57.5	45.5	116	91.9	129.45

Chloride in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	920	98	73	200	190	430	91		110	57	63	2000	19	354.25
Nov-07	159	299	78	433	362	713	1012		260	116	83	208	123	320.50
Nov-08	920	98	73	200	190	430	91	110	57	63	2000	19		354.25
Jan-10				352		513				320	61.5	12000		
Nov-10	574	233	44.6	251	1830	824		79		121	25.4	5020		900.20
Dec-11		146.00		204	179	638	103				26.4	3250		649.49
Jan-13	1310	153	97.6	215	235	599	74.3	80.7	70.3	583	17.5	2650	387	497.88
Dec-17	970	106	88.8		94.7	525	22.8	37.7	16.9	35	21.9	1440	341	308.32

Phosphate in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	1.17	5	0.08	1	0.21	1.39	5.11		8.23	0.08	0.08	0.08	4.27	2.23
Nov-07	5.4	0.44	0.08	2.1	0.22	2.5	4	1.4	6.9	0.64	0.09	0.34	8	2.47
Nov-08	3	0.4	0.08	1.9	0.08	1.9	7.4	7.5	4.7	0.36	0.25	0.16		2.31
Nov-10	2.4	0.316	0.328	0.05	0.388	6.79	12.6	6.21		0.28	0.05	0.8	1.99	2.68
Jan-13	1.52	0.305	18.3	0.061	0.5	4.99	4.83	3.57	13.3	4.24	0.12	0.233	0.726	4.05
Dec-17	1.43	1.61	17.7		0.05	4.21	1.97	1.03	0.238	1.2	0.05	0.051	2.3	2.65

Bromide in mg/l

Date	BH1	BH3	BH5	BH6	BH7	BH8	BH9	BH10	BH11	BH105	BH108	BH110	BH113	Average
Nov-06	3.7	2.4	0.4	10.6	8.6	6			1.5	0.5	0.6	5.4	2.8	3.86
Nov-07	2.6	1	1.1	1.2	1.3	1	1.8	0.9	1.3	1.3	0.3	23	3.8	3.12
Nov-08	1.6	0.5	1.1	0.7	0.5	0.5	0.2	0.2	0.2	0.5	8.1	0.4		1.21
Nov-10	1.72	1.13	0.269	0.683	0.768	1.21	2.27	1.48		1.84	0.535		3.77	1.43
Jan-13	1.91	1.31	0.199	0.943	0.487	1.82	1.61	1.5	1.5	1.44	0.369	1.79	0.807	1.21
Dec-17	0.06	0.832	0.06		0.4	1.15	0.806	0.978	0.171	2.53	0.292	0.06	0.06	0.62

Table 2 - Groundwater Analysis Results
Cabot Carbon Ltd

Location_Code		BH1	BH3	BH5A	BH7	BH8	BH9	BH10	BH10	BH11A	BH105	BH108	BH110	BH113
Sample_Type	Field_B	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal	Normal	Normal	Normal	Normal

Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_EQS-Fresh														
	Formaldehyde	mg/L		0.005[#5]	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	-
Metals	Arsenic (Filtered)	µg/L	0.5	50[#2]	<0.5	17.5	0.82	47.2	14.1	8.73	3.91	3.17	3.47	1.5	2.53	0.918	6.16	4.7
	Boron (Filtered)	µg/L	5	2,000[#6]	-	741	554	3230	137	793	647	539	1070	150	81.9	79.2	1400	2230
	Cadmium (Filtered)	µg/L	0.08	0.08[#3]	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.0979	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
	Chromium (III+VI) (Filtered)	µg/L	1		4.69	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Copper (Filtered)	µg/L	0.3	1[#2]	<0.3	12.8	1.67	2.04	<0.3	<0.3	2.86	<0.3	<0.3	5.07	2.78	0.706	<0.3	1.46
	Lead (Filtered)	µg/L	0.2	1.2[#3]	<0.2	<0.2	<0.2	0.566	<0.2	0.233	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Nickel (Filtered)	µg/L	0.4	4[#3]	<0.4	0.493	0.919	1.39	1.39	2.28	7.33	2.15	1.48	<0.4	<0.4	<0.4	6.85	1.59
	Selenium (Filtered)	µg/L	0.5		<0.5	<0.5	1.19	<0.5	<0.5	2.22	0.501	<0.5	<0.5	1.94	4.8	9.12	1.29	<0.5
	Zinc (Filtered)	µg/L	1	10.9[#2]	<1	1.4	11.4	4.6	<1	3.28	2.72	2.11	<1	<1	3.24	1.37	2.49	<1
	Chromium (hexavalent)	µg/L	30	3.4[#2]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
	Chromium (Trivalent)	µg/L	30	4.7[#2]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Inorganics	Acidity	mg/L	4		<4	16.4	36.5	7.3	14.6	14.6	16.4	11	16.4	<4	12.8	5.48	9.13	16.4
	BOD	mg/L	1		-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Bromide	µg/L	60		<60	<60	832	<60	400	1150	806	978	1080	171	2530	292	<60	<60
	Chloride	mg/L	2	250[#6]	<2	970	106	88.8	94.7	525	22.8	37.7	47.5	16.9	35	21.9	1440	341
	Nitrate (as NO3-)	mg/L	0.3		<0.3	<0.3	4.8	<0.3	<0.3	0.81	<0.3	<0.3	<0.3	2.75	5.76	10.4	0.836	0.99
	Nitrite (as NO2-)	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Sulphide	mg/L	0.01		<0.01	0.0449	<0.01	<0.01	0.0308	0.0408	0.0497	<0.01	<0.01	<0.01	0.0361	0.0258	0.145	0.0658
	Phosphate	µg/L	50		<50	1430	161	17,700	<50	4210	1970	1030	1700	238	1200	<50	51	2300
	Alkalinity (total) as CaCO3	mg/L	2		5	590	575	1470	325	485	465	450	505	215	250	155	1150	900
	Sulphate (soluble)	mg/L	2		<2	154	222	459	112	90.6	88.2	75.7	78.7	41	57.5	45.5	116	91.9
	COD	mg/L	7		<7	45.6	7.14	63.9	13.9	29.6	18.1	23.1	25.7	50.8	7	7.81	52.6	51.4
	pH (Lab)	pH_Units	1		6.78	7.63	7.39	8.11	7.53	7.67	7.23	7.68	7.78	8.07	7.73	8.16	8.25	7.93

Statistical Summary

Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects Only)
6	0	<0.05	ND	<0.05	ND	0.025	0.025	0	6	0
7	6	<0.5	0.82	47.2	47.2	13	8.73	16	0	0
6	6	137	137	3230	3230	1017	694	1109	1	1
7	1	<0.08	0.0979	0.0979	0.0979	0.048	0.04	0.022	1	1
7	1	<1	4.69	4.69	4.69	1.1	0.5	1.6	0	0
7	4	<0.3	1.67	12.8	12.8	2.8	1.67	4.5	4	4
7	2	<0.2	0.233	0.566	0.566	0.19	0.1	0.17	0	0
7	6	<0.4	0.493	7.33	7.33	2	1.39	2.4	1	1
7	3	<0.5	0.501	2.22	2.22	0.7	0.25	0.75	0	0
7	5	<1	1.4	11.4	11.4	3.5	2.72	3.8	1	1
7	0	<30	ND	<30	ND	15	15	0	7	0
7	0	<30	ND	<30	ND	15	15	0	7	0
7	6	<4	7.3	36.5	36.5	15	14.6	11	0	0
6	0	<1	ND	<1	ND	0.5	0.5	0	0	0
7	4	<60	400	1150	1150	468	400	464	0	0
7	6	<2	22.8	970	970	258	94.7	360	2	2
7	2	<0.3	0.81	4.8	4.8	0.91	0.15	1.7	0	0
7	0	<0.05	ND	<0.05	ND	0.025	0.025	0	0	0
7	4	<0.01	0.0308	0.0497	0.0497	0.026	0.0308	0.02	0	0
7	5	<50	161	17700	17700	3646	1430	6376	0	0
7	7	5	5	1470	1470	559	485	449	0	0
7	6	<2	88.2	459	459	161	112	148	0	0
7	6	<7	7.14	63.9	63.9	26	18.1	22	0	0
7	7	6.78	6.78	8.11	8.11	7.5	7.53	0.41	0	0

Comments
#1 WFD England/Wales. 2015 - MAC-EQS Inland
#2 WFD England/Wales. 2015 - Freshwater Standards
#3 WFD England/Wales. 2015 - AA-EQS Inland
#4 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#5 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#6 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#7 PNEC (EU REACH) - Freshwater
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed
Field_D: Field Duplicate

Key
XXX Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater

Field Duplicates (water)

SDG	171216-13	171216-13	
Field_ID	BH10	DUP01	RPD
Sampled_	14/12/2017	14/12/2017	

Chem_Group	ChemName	Units	EQL			
	Acidity	mg/l	4	11	16.4	39
Inorganics	BOD	mg/l	1	<1	<1	0
	Bromide	µg/l	60	978	1080	10
	Chloride	mg/l	2	37.7	47.5	23
	Nitrate (as NO3-)	mg/l	0.3	<0.3	<0.3	0
	Nitrite (as NO2-)	mg/l	0.05	<0.05	<0.05	0
	Sulphide	mg/l	0.01	<0.01	<0.01	0
	Phosphate	µg/l	50	**1030**	**1700**	**49**
	Alkalinity (total) as CaCO3	mg/l	2	450	505	12
	Sulphate (soluble)	mg/l	2	75.7	78.7	4
	COD	mg/l	7	23.1	25.7	11
	pH (Lab)	pH_Units	1	7.68	7.78	1
Metals	Arsenic (Filtered)	µg/l	0.5	3.17	3.47	9
	Boron (Filtered)	µg/l	5	**539**	**1070**	**66**
	Cadmium (Filtered)	µg/l	0.08	<0.08	<0.08	0
	Chromium (III+VI) (Filtered)	µg/l	1	<1	<1	0
	Copper (Filtered)	µg/l	0.3	<0.3	<0.3	0
	Lead (Filtered)	µg/l	0.2	<0.2	<0.2	0
	Nickel (Filtered)	µg/l	0.4	2.15	1.48	37
	Selenium (Filtered)	µg/l	0.5	<0.5	<0.5	0
	Zinc (Filtered)	µg/l	1	2.11	<1	71
	Chromium (hexavalent)	µg/l	30	<30	<30	0
	Chromium (Trivalent)	µg/l	30	<30	<30	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 100 (1-10 x EQL); 50 (10-20 x EQL); 30 (> 20 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Field Blanks (water)

SDG	171216-26
Field_ID	EB
Sampled_Date-Time	15/12/2017
Sample_Type	Field_B

Chem_Group	ChemName	Units	EQL	
	Acidity	mg/l	4	<4
Inorganics	BOD	mg/l	1	
	Bromide	µg/l	60	<60
	Chloride	mg/l	2	<2
	Nitrate (as NO3-)	mg/l	0.3	<0.3
	Nitrite (as NO2-)	mg/l	0.05	<0.05
	Sulphide	mg/l	0.01	<0.01
	Phosphate	µg/l	50	<50
	Alkalinity (total) as CaCO3	mg/l	2	**5**
	Sulphate (soluble)	mg/l	2	<2
	COD	mg/l	7	<7
	pH (Lab)	pH_Units	1	**6.78**
Metals	Arsenic (Filtered)	µg/l	0.5	<0.5
	Boron (Filtered)	µg/l	5	
	Cadmium (Filtered)	µg/l	0.08	<0.08
	Chromium (III+VI) (Filtered)	µg/l	1	**4.69**
	Copper (Filtered)	µg/l	0.3	<0.3
	Lead (Filtered)	µg/l	0.2	<0.2
	Nickel (Filtered)	µg/l	0.4	<0.4
	Selenium (Filtered)	µg/l	0.5	<0.5
	Zinc (Filtered)	µg/l	1	<1
	Chromium (hexavalent)	µg/l	30	<30
	Chromium (Trivalent)	µg/l	30	<30

Appendix D - Laboratory MCERTS

James Cochrane
AECOM Infrastructure & Environment UK limited
1 Callaghan Square
Cardiff
CF10 5BT

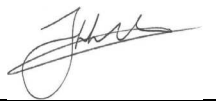
e: james.cochrane@aecom.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 17-70981

Project / Site name:	Cabot Carbon	**Samples received on:**	18/12/2017
Your job number:		**Samples instructed on:**	18/12/2017
Your order number:		**Analysis completed by:**	21/12/2017
Report Issue Number:	1	**Report issued on:**	21/12/2017
Samples Analysed:	10 water samples		

Signed: 

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 17-70981

Project / Site name: Cabot Carbon

Lab Sample Number				877456	877457	877458	877459	877460
Sample Reference				BH11A	BH10	BH9	BH110	BH8
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				15/12/2017	15/12/2017	15/12/2017	15/12/2017	15/12/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Environmental Forensics								
Formaldehyde	µg/l	50	NONE	< 50	< 50	< 50	< 50	< 50

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 17-70981

Project / Site name: Cabot Carbon

Lab Sample Number				877461	877462	877463	877464	877465
Sample Reference				BH7	BH105	BH1	BH5A	BH3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				15/12/2017	15/12/2017	15/12/2017	15/12/2017	15/12/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Environmental Forensics								
Formaldehyde	µg/l	50	NONE	< 50	< 50	< 50	< 50	< 50

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 17-70981

Project / Site name: Cabot Carbon

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TO - Aldehyde in water	Determination of aldehydes by LC-UV	In-house method based on EPA 8315		W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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

Aecom
1 Callaghan Square
Cardiff
CF10 5BT

Attention: James Cochrane

CERTIFICATE OF ANALYSIS

Date:	29 December 2017
Customer:	H_AECOM_CDF
Sample Delivery Group (SDG):	171216-13
Your Reference:	60560304
Location:	CABOT CARBON
Report No:	438411

We received 7 samples on Saturday December 16, 2017 and 7 of these samples were scheduled for analysis which was completed on Friday December 29, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

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

Approved By:

Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	171216-13	**Client Reference:**	60560304	**Report Number:**	438411
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
16771940	BH1			14/12/2017
16771938	BH7			14/12/2017
16771935	BH8			14/12/2017
16771936	BH9			14/12/2017
16771941	BH10			14/12/2017
16771937	BH105			14/12/2017
16771942	DUP01			14/12/2017

Maximum Sample/Coolbox Temperature (°C) : **3.8**

ISO5667-3 Water quality - Sampling - Part3 -
During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

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

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

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-13	**Client Reference:**	60560304	**Report Number:**	438411
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

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

Lab Sample No(s)						16771940					16771938					16771935				16771936
Customer Sample Reference						BH1					BH7					BH8				BH9
AGS Reference																				
Depth (m)																				
Container						1plastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)	ZnAc (ALE246)	1plastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)	ZnAc (ALE246)	1plastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)	ZnAc (ALE246)	1plastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)
Sample Type						GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Acidity as HCl	All	NDPs: 0 Tests: 7				X					X					X					X			
Alkalinity as CaCO3	All	NDPs: 0 Tests: 7				X					X					X					X			
Anions by ion Chromatography	All	NDPs: 0 Tests: 7				X					X					X					X			
Anions by Kone (w)	All	NDPs: 0 Tests: 7				X					X					X					X			
BOD True Total	All	NDPs: 0 Tests: 7					X					X					X					X		
Chromium III	All	NDPs: 0 Tests: 7						X					X					X					X	
COD Unfiltered	All	NDPs: 0 Tests: 7					X					X					X					X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 7						X					X					X					X	
Hexavalent Chromium (w)	All	NDPs: 0 Tests: 7				X					X					X					X			
Nitrite by Kone (w)	All	NDPs: 0 Tests: 7							X					X					X					X
pH Value	All	NDPs: 0 Tests: 7				X					X					X					X			
Phosphate by Kone (w)	All	NDPs: 0 Tests: 7				X					X					X					X			
Sulphide	All	NDPs: 0 Tests: 7								X					X					X				

16771942	DUP01			ZnAc (ALE246)	GW																X
				NaOH (ALE245)	GW												X				
				HNO3 Filtered (ALE204)	GW						X		X								
				250ml BOD (ALE212)	GW					X		X									
				1lplastic (ALE221)	GW	X	X	X	X					X				X		X	
16771937	BH105			ZnAc (ALE246)	GW																X
				NaOH (ALE245)	GW												X				
				HNO3 Filtered (ALE204)	GW						X		X								
				250ml BOD (ALE212)	GW					X		X									
				1lplastic (ALE221)	GW	X	X	X	X					X				X		X	
16771941	BH10			ZnAc (ALE246)	GW																X
				NaOH (ALE245)	GW												X				
				HNO3 Filtered (ALE204)	GW						X		X								
				250ml BOD (ALE212)	GW					X		X									
				1lplastic (ALE221)	GW	X	X	X	X					X				X		X	
16771936	BH9			ZnAc (ALE246)	GW																X

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-13	**Client Reference:**	60560304	**Report Number:**	438411
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH1	BH7	BH8	BH9	BH10	BH105
			Depth (m)	.	.	.	.	.	.
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	14/12/2017	14/12/2017	14/12/2017	14/12/2017	14/12/2017	14/12/2017
			Sample Time	.	.	.	.	.	.
			Date Received	16/12/2017	16/12/2017	16/12/2017	16/12/2017	16/12/2017	16/12/2017
			SDG Ref	171216-13	171216-13	171216-13	171216-13	171216-13	171216-13
			Lab Sample No.(s)	16771940	16771938	16771935	16771936	16771941	16771937
			AGS Reference						
Alkalinity, Total as CaCO3	<2 mg/l	TM043		590 #	325 #	485 #	465 #	450 #	250 #
BOD, unfiltered	<1 mg/l	TM045		<1 ♦ #	<1 ♦ #	<1 ♦ #	<1 ♦ #	<1 ♦ #	<1 ♦ #
Acidity as HCl	<4 mg/l	TM094		16.4	14.6	14.6	16.4	11	12.8
Sulphide	<0.01 mg/l	TM101		0.0449 #	0.0308 #	0.0408 #	0.0497 #	<0.01 #	0.0361 #
COD, unfiltered	<7 mg/l	TM107		45.6 #	13.9 #	29.6 #	18.1 #	23.1 #	7 #
Chromium, Trivalent	<0.03 mg/l	TM152		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Arsenic (diss.filt)	<0.5 µg/l	TM152		17.5 #	14.1 #	8.73 #	3.91 #	3.17 #	2.53 #
Boron (diss.filt)	<5 µg/l	TM152		741 #	137 #	793 #	647 #	539 #	81.9 #
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	<0.08 #	<0.08 #	0.0979 #	<0.08 #	<0.08 #
Chromium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Copper (diss.filt)	<0.3 µg/l	TM152		12.8 #	<0.3 #	<0.3 #	2.86 #	<0.3 #	2.78 #
Lead (diss.filt)	<0.2 µg/l	TM152		<0.2 #	<0.2 #	0.233 #	<0.2 #	<0.2 #	<0.2 #
Nickel (diss.filt)	<0.4 µg/l	TM152		0.493 #	1.39 #	2.28 #	7.33 #	2.15 #	<0.4 #
Selenium (diss.filt)	<0.5 µg/l	TM152		<0.5 #	<0.5 #	2.22 #	0.501 #	<0.5 #	4.8 #
Zinc (diss.filt)	<1 µg/l	TM152		1.4 #	<1 #	3.28 #	2.72 #	2.11 #	3.24 #
Nitrite as NO2	<0.05 mg/l	TM184		<0.05 #	<0.05 #	<0.05 #	<0.05 #	<0.05 #	<0.05 #
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184		1.43 #	<0.05 #	4.21 #	1.97 #	1.03 #	1.2 #
Sulphate	<2 mg/l	TM184		154 #	112 #	90.6 #	88.2 #	75.7 #	57.5 #
Chloride	<2 mg/l	TM184		970 #	94.7 #	525 #	22.8 #	37.7 #	35 #
Nitrate as NO3	<0.3 mg/l	TM184		<0.3	<0.3	0.81	<0.3	<0.3	5.76
Bromide	<0.06 mg/l	TM226		<0.06 #	0.4 #	1.15 #	0.806 #	0.978 #	2.53 #
Chromium, Hexavalent	<0.03 mg/l	TM241		<0.03 #	<0.03 #	<0.03 #	<0.03 #	<0.03 #	<0.03 #
pH	<1 pH Units	TM256		7.63 #	7.53 #	7.67 #	7.23 #	7.68 #	7.73 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-13	**Client Reference:**	60560304	**Report Number:**	438411
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Customer Sample Ref.			DUP01					
Depth (m)			.					
Sample Type			Ground Water (GW)					
Date Sampled			14/12/2017					
Sample Time			.					
Date Received			16/12/2017					
SDG Ref			171216-13					
Lab Sample No.(s)			16771942					
AGS Reference								
Component	**LOD/Units**	**Method**						
Alkalinity, Total as CaCO3	<2 mg/l	TM043	505 #					
BOD, unfiltered	<1 mg/l	TM045	<1 ♦ #					
Acidity as HCl	<4 mg/l	TM094	16.4					
Sulphide	<0.01 mg/l	TM101	<0.01 #					
COD, unfiltered	<7 mg/l	TM107	25.7 #					
Chromium, Trivalent	<0.03 mg/l	TM152	<0.03					
Arsenic (diss.filt)	<0.5 µg/l	TM152	3.47 #					
Boron (diss.filt)	<5 µg/l	TM152	1070 #					
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #					
Chromium (diss.filt)	<1 µg/l	TM152	<1 #					
Copper (diss.filt)	<0.3 µg/l	TM152	<0.3 #					
Lead (diss.filt)	<0.2 µg/l	TM152	<0.2 #					
Nickel (diss.filt)	<0.4 µg/l	TM152	1.48 #					
Selenium (diss.filt)	<0.5 µg/l	TM152	<0.5 #					
Zinc (diss.filt)	<1 µg/l	TM152	<1 #					
Nitrite as NO2	<0.05 mg/l	TM184	<0.05 #					
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184	1.7 #					
Sulphate	<2 mg/l	TM184	78.7 #					
Chloride	<2 mg/l	TM184	47.5 #					
Nitrate as NO3	<0.3 mg/l	TM184	<0.3					
Bromide	<0.06 mg/l	TM226	1.08 #					
Chromium, Hexavalent	<0.03 mg/l	TM241	<0.03 #					
pH	<1 pH Units	TM256	7.78 #					

CERTIFICATE OF ANALYSIS

SDG:	171216-13	**Client Reference:**	60560304	**Report Number:**	438411
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM094	Method 2310B, AWWA/APHA, 19th Ed., 1981	Determination of Acidity by titration
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM226	In-House Method	Determination of Anions in Waters using Ion Chromatography
TM241	Methods for the Examination of Waters and Associated Materials; Chromium in Raw and Potable Waters and Sewage Effluents 1980.	The Determination of Hexavalent Chromium in Waters and Leachates using the Kone Analyser
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

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

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-13	**Client Reference:**	60560304	**Report Number:**	438411
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	16771940	16771938	16771935	16771936	16771941	16771937	16771942
Customer Sample Ref.	BH1	BH7	BH8	BH9	BH10	BH105	DUP01
AGS Ref.							
Depth							
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Acidity as HCl	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Alkalinity as CaCO3	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Anions by ion Chromatography	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017
Anions by Kone (w)	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017
BOD True Total	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017
Chromium III	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017
COD Unfiltered	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Dissolved Metals by ICP-MS	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017
Hexavalent Chromium (w)	22-Dec-2017	22-Dec-2017	21-Dec-2017	21-Dec-2017	22-Dec-2017	21-Dec-2017	22-Dec-2017
Nitrite by Kone (w)	22-Dec-2017	22-Dec-2017	21-Dec-2017	21-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017
pH Value	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Phosphate by Kone (w)	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017
Sulphide	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017

Appendix General

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

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

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

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

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

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

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

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

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

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

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

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

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

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

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

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

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

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

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

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

Sample Deviations

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

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

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

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

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

Visual Estimation Of Fibre Content

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

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

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

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

Aecom
1 Callaghan Square
Cardiff
CF10 5BT

Attention: James Cochrane

CERTIFICATE OF ANALYSIS

Date:	29 December 2017
Customer:	H_AECOM_CDF
Sample Delivery Group (SDG):	171216-26
Your Reference:	60560304
Location:	CABOT CARBON
Report No:	438412

We received 7 samples on Saturday December 16, 2017 and 7 of these samples were scheduled for analysis which was completed on Friday December 29, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

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

Approved By:

Sonia McWhan
Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	171216-26	**Client Reference:**	60560304	**Report Number:**	438412
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
16772970	BH3			15/12/2017
16772966	BH108			15/12/2017
16772968	BH110			15/12/2017
16772965	BH113			15/12/2017
16772969	BH5A			15/12/2017
16772967	BH11A			15/12/2017
16772971	EB			15/12/2017

Maximum Sample/Coolbox Temperature (°C) :

ISO5667-3 Water quality - Sampling - Part3 -

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

6.2

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

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

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-26	**Client Reference:**	60560304	**Report Number:**	438412
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

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

Lab Sample No(s)					16772970					16772966				16772968		16772965				16772969	
Customer Sample Reference					BH3					BH108				BH110		BH113				BH5A	
AGS Reference																					
Depth (m)																					
Container					1lplastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)	ZnAc (ALE246)	1lplastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)	ZnAc (ALE246)	1lplastic (ALE221)	250ml BOD (ALE212)	1lplastic (ALE221)	250ml BOD (ALE212)	HNO3 Filtered (ALE204)	NaOH (ALE245)	ZnAc (ALE246)	1lplastic (ALE221)	250ml BOD (ALE212)
Sample Type					GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Acidity as HCl	All	NDPs: 0 Tests: 7			X					X					X		X					X	
Alkalinity as CaCO3	All	NDPs: 0 Tests: 7			X					X					X		X					X	
Anions by ion Chromatography	All	NDPs: 0 Tests: 7			X					X					X		X					X	
Anions by Kone (w)	All	NDPs: 0 Tests: 7			X					X					X		X					X	
BOD True Total	All	NDPs: 0 Tests: 6				X					X					X		X					X
Chromium III	All	NDPs: 0 Tests: 7					X					X			X				X				
COD Unfiltered	All	NDPs: 0 Tests: 7				X					X					X		X					X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 7					X					X			X				X				
Hexavalent Chromium (w)	All	NDPs: 0 Tests: 7			X					X					X		X					X	
Nitrite by Kone (w)	All	NDPs: 0 Tests: 7						X					X		X					X			
pH Value	All	NDPs: 0 Tests: 7			X					X					X		X					X	
Phosphate by Kone (w)	All	NDPs: 0 Tests: 7			X					X					X		X					X	
Sulphide	All	NDPs: 0 Tests: 7							X					X	X						X		

16772971	EB			ZnAc (ALE246)	GW													X
				NaOH (ALE245)	GW										X			
				250ml BOD (ALE212)	GW							X						
				1lplastic (ALE221)	GW	X	X	X	X		X		X	X		X	X	
16772967	BH11A			ZnAc (ALE246)	GW													X
				NaOH (ALE245)	GW										X			
				HNO3 Filtered (ALE204)	GW						X		X					
				250ml BOD (ALE212)	GW					X		X						
				1lplastic (ALE221)	GW	X	X	X	X					X		X	X	
16772969	BH5A			ZnAc (ALE246)	GW													X
				NaOH (ALE245)	GW										X			
				HNO3 Filtered (ALE204)	GW						X		X					

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-26	**Client Reference:**	60560304	**Report Number:**	438412
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH3	BH108	BH110	BH113	BH5A	BH11A
			Depth (m)	.	.	.	.	.	.
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	15/12/2017	15/12/2017	15/12/2017	15/12/2017	15/12/2017	15/12/2017
			Sample Time	.	.	.	.	.	.
			Date Received	16/12/2017	16/12/2017	16/12/2017	16/12/2017	16/12/2017	16/12/2017
			SDG Ref	171216-26	171216-26	171216-26	171216-26	171216-26	171216-26
			Lab Sample No.(s)	16772970	16772966	16772968	16772965	16772969	16772967
			AGS Reference						
Alkalinity, Total as CaCO3	<2 mg/l	TM043		575 #	155 #	1150 #	900 #	1470 #	215 #
BOD, unfiltered	<1 mg/l	TM045		<1 ♦ #	<1 ♦ #	<1 ♦ #	<1 ♦ #	<1 ♦ #	<1 ♦ #
Acidity as HCl	<4 mg/l	TM094		36.5	5.48	9.13	16.4	7.3	<4
Sulphide	<0.01 mg/l	TM101		<0.01 #	0.0258 #	0.145 #	0.0658 #	<0.01 #	<0.01 #
COD, unfiltered	<7 mg/l	TM107		7.14 #	7.81 #	52.6 #	51.4 #	63.9 #	50.8 #
Chromium, Trivalent	<0.03 mg/l	TM152		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Arsenic (diss.filt)	<0.5 µg/l	TM152		0.82 #	0.918 #	6.16 #	4.7 #	47.2 #	1.5 #
Boron (diss.filt)	<5 µg/l	TM152		554 #	79.2 #	1400 #	2230 #	3230 #	150 #
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	<0.08 #	<0.08 #	<0.08 #	<0.08 #	<0.08 #
Chromium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Copper (diss.filt)	<0.3 µg/l	TM152		1.67 #	0.706 #	<0.3 #	1.46 #	2.04 #	5.07 #
Lead (diss.filt)	<0.2 µg/l	TM152		<0.2 #	<0.2 #	<0.2 #	<0.2 #	0.566 #	<0.2 #
Nickel (diss.filt)	<0.4 µg/l	TM152		0.919 #	<0.4 #	6.85 #	1.59 #	1.39 #	<0.4 #
Selenium (diss.filt)	<0.5 µg/l	TM152		1.19 #	9.12 #	1.29 #	<0.5 #	<0.5 #	1.94 #
Zinc (diss.filt)	<1 µg/l	TM152		11.4 #	1.37 #	2.49 #	<1 #	4.6 #	<1 #
Nitrite as NO2	<0.05 mg/l	TM184		<0.05 #	<0.05 #	<0.05 2 #	<0.05 #	<0.05 #	<0.05 #
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184		0.161 #	<0.05 #	0.051 #	2.3 #	17.7 #	0.238 #
Sulphate	<2 mg/l	TM184		222 #	45.5 #	116 #	91.9 #	459 #	41 #
Chloride	<2 mg/l	TM184		106 #	21.9 #	1440 #	341 #	88.8 #	16.9 #
Nitrate as NO3	<0.3 mg/l	TM184		4.8	10.4	0.836	0.99	<0.3	2.75
Bromide	<0.06 mg/l	TM226		0.832 #	0.292 #	<0.06 #	<0.06 #	<0.06 #	0.171 #
Chromium, Hexavalent	<0.03 mg/l	TM241		<0.03 #	<0.03 #	<0.03 #	<0.03 #	<0.03 #	<0.03 #
pH	<1 pH Units	TM256		7.39 #	8.16 #	8.25 #	7.93 #	8.11 #	8.07 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-26	**Client Reference:**	60560304	**Report Number:**	438412
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Customer Sample Ref.			EB					
Depth (m)			.					
Sample Type			Ground Water (GW)					
Date Sampled			15/12/2017					
Sample Time			.					
Date Received			16/12/2017					
SDG Ref			171216-26					
Lab Sample No.(s)			16772971					
AGS Reference								
Component	**LOD/Units**	**Method**						
Alkalinity, Total as CaCO3	<2 mg/l	TM043	5 #					
Acidity as HCl	<4 mg/l	TM094	<4					
Sulphide	<0.01 mg/l	TM101	<0.01 #					
COD, unfiltered	<7 mg/l	TM107	<7 #					
Chromium, Trivalent	<0.03 mg/l	TM152	<0.03					
Arsenic (diss.filt)	<0.5 µg/l	TM152	<0.5 #					
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #					
Chromium (diss.filt)	<1 µg/l	TM152	4.69 #					
Copper (diss.filt)	<0.3 µg/l	TM152	<0.3 #					
Lead (diss.filt)	<0.2 µg/l	TM152	<0.2 #					
Nickel (diss.filt)	<0.4 µg/l	TM152	<0.4 #					
Selenium (diss.filt)	<0.5 µg/l	TM152	<0.5 #					
Zinc (diss.filt)	<1 µg/l	TM152	<1 #					
Nitrite as NO2	<0.05 mg/l	TM184	<0.05 #					
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184	<0.05 #					
Sulphate	<2 mg/l	TM184	<2 #					
Chloride	<2 mg/l	TM184	<2 #					
Nitrate as NO3	<0.3 mg/l	TM184	<0.3					
Bromide	<0.06 mg/l	TM226	<0.06 #					
Chromium, Hexavalent	<0.03 mg/l	TM241	<0.03 #					
pH	<1 pH Units	TM256	6.78 #					

CERTIFICATE OF ANALYSIS

SDG:	171216-26	**Client Reference:**	60560304	**Report Number:**	438412
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM094	Method 2310B, AWWA/APHA, 19th Ed., 1981	Determination of Acidity by titration
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM226	In-House Method	Determination of Anions in Waters using Ion Chromatography
TM241	Methods for the Examination of Waters and Associated Materials; Chromium in Raw and Potable Waters and Sewage Effluents 1980.	The Determination of Hexavalent Chromium in Waters and Leachates using the Kone Analyser
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

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

Validated

CERTIFICATE OF ANALYSIS

SDG:	171216-26	**Client Reference:**	60560304	**Report Number:**	438412
Location:	CABOT CARBON	**Order Number:**	60560304	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	16772970	16772966	16772968	16772965	16772969	16772967	16772971
Customer Sample Ref.	BH3	BH108	BH110	BH113	BH5A	BH11A	EB
AGS Ref.							
Depth							
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Acidity as HCl	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Alkalinity as CaCO3	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Anions by ion Chromatography	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017	29-Dec-2017
Anions by Kone (w)	21-Dec-2017	22-Dec-2017	21-Dec-2017	21-Dec-2017	22-Dec-2017	21-Dec-2017	22-Dec-2017
BOD True Total	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017	23-Dec-2017	
Chromium III	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	27-Dec-2017
COD Unfiltered	21-Dec-2017	21-Dec-2017	17-Dec-2017	17-Dec-2017	21-Dec-2017	17-Dec-2017	21-Dec-2017
Dissolved Metals by ICP-MS	27-Dec-2017	27-Dec-2017	27-Dec-2017	27-Dec-2017	27-Dec-2017	27-Dec-2017	27-Dec-2017
Fluoride	20-Dec-2017	19-Dec-2017	20-Dec-2017	19-Dec-2017	20-Dec-2017	19-Dec-2017	
Hexavalent Chromium (w)	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Nitrite by Kone (w)	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
pH Value	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017	21-Dec-2017
Phosphate by Kone (w)	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017
Sulphide	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017	22-Dec-2017

Appendix General

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

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

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

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

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

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

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

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

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

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

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

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

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

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

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

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

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

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

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

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

Sample Deviations

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

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

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

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

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

Visual Estimation Of Fibre Content

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

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

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