



# Easthouses Great Seam Borehole Survey

Produced by: Megan Nicholson

Checked by John Leyland

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## Summary

A CCTV survey was carried out on the Easthouses Great Seam Borehole (site ref 787.1) on the 11 July 2019. In addition to conductivity and temperature profiling, a calliper survey (which incorporates natural gamma) and sampling of water in the borehole was undertaken.

Immediately prior to the survey, water level was manually dipped at 47.84mBGL. This matched the water level observed by the CCTV survey at 47.8mBGL. The conductivity and temperature logs further confirm the water level.

The borehole was drilled in 2013 to workings in the Great Seam at a depth of 229.5 mBGL. Final completion details were:

- 168mm diameter solid casing from surface to 217 mBGL
- Open hole (unlined) from 217 mBGL to 229.5 mBGL

It was intended to take the water sample at 228 mBGL, 1 metre above the base of the borehole. On site it was decided to take the water sample at 225 mBGL, this decision was based on the casing level within the borehole, along with results from the conductivity and temperature probe.

The samples were tested in a laboratory at SOCOTEC Ltd (See laboratory UKAS report reference W28\_7271).

The calliper survey confirmed an average casing internal diameter of 160.8 mm. The survey showed no significant damage to the casing with a consistent diameter until approximately 210 mBGL, where the diameter appears to decrease in the last section of the casing. The open hole section showed a variable diameter, reaching a maximum of 338 mm at the bottom.

## Visual observations

The downhole CCTV camera survey was conducted to assess borehole condition, to identify potential obstructions and to provide a subjective assessment of water quality and/or stratification (as indicated by visibility/clarity). Key observations are included below:

- No visible water quality differences at both step changes (150 and 210 mBGL);
- Minor debris/suspended solids visible from 150 mBGL, the amount of debris increases gradually with depth;

- There is a clear reduction in clarity from 209 mBGL, visibility gradually deteriorates before being completely lost below 213 mBGL: and
- Debris accumulation appears to have caused a reduction of the borehole diameter and possibly an obstruction at 211 mBGL.

## Physical and Chemical Results

Water was encountered in the borehole at approximately 47.84 mBGL. The sample was taken approximately 5 m above the base of the borehole at 225 mBGL.

Summaries of chemical results are presented in **Table 1**, **Figure 4**, **Figure 5**, **Figure 6** and **Figure 7**.

The conductivity data shows two step changes in the borehole at approximately 150 mBGL and 210 mBGL (shown in **Figure 1** and **Figure 4**).

The temperature increases by approximately 5°C throughout the hole, with further increases at the two step changes.

**Table 1: Summary of selected laboratory results on the 4 samples taken during the survey**

Parameter	Sample Depth (mBGL)
	225
Iron (mg/l) Total	85.3
Iron (mg/l) Dissolved	66.3
pH	6.4
Sulphur as SO <sub>4</sub> (mg/l) Dissolved	2240
Chloride (mg/l)	68
Alkalinity as CaCO <sub>3</sub> (mg/l)	305
Electrical Conductivity (µS/cm at 25°C)	2910
On-site Temperature (°C)	14.5

Full results of laboratory analysis are presented in SOCOTEC laboratory UKAS report reference W28\_7271 included as appendix B.

## Comparison to Previous Surveys

The average casing internal diameter of the 2019 survey was 160.8 mm, the average of the 2016 survey was 162.4 mm. The calliper survey results were broadly similar to the 2016 results, both of the surveys showed a relatively consistent diameter throughout (**Figure 2**).

The main chemistry changes between the two surveys can be summarised as:

- The iron concentrations have increased by ~57 mg/L since the 2016 survey;
- The sulphate concentrations have decreased by ~500 mg/L since the 2016 survey;
- The chloride concentrations have increased by ~20 mg/L since the 2016 survey;

- The alkalinity results are within ~20 mg/L difference between the two surveys.

The temperature results from the 2019 survey show a ~1°C increase when compared to the 2016 survey (Figure 2). Overall, throughout the borehole the temperature profile remains the same as that of the 2016 survey, showing a gradual increase of approximately 4°C with borehole depth (**Figure 2**).

The conductivity results from the 2019 survey show two main step changes throughout the borehole, at 150 mBGL and 210 mBGL. This differs from the 2016 survey, which shows three main step changes at 170 mBGL, 190 mBGL and 210 mBGL (**Figure 3**).

The mine water level in the Easthouses mining system has risen by approximately 12m between 2016 and 2019 as measured in the Easthouses Great Seam Borehole. The water level at time of survey is indicated in the comparative figures (**Figure 4, Figure 5, Figure 6 and Figure 7**). The average rate of mine water rise in the period 2016 and 2019 was 4 m/year, this was also observed via the routine water level monitoring that has been ongoing in the period between the downhole surveys.

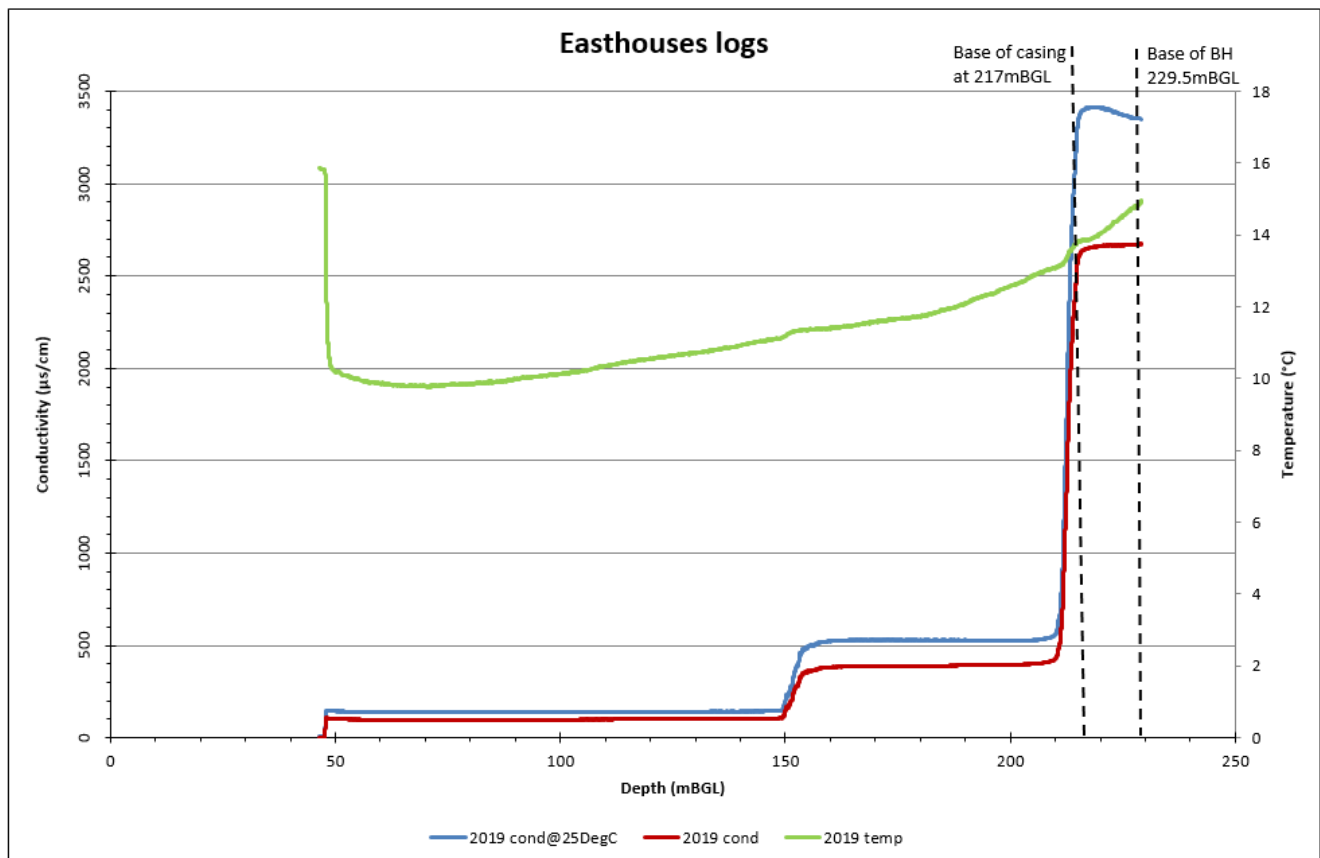


Figure 1: Graph showing all data for the 2019 survey. Including; conductivity, temperature and natural gamma

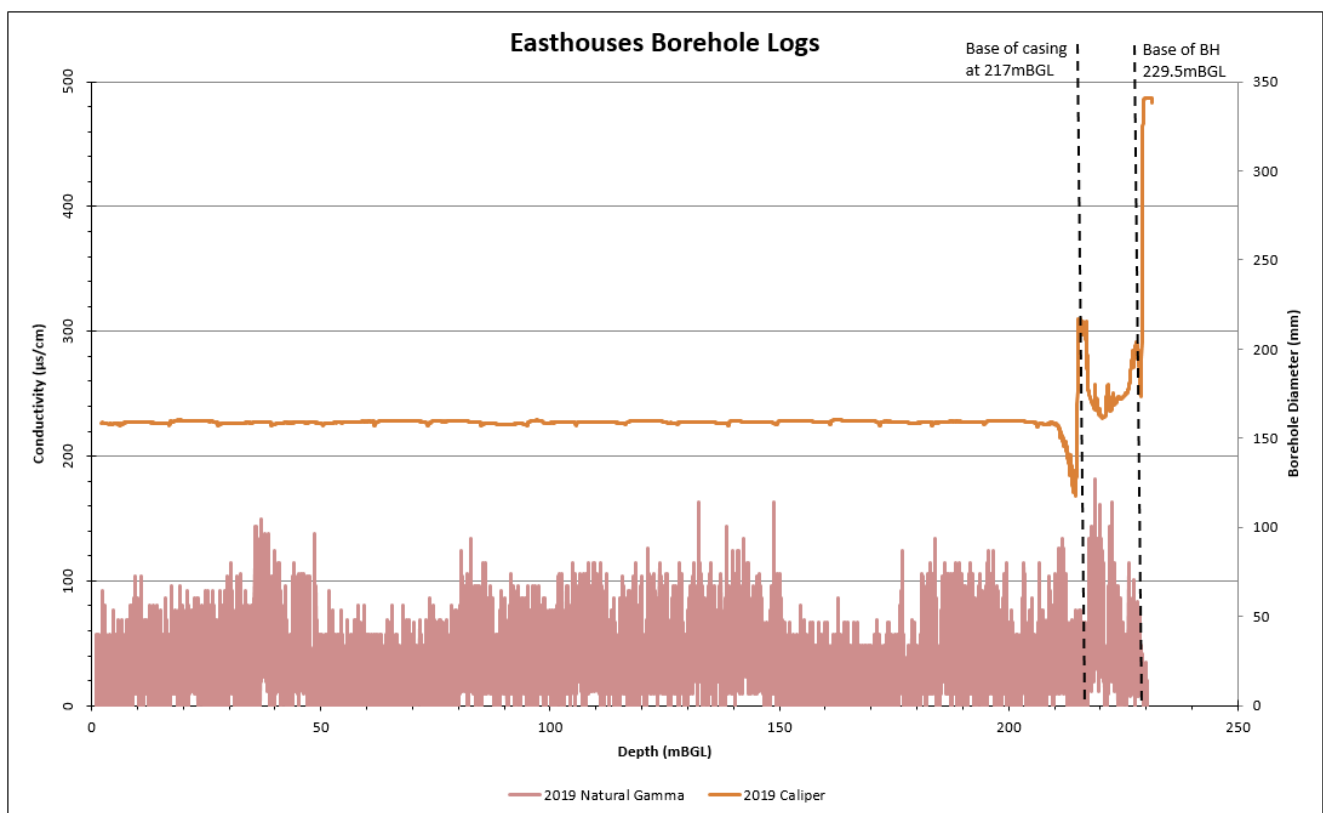


Figure 2: Natural gamma results against the calliper data for the 2019 survey

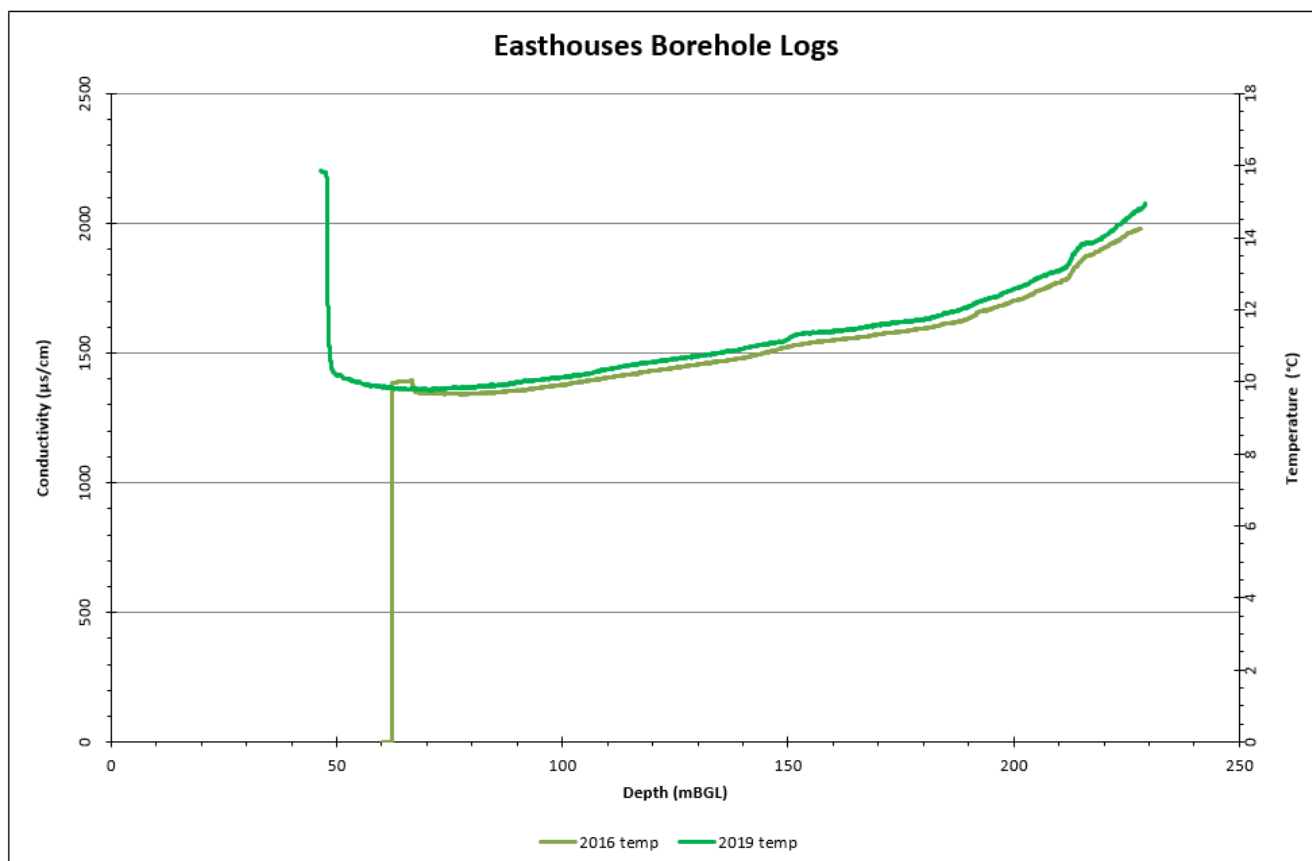


Figure 3: Graph showing the temperature data for the 2016 and 2019 surveys

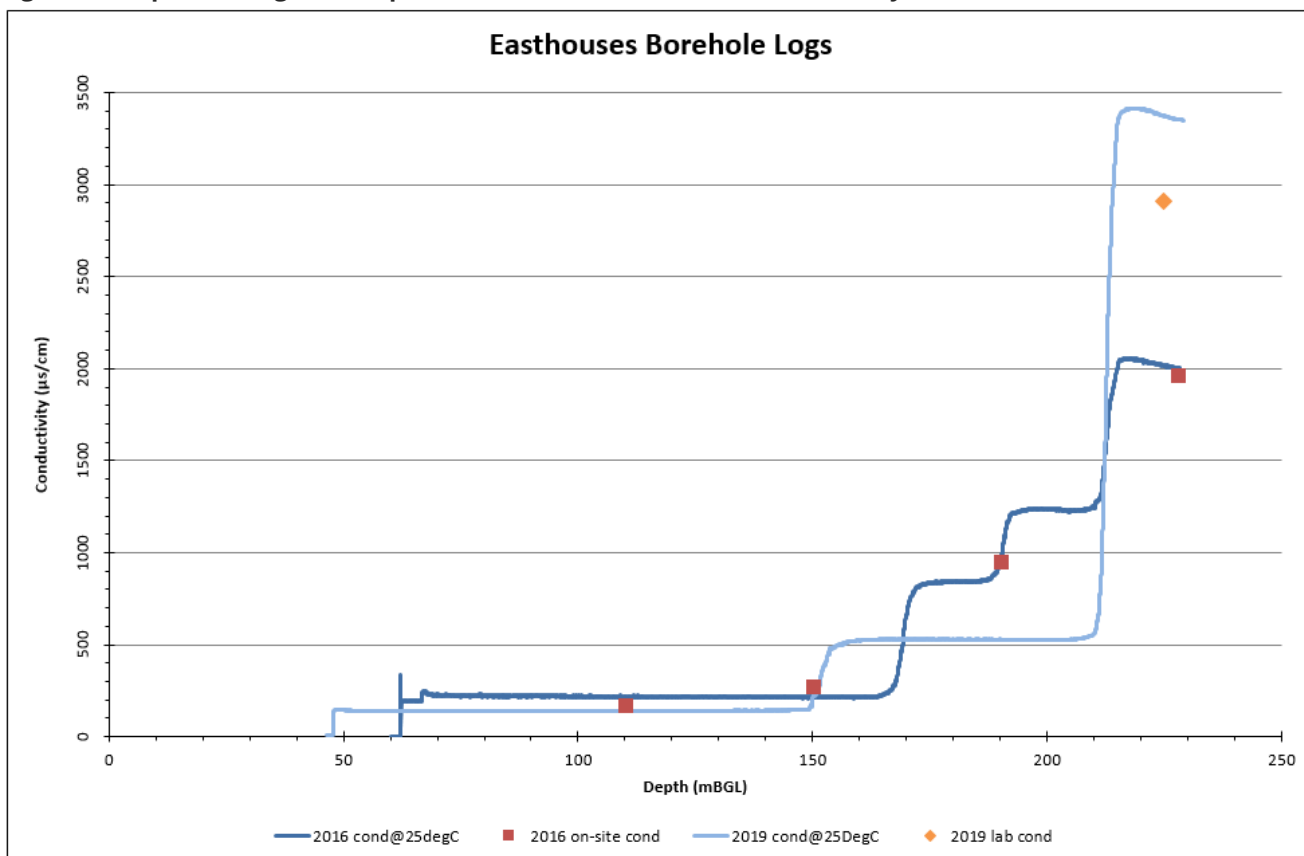


Figure 4: Graph showing the conductivity for the 2016 and 2019 surveys

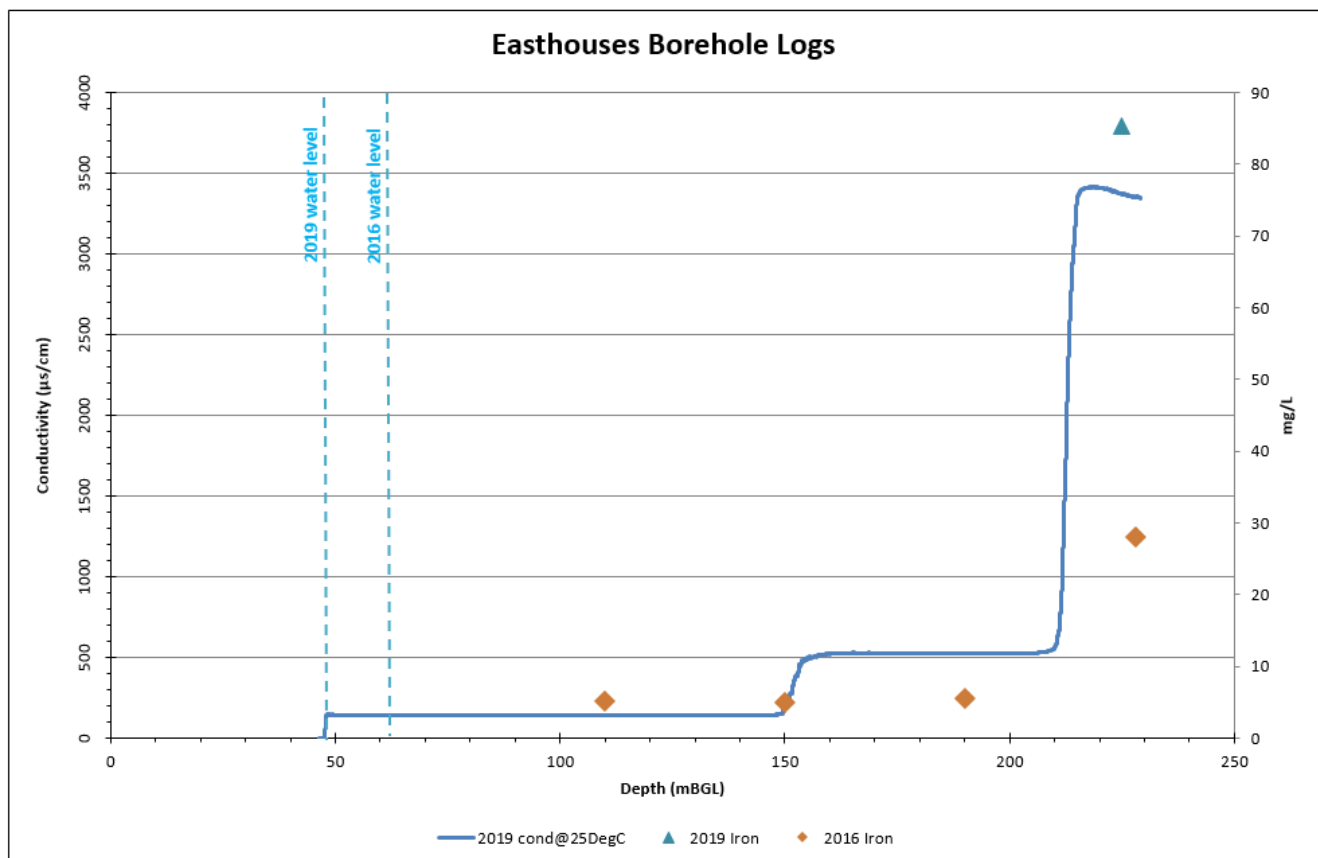


Figure 5: Graph showing the iron data from the 2016 and 2019 surveys

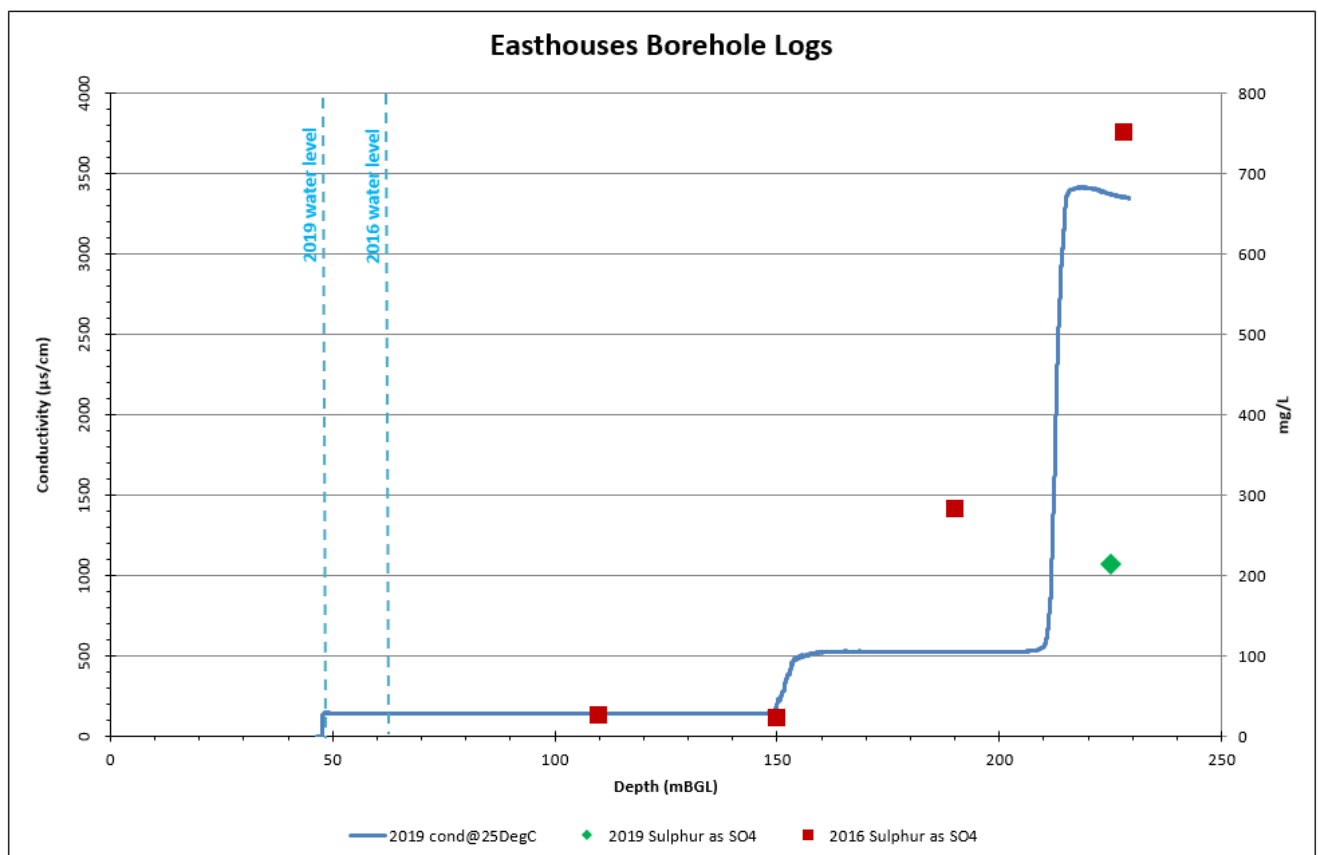


Figure 6: Graph showing the sulphur data from the 2016 and 2019 surveys

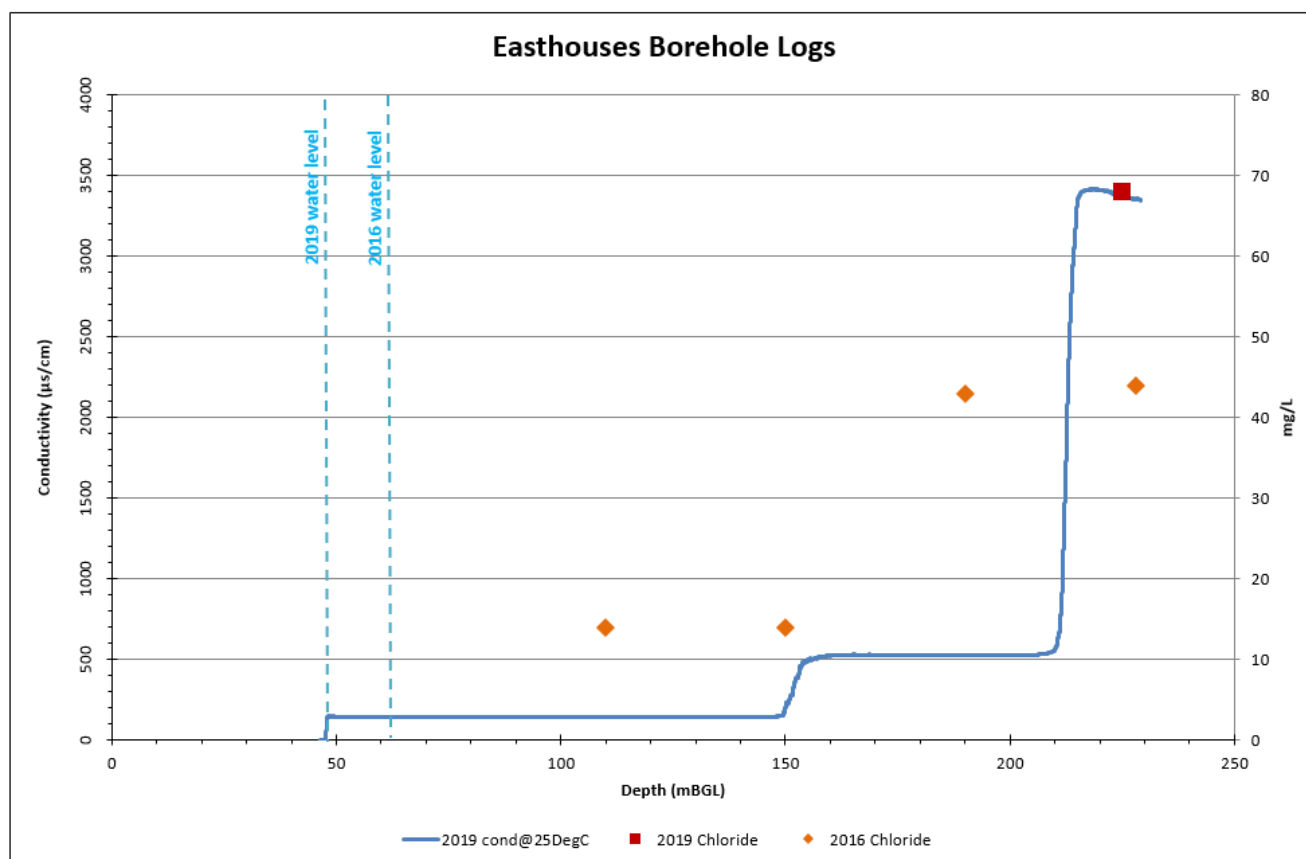


Figure 7: Graph showing the chloride data from the 2016 and 2019 surveys

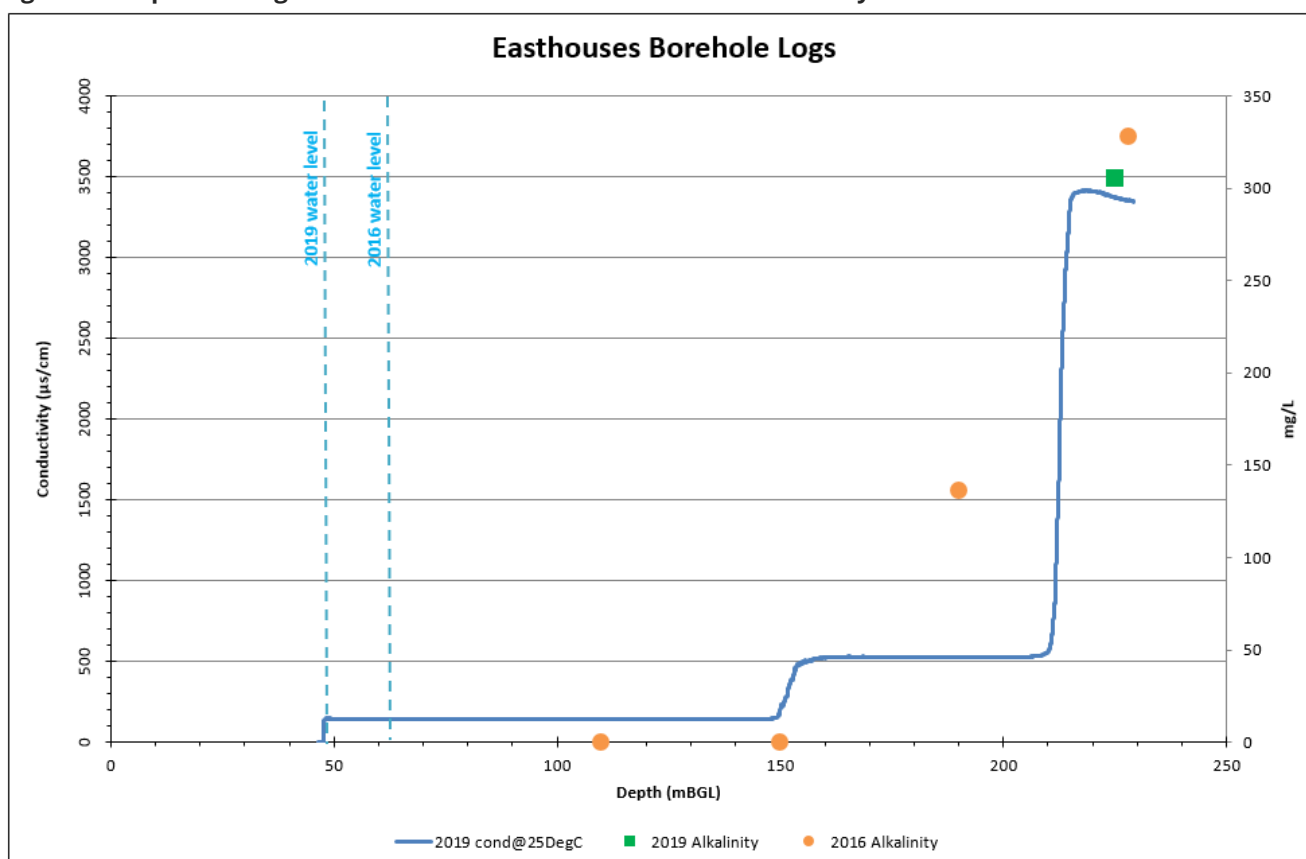


Figure 8: Graph showing the alkalinity data from 2016 and 2019

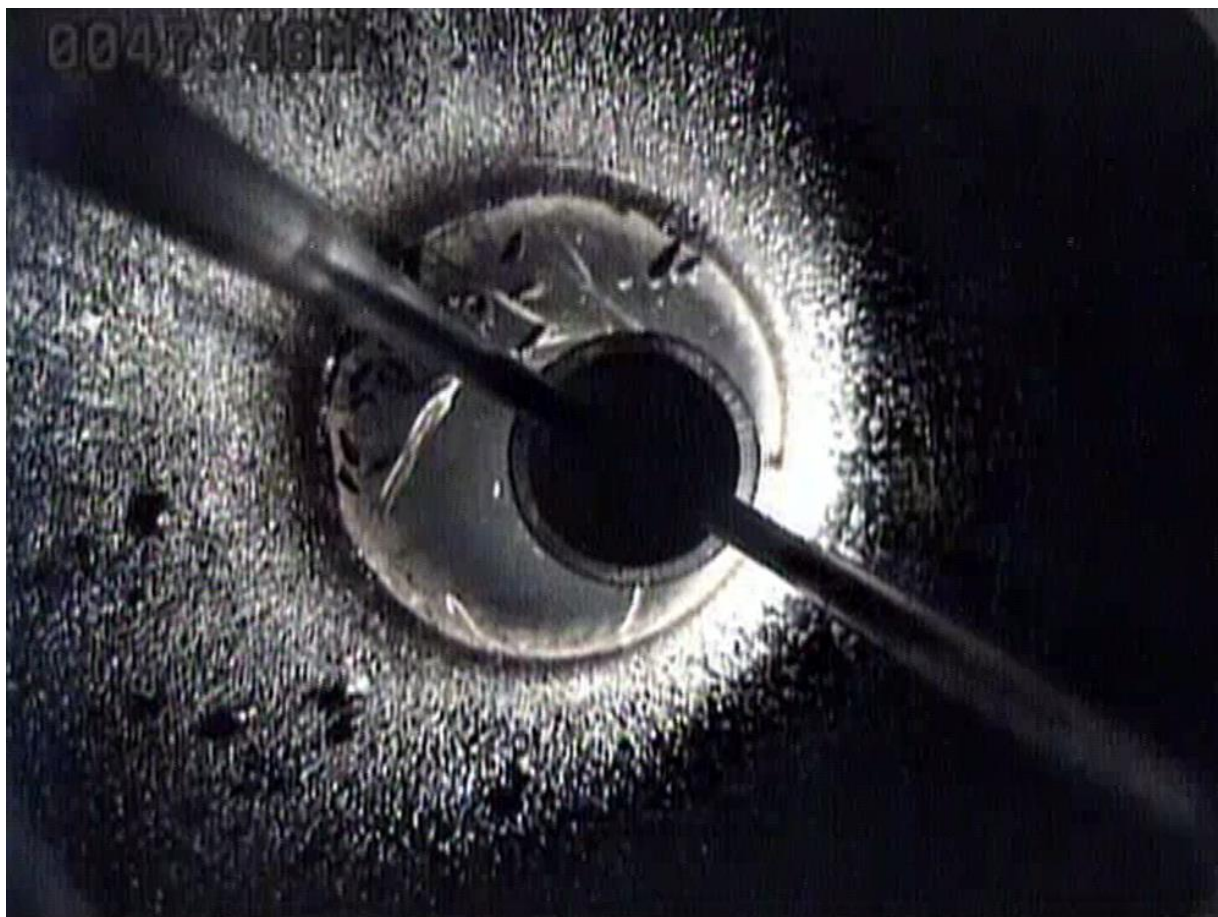
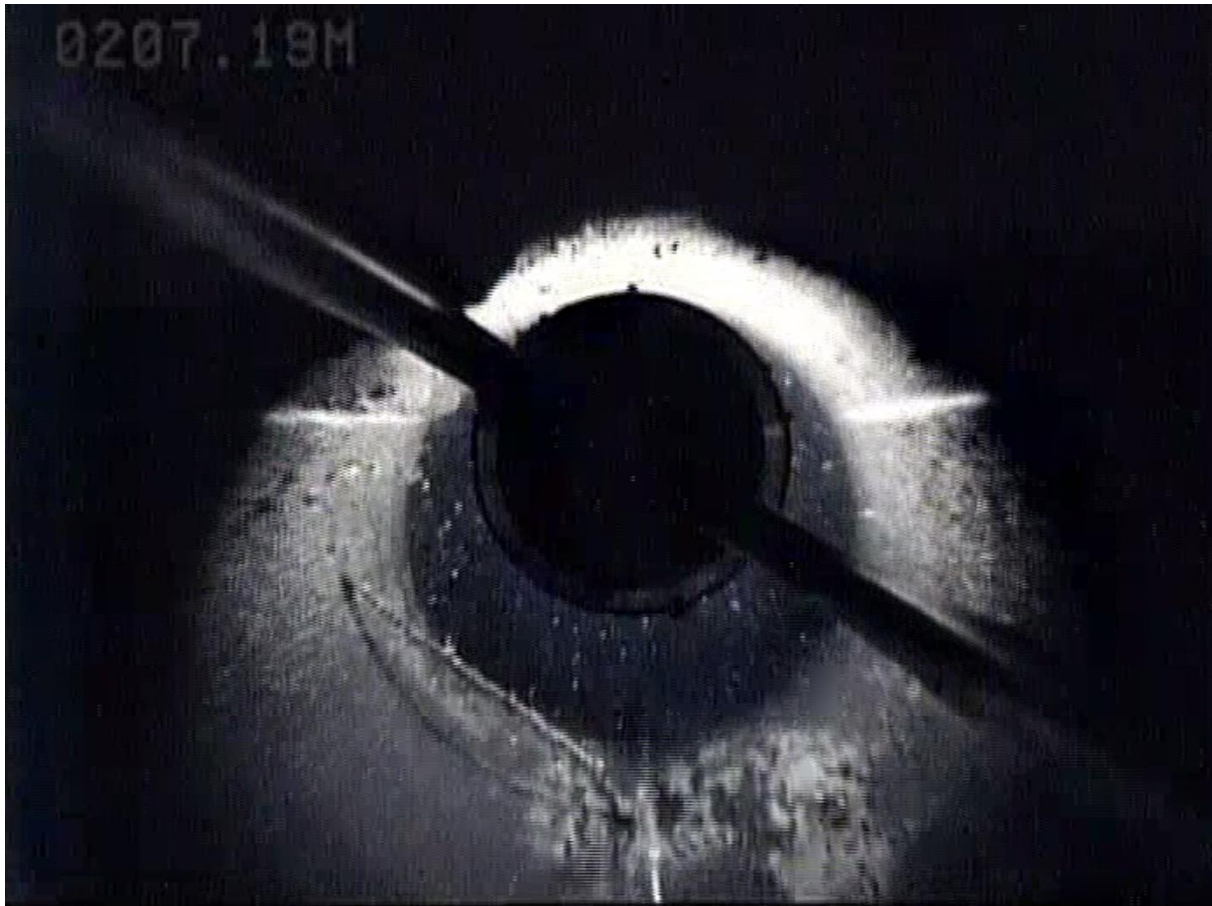


Plate 1: Water level at 47.6 mBGL.



Plate 2: Level of the first step change in the borehole with a casing joint at 149mBGL





**Plate 3: Scratches from a previous calliper survey and debris at 207mBGL**



**Plate 4: Level of the second step change and increase in debris in the borehole at 210mBGL**



**Plate 5: Build-up of debris in borehole at 212mBGL. CCTV survey ended at 214.27mBGL due to poor image**

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# Appendix A – Geophysical Logs

CA08/20/1/901/5

[20190712 Easthouses CCTV.zip](#) ([metadata](#))



## Certificate of Conformity

This is to certify that the following equipment conforms to the specification detailed below



**Equipment type:** Temperature Conductivity Probe

**RG Order No:** ORD00000

**Serial No:** TCDS 2822

**Comm. Type:** Standard 4-Core

**Quality Management System:**

**ISO 9001:2015**

Certified by TÜV SÜD

**Tested by:** T Hamflett

**Date:** 14/03/19

**Approved by:**

Tim Hamflett | *Test Engineer*

**Date:** 14/03/19



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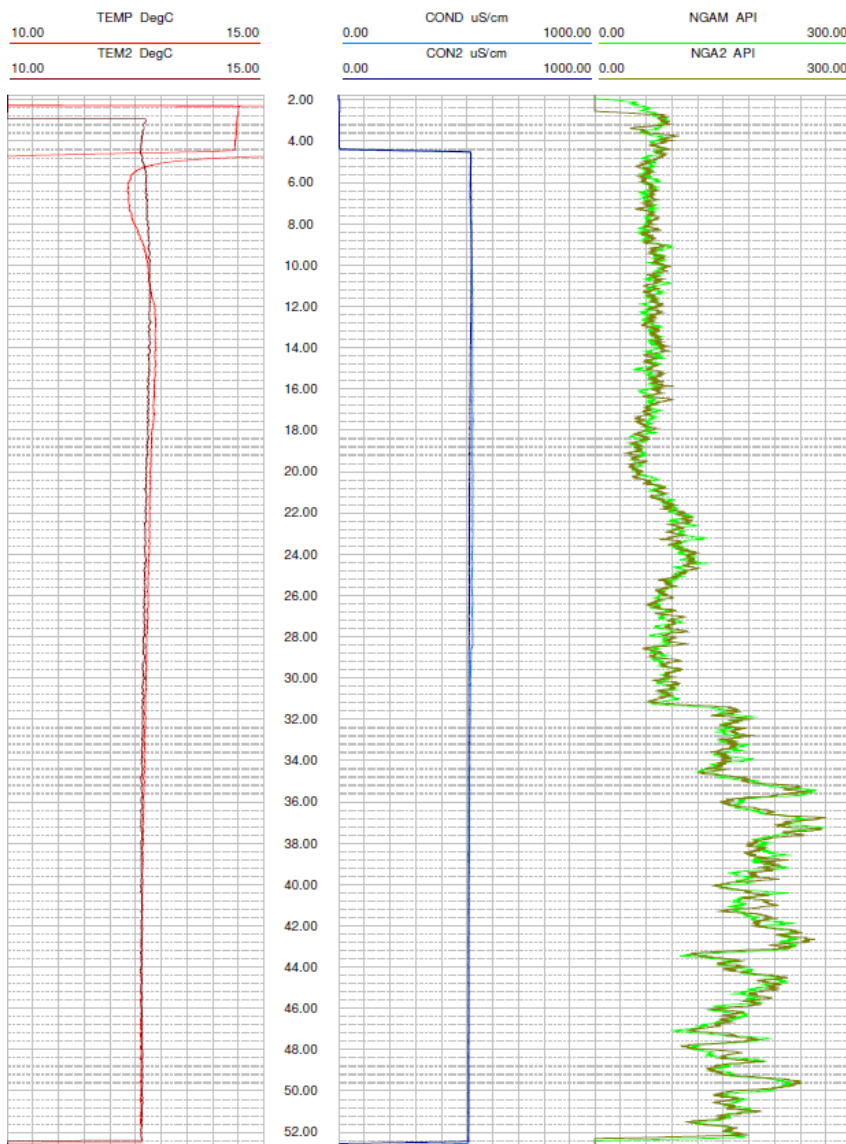


# CERTIFICATE OF CONFORMITY

The probe detailed has been calibrated and then logged in the **ROBERTSON GEO** Test Borehole (Deganwy, UK). The resulting data falls within acceptable tolerances and meets all test criteria.



Down Pass: 0-50m  
Up Pass: 50-0m



Channel	x <sup>n</sup>	Coefficient
1 TEMP	0	-8.81863
	1	4.81721E-3
	2	0.0
	3	0.0
2 COND	0	4.33278
	1	0.958435
	2	3.76568E-7
	3	7.06512E-11
3 NGAM	0	0.0
	1	1.29518
	2	0.0
	3	0.0
4	0	0.0
	1	1.0
	2	0.0
	3	0.0
5	0	0.0
	1	1.0
	2	0.0
	3	0.0
6	0	0.0
	1	1.0
	2	0.0
	3	0.0
7	0	0.0
	1	1.0
	2	0.0
	3	0.0
8	0	0.0
	1	1.0
	2	0.0
	3	0.0
9	0	0.0
	1	1.0
	2	0.0
	3	0.0
10	0	0.0
	1	1.0
	2	0.0
	3	0.0
11	0	0.0
	1	1.0
	2	0.0
	3	0.0
12	0	0.0
	1	1.0
	2	0.0
	3	0.0

$$\text{Calibrated Value} = ax^0 + bx^1 + cx^2 + dx^3$$



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## Certificate of Conformity

This is to certify that the following equipment conforms to the specification detailed below



**Equipment type:** 3-Arm Caliper Probe (710mm range)

**RG Order No:** ORD03163

**Serial No:** 3ACS 11132

**Comm. Type:** Standard 4-Core

**Quality Management System:**

**ISO 9001:2015**

Certified by TÜV SÜD

**Tested by:** T Hamflett

**Date:** 21/01/19

**Approved by:**

Tim Hamflett | *Test Engineer*

**Date:** 21/01/19



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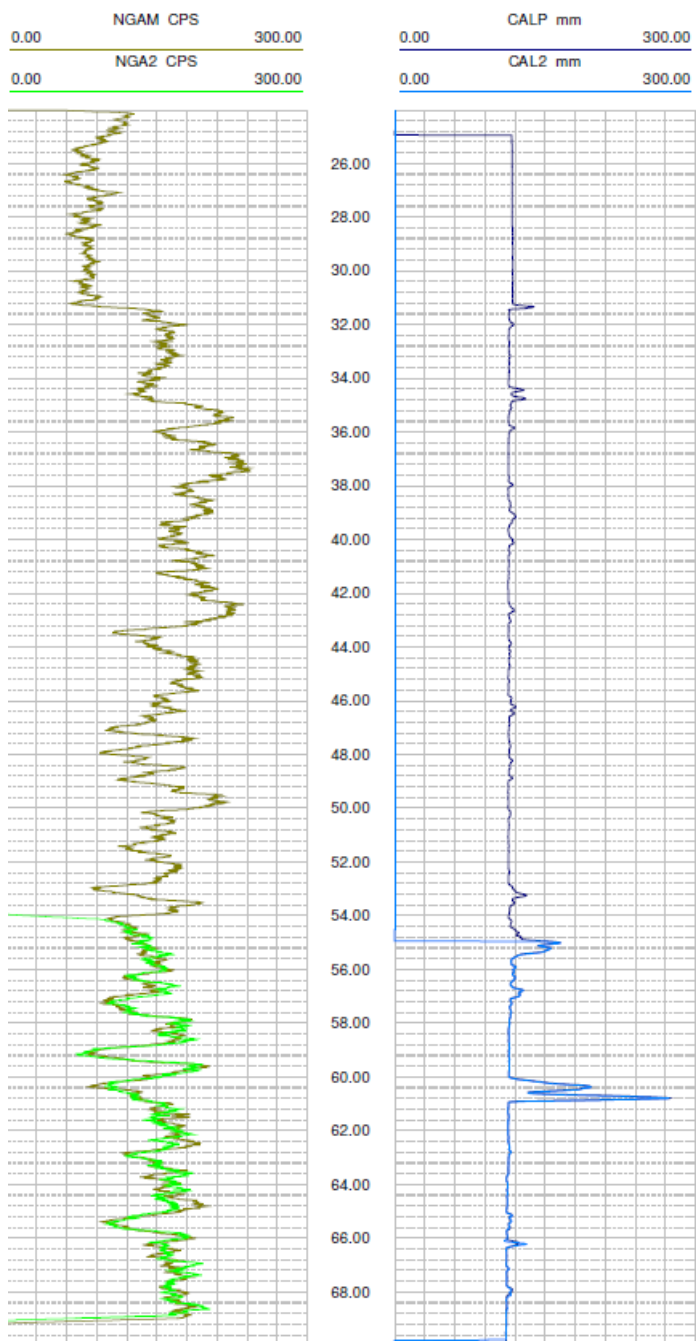
# CERTIFICATE OF CONFORMITY

The probe detailed has been calibrated and then logged in the **ROBERTSON GEO** Test Borehole (Deganwy, UK). The resulting data falls within acceptable tolerances and meets all test criteria.



**Main Pass:** 70-25m

**Repeat Pass:** 70-55m



Channel	$x^n$	Coefficient
1 NGAM	0	0.0
	1	1.14973
	2	0.0
	3	0.0
2 CALP	0	-496.237
	1	0.0767045
	2	-1.23290E-6
	3	0.0
3	0	0.0
	1	1.0
	2	0.0
	3	0.0
4	0	0.0
	1	1.0
	2	0.0
	3	0.0
5	0	0.0
	1	1.0
	2	0.0
	3	0.0
6	0	0.0
	1	1.0
	2	0.0
	3	0.0
7	0	0.0
	1	1.0
	2	0.0
	3	0.0
8	0	0.0
	1	1.0
	2	0.0
	3	0.0
9	0	0.0
	1	1.0
	2	0.0
	3	0.0
10	0	0.0
	1	1.0
	2	0.0
	3	0.0
11	0	0.0
	1	1.0
	2	0.0
	3	0.0
12	0	0.0
	1	1.0
	2	0.0
	3	0.0

$$\text{Calibrated Value} = ax^0 + bx^1 + cx^2 + dx^3$$



**ISO 9001**  
Certified  
Quality Management System  
[www.tuv-sud.com/ms-cert](http://www.tuv-sud.com/ms-cert)

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# Appendix B – Laboratory Certificate of Analysis

CA08/20/1/901/5

[20190712 Easthouses CCTV.zip](#) ([metadata](#))

Our Ref: EXR/287271 (Ver. 1)

Your Ref:

July 22, 2019



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

John Leyland  
Coal Authority  
200 Lichfield Lane  
Berry Hill  
Mansfield  
Nottinghamshire  
NG18 4RG

For the attention of John Leyland

Dear John Leyland

**Sample Analysis - Bilston Glen**

Samples from the above site have been analysed in accordance with the schedule supplied.

The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

A handwritten signature in black ink that reads 'E. Jones' with a long horizontal flourish extending to the right.

E Jones

Project Co-ordinator

01283 554400

# TEST REPORT

Report No. EXR/287271 (Ver. 1)

Coal Authority  
200 Lichfield Lane  
Berry Hill  
Mansfield  
Nottinghamshire  
NG18 4RG

**Site: Bilston Glen**

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 13-Jul-2019. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 22-Jul-2019

The following tables are contained in this report:

Table 1 Main Analysis Results (Pages 2 to 4)  
Analytical and Deviating Sample Overview (Pages 5 to 6)  
Table of Method Descriptions (Page 7)  
Table of Report Notes (Page 8)  
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of  
SOCOTEC UK Lim  
Becky Batham



Operations Manager  
Energy & Waste Services

Date of Issue: 22-Jul-2019

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.







## Sample Analysis

## SOCOTEC UK Ltd Environmental Chemistry Analytical and Deviating Sample Overview

**W287271**

**Customer**                      **Coal Authority**  
**Site**                                **Bilston Glen**  
**Report No**                      **W287271**

Consignment No W157707  
Date Logged 13-Jul-2019  
In-House Report Due 22-Jul-2019

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

	ICPMATVAR	Iron as Fe (Total) VAR	✓	
		Silicon as Si (Dissolved) VAR		
		Boron as B (Dissolved) VAR	✓	
		Iron as Fe (Dissolved) VAR	✓	
		Lead as Pb (Dissolved) VAR	✓	
		Copper as Cu (Dissolved) VAR	✓	
		Cadmium as Cd (Dissolved) VAR	✓	
		Potassium as K (Dissolved) VAR	✓	
		Sodium as Na (Dissolved) VAR	✓	
		Strontium as Sr (Dissolved) VAR	✓	
		Barium as Ba (Dissolved) VAR	✓	
		Magnesium as Mg (Dissolved) VAR	✓	
		Calcium as Ca (Dissolved) VAR	✓	
	ICPMATVAR	Total Sulphur as SO4 (Diss) VAR	✓	
	ICPMASWT	Manganese as Mn MS (Total)	✓	
	ICPMSW	Zinc as Zn MS (Dissolved)	✓	
	ICPMSW	Nickel as Ni MS (Dissolved)	✓	
	CURT SERV	Report A		
	MethodID	Sampled		
		Matrix Type		
ID Number	Description			
EX/1988836	No.1 DC Shaft 220	Unclassified	10/07/19	
EX/1988837	No.1 DC Shaft 350	Unclassified	10/07/19	
EX/1988838	No.1 DC Shaft 480	Unclassified	10/07/19	
EX/1988839	No.1 DC Shaft 610	Unclassified	10/07/19	
EX/1988840	Great Seam BH 225	Unclassified	11/07/19	

**Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.**

**If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.**

### Deviating Sample Key

- |   |  |
|---|--|
| A | The sample was received in an inappropriate container for this analysis                            |
| B | The sample was received without the correct preservation for this analysis                         |
| C | Headspace present in the sample container  |
| D | The sampling date was not supplied so holding time may be compromised - applicable to all analysis |
| E | Sample processing did not commence within the appropriate holding time                             |
| F | Sample processing did not commence within the appropriate handling time                            |

## Requested Analysis Key

- |   |   |
|---|---|
|   | Analysis Required   |
|   | Analysis dependant upon trigger result - <b>Note: due date may be affected if triggered</b> |
|   | No analysis scheduled   |
| ^ | Analysis Subcontracted - <b>Note: due date may vary</b>                                     |

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling. Where individual results are flagged see report notes for status.

Customer Coal Authority  
Site Bilston Glen  
Report No W287271

Consignment No W157707  
Date Logged 13-Jul-2019  
In-House Report Due 22-Jul-2019

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

ID Number	Description	Matrix Type	Sampled	MethodID	CPMA TYPET	KONEFE	KONENS					WCA1C1			WSLM10	WSLM12	WSLM13	WSLM17	WSLM2	WSLM3
							Iron as Fe (Total) KONE	Ferrous Iron as Fe(2+) KONE	Aluminium as Al (Total) VAR	Ammoniacal Nitrogen (Kone)	Nitrate as N (Kone calc)	Phosphate as P. (kone)	Ionic Balance %	Total Anions meq	Total Cations meq	Suspended Solids	Total Alkalinity as CaCO3	Total Organic Carbon	Dissolved Organic Carbon	Total Acidity as CaCO3
					✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
EX/1988836	No.1 DC Shaft 220	Unclassified	10/07/19																	
EX/1988837	No.1 DC Shaft 350	Unclassified	10/07/19																	
EX/1988838	No.1 DC Shaft 480	Unclassified	10/07/19																	
EX/1988839	No.1 DC Shaft 610	Unclassified	10/07/19																	
EX/1988840	Great Seam BH 225	Unclassified	11/07/19																	

**Note:** We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key	
A	The sample was received in an inappropriate container for this analysis
B	The sample was received without the correct preservation for this analysis
C	Headspace present in the sample container
D	The sampling date was not supplied so holding time may be compromised - applicable to all analysis
E	Sample processing did not commence within the appropriate holding time
F	Sample processing did not commence within the appropriate handling time
Requested Analysis Key	
	Analysis Required
	Analysis dependant upon trigger result - <b>Note: due date may be affected if triggered</b>
	No analysis scheduled
^	Analysis Subcontracted - <b>Note: due date may vary</b>

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling. Where individual results are flagged see report notes for status.



# Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPMSWT	As Received	Determination of Total Metals in water samples using nitric acid digestion and ICPMS quantitation
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ICPWATVART	As Received	Determination of Total Metals in water samples using nitric acid digestion and ICPOES quantitation
Water	KONEFE	As Received	Direct analysis using discrete colorimetric analysis (calculation of Ferric Iron from Total Iron and Ferrous Iron data if required)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	WCALC1	As Received	Calculation based on concentrations of dissolved Cations and anions
Water	WSLM10	As Received	Determination of Suspended Solids in waters by gravimetry
Water	WSLM12	As Received	Titration with Sulphuric Acid to required pH
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non-dispersive IR detection
Water	WSLM17	As Received	Titration with Sodium Hydroxide to required pH
Water	WSLM2	As Received	Determination of the Electrical Conductivity ( $\mu\text{S}/\text{cm}$ ) by electrical conductivity probe.
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

# Report Notes

## Generic Notes

### Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.  
All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

### Waters Analysis

Unless stated otherwise results are expressed as mg/l

**Nil:** Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

### Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm<sup>3</sup> @ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**NAIIS** No Asbestos Identified in Sample

**NADIS** No Asbestos Detected In Sample

## Symbol Reference

**^** Sub-contracted analysis.

**\$\$** Unable to analyse due to the nature of the sample

**¶** Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

**¥** Results for guidance only due to possible interference

**&** Blank corrected result

**I.S** Insufficient sample to complete requested analysis

**I.S(g)** Insufficient sample to re-analyse, results for guidance only

**Intf** Unable to analyse due to interferences

**N.D** Not determined

**N.Det** Not detected

**N.F** No Flow

**NS** Information Not Supplied

**Req** Analysis requested, see attached sheets for results

**▮** Raised detection limit due to nature of the sample

\* All accreditation has been removed by the laboratory for this result

**‡** MCERTS accreditation has been removed for this result

**§** accreditation has been removed for this result as it is a non-accredited matrix

**Note:** The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

## Sample Descriptions

**Client :** Coal Authority  
**Site :** Bilston Glen  
**Report Number :** W28\_7271